Application for Letter of Authorization under the Marine Mammal Protection Act for the Maryland Offshore Wind Project

Submitted to:

National Marine Fisheries Service
Office of Protected Resources
Silver Spring, MD

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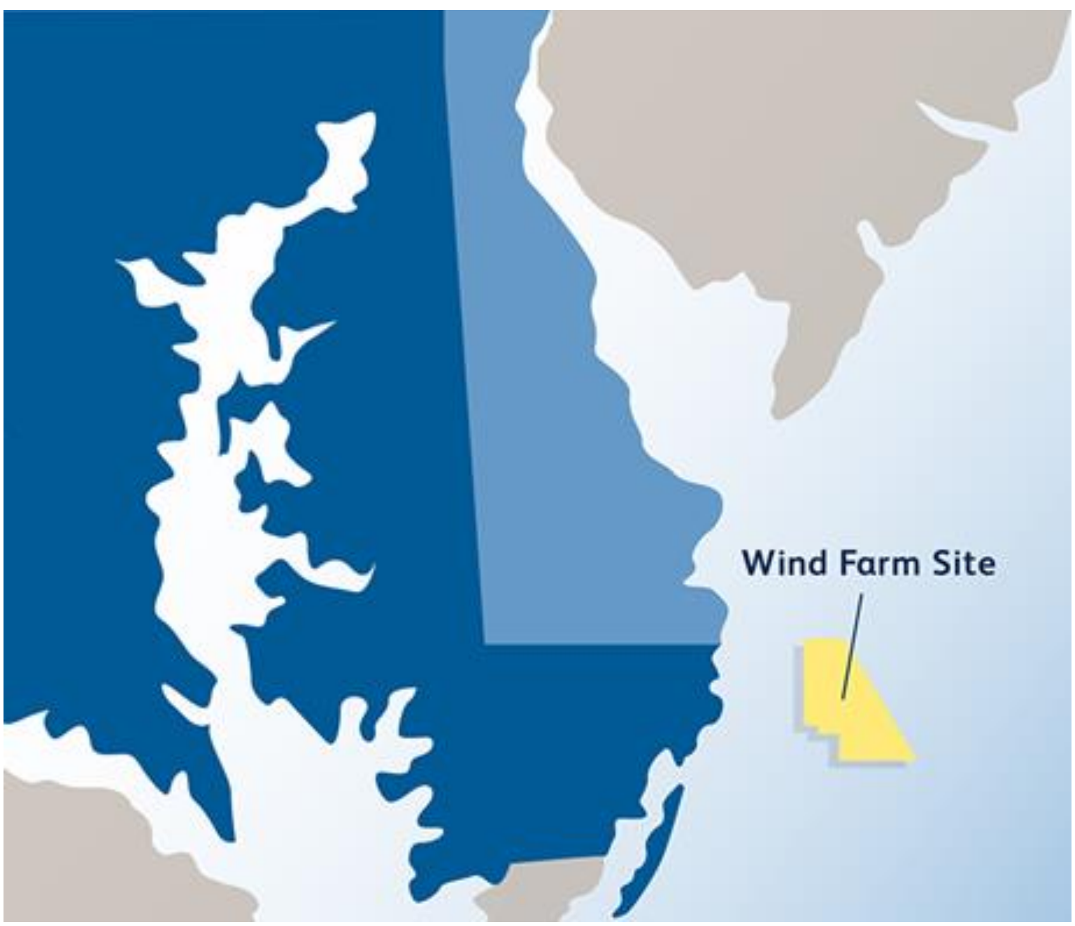

Revision History

Date Submitted	Description
August 31, 2022	Initial Submission
November 15, 2022	Revisions to incorporate response to NMFS comments Inclusion of Appendices A and B
January 24, 2023	Revisions to incorporate response to NMFS comments
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March 31, 2023	Revisions to incorporate response to NMFS comments

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Appendices

Acronyms and Abbreviations

Notation	Definition
%	Percent
°	Degrees
BACI	Before After Control Impact
BAG	Before After Gradient
BOEM	Bureau of Ocean Energy Management
BSB	Black sea bass
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
cum	Cumulative
CV	Coefficient of variation
dB	Decibel
dB re 1 $\mu Pa^2 m^2$	Decibel referenced to a pressure of 1 microPascal squared per meter squared
dBpeak	Peak source level
dBrms	RMS source level
DEIS	Draft Environmental Impact Statement
DMA	Dynamic Management Area
DP	Dynamic positioning
EEZ	Exclusive Economic Zone
EOD	Explosive ordnance disposal
EPR	Ethylene Propylene Rubber
ESA	Endangered Species Act
ESP	Electric service platform
FR	Federal Register
ft	Feet
gal	Gallons
GW	Gigawatt
h	Hour
HDD	Horizontal directional drilling
HF	High frequency
hr	Hour
HRG	High-resolution
Hz	Hertz
IHA	Incidental Harassment Authorization
IMO	International Maritime Organization
ITA	Incidental Take Authorization
kHz	Kilohertz
kJ	Kilojoule
km	Kilometer
kV	Kilovolt

Notation	Definition
L	Liters
L_E	Cumulative sound exposure
LOA	Letter of Authorization
LF	Low frequency
L_P	Root-mean-square pressure level
L_{pk}	peak sound pressure level
L_{pp}	peak to peak sound level for a given event
m	Meter
M/SI	Annual mortality/serious injury
MEC	Munition of explosive concern
Met Tower	Meteorological tower
MF	Mid-frequency
mi	Statute miles
MMPA	Marine Mammal Protection Act
MLLW	Mean Lower Low Water
ms	milli-second
MV	Medium-voltage
MW	Megawatt
N	North
NARW	North Atlantic right whale
NEFSC	Northeast Fisheries Science Center
NM	Nautical miles
Nmin	Minimum estimate of stock abundance
NMFS	National Marine Fisheries Service, or NOAA Fisheries
NMS	Noise Mitigation System
NOAA	National Oceanic and Atmospheric Administration
NMFS OPR	NMFS Office of Protected Resources
NMFS GARFO	NOAA Fisheries Greater Atlantic Regional Fisheries Office
OCS	Outer Continental Shelf
OREC	Offshore Wind Renewable Energy Credit
OSCLA	Outer Continental Shelf Lands Act
OSP	Optimum Sustainable Population
OSS	Offshore substation
OTM	Offshore transformer module
OW	Otariids Underwater
PAM	Passive Acoustic Modelling
PBR	Potential biological removal
Peak	Peak SPL injury exposure
PJM	PJM Grid Operator
pk	Peak

Notation	Definition
POI	Point of Interconnection
PSC	Public Service Commission
PSO	Protected Species Observer
PTS	Permanent threshold shift
PW	Phocids Underwater
RMS	Root-mean-square
ROSA	Responsible Offshore Science Alliance
ROV	Remotely operated vehicle
s	Seconds
S	South
SAR	Stock Assessment Reports
SBP	Sub bottom profiler
SCADA	Supervisory Control and Data Acquisition
SEL	Behavioral exposure
SL	Sound loudness
SMA	Seasonal Management Area
SPL	SEL_{cum} injury exposure
t	tonnes
TP	Transition piece
TTS	Temporary threshold shift
UMCES	University of Maryland Center for Environmental Science
UNK	Unknown
U.S	United States
U.S.C.	United States Code
US Wind	US Wind, Inc.
USBL	Ultra-short baseline system
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
UXO	Unexploded ordnance
WTG	Wind turbine generator
XLPE	Cross-linked polyethylene
ZOI	Area of the zone of influence
μPa	microPascal

Glossary

Term	Definition
Feeder vessel	A vessel that delivers or receives cargo from a port or another vessel
Micro-siting HRG surveys	Potential surveys prior to construction if adjustments to project elements are needed. Equipment used for the survey is anticipated to create low-frequency sound underwater.
Pin pile	Pile used for the Met Tower foundation including both the bracing piles and the main caisson.
Skirt pile	Pile used for a post-piled jacket foundation for the OSS.
Sound level offset	The modelled difference between the maximum hammer energy (4,400 kJ) and the intended hammer energy (1,100 kJ, 2,200 kJ, and 3,300 kJ).

1.0 Description of Specified Activity

1.1 Introduction

US Wind, Inc. (US Wind) proposes to install up to 121 wind turbine generators (WTGs) and four offshore substations (OSSs) on monopile foundations (possibly jacket foundations for the OSSs), install a meteorological tower (Met Tower), and install export cables on the Outer Continental Shelf (OCS) to a landfall location in Delaware to support the construction of an offshore wind energy project located approximately 18.5 km (11.5 miles) off the coast of Maryland on the Outer Continental Shelf. If required, US Wind may conduct high-resolution geophysical (HRG) surveys to for equipment micro-siting, to confirm site conditions, or to identify potential unexploded ordnances (UXO). The Maryland Offshore Wind Project (the Project) would be developed within the area described in the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0490 (the Lease) issued to US Wind by the Bureau of Ocean Energy Management (BOEM).

US Wind submits this application for a Letter of Authorization (LOA Application) to the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) pursuant to Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA) and 50 Code of Federal Regulations (CFR) § 216 Subpart I to allow for the incidental take of a small number of marine mammals resulting from the following Project activities:

- Potential HRG surveys
- Installation of monopile foundations for the WTGs
- Installation of monopiles, jackets on piles ("piled jackets"), or jackets on suction buckets foundations for OSSs
- Installation of bracing piles for the Met Tower

The Project activities will be located offshore of Maryland and Delaware on the Outer Continental Shelf and within Delaware state waters (Figure 1-1).

The LOA Application includes the 14 specific pieces of information required by 50 CFR § 216.104(a) for an Incidental Take Application as follows:

- Section 1: Description of Specified Activity
- Section 2: Dates, Duration, and Specified Geographic Region
- Section 3: Species and Numbers of Marine Mammals
- Section 4: Affected Species Status and Distribution
- Section 5: Type of Incidental Taking Authorization Requested
- Section 6: Take Estimates for Marine Mammals
- Section 7: Anticipated Impact of the Activity
- Section 8: Anticipated Impacts of Subsistence Uses (not applicable)
- Section 9: Anticipated Impacts on Habitat
- Section 10: Anticipated Effects of Habitat Impacts on Marine Mammals
- Section 11: Mitigation Measures to Protect Marine Mammals and Their Habitat
- Section 12: Mitigation Measures to Protect Subsistence Uses (not applicable)
- Section 13: Monitoring and Reporting
- Section 14: Suggested Means of Coordination

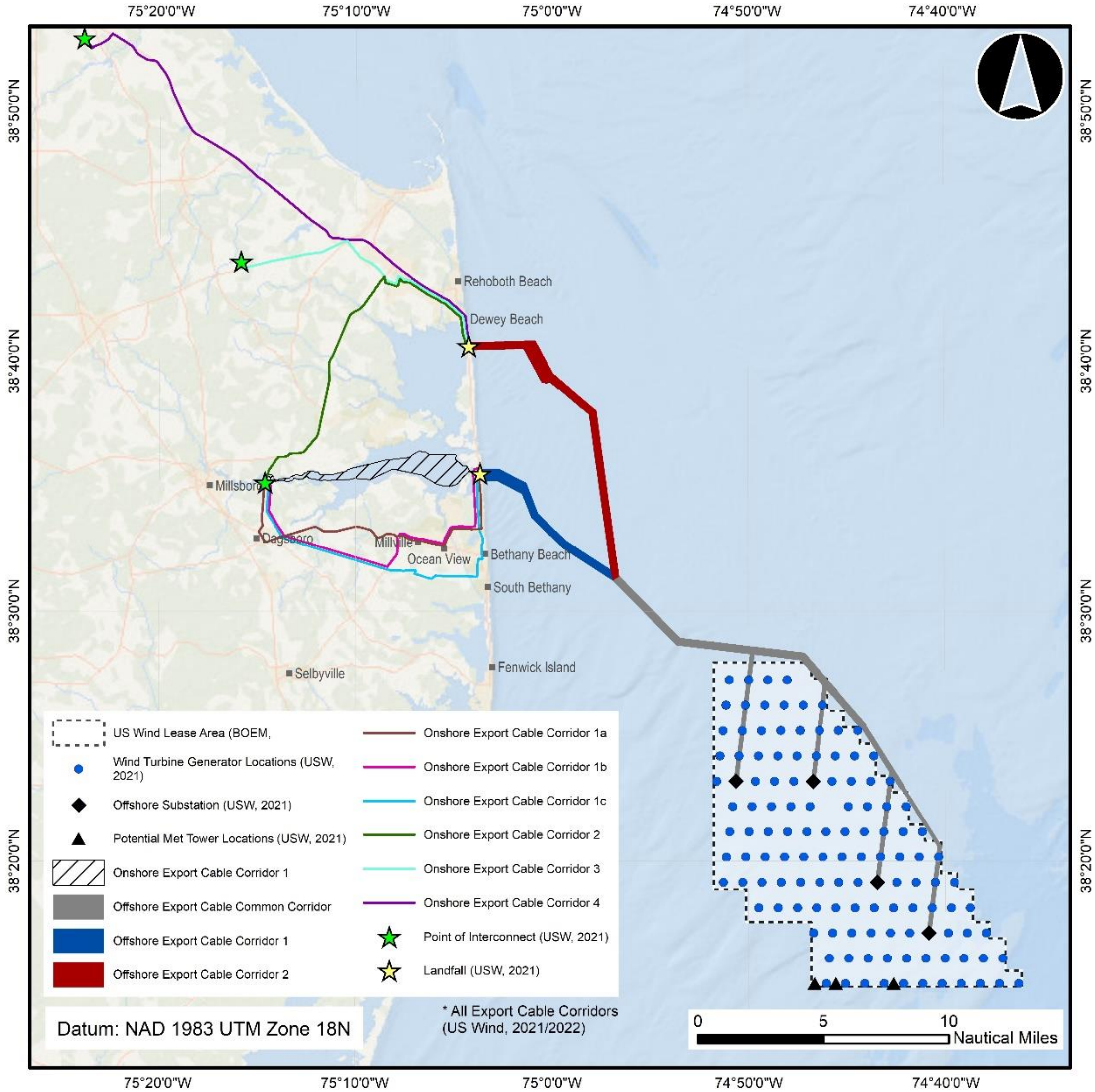

Figure 1-1. US Wind Project Design Envelope

1.2 Project Purpose and Need

The purpose of the Project is to develop offshore wind energy under the Lease and to transmit this energy to the Delmarva Peninsula in fulfilment of state and federal clean energy standards and targets. The Project includes MarWin, a wind farm of approximately 300 MW for which US Wind was awarded Offshore Wind Renewable Energy Credits (OREC) in 2017 by the state of Maryland Public Service Commission (PSC); Momentum Wind, consisting of approximately 808 MW for which the state of Maryland PSC awarded additional ORECs in 2021; and build out of the remainder of the Lease area to fulfill ongoing, government-sanctioned demands for offshore wind energy. Once developed, the Project will play a critical role in advancing the offshore wind targets set forth by the federal government and the state of Maryland, reduce greenhouse gas emissions, increase grid reliability, and support economic development growth in the region, including thousands of union jobs. The Project may also provide renewable energy to other states and private enterprises in the region.

As a follow up to Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad,” which set forth a renewed commitment to U.S. offshore wind development, the Biden Administration in March 2021 announced a new federal effort to facilitate the deployment of 30 gigawatts (GW) of offshore wind energy by 2030[1]. There are currently 23 active commercial leases in various stages of development, including US Wind’s Lease area within the Mid-Atlantic region. BOEM’s award of leases and timely review and authorization of project proposals comports with Congress’ intent expressed in the Outer Continental Shelf Lands Act (OSCLA) to make the Outer Continental Shelf available for the “expeditious and orderly development,” including for renewable projects (43 U.S.C. §§ 1332 & 1337(p)).

The Project is essential to achieving Maryland’s renewable energy goals. As a result of two successful bids to secure ORECs from the PSC, US Wind currently has more than a gigawatt (1.1 GW) of offshore wind energy capacity under contract with the state to deliver a combined 3,427,598 megawatt hours per year when both MarWin and Momentum Wind area operational.[2] While this advances the state’s renewable energy goals of 50% by 2030, the full buildout of US Wind’s Lease area would go further in achieving those targets and boost President Biden’s offshore wind goals.

Offshore wind is Maryland’s largest clean energy resource; as such, the state is unlikely to meet its goals without the full capacity of offshore wind energy US Wind intends to develop in the Lease area. Thus, the sizeable contribution available from development of US Wind’s Lease on approximately 80,000 acres would power more than 500,000 homes in the region with clean, renewable energy, support thousands of union jobs, and may also provide renewable energy to other states and private enterprises in the Mid-Atlantic.

1.3 Project Overview

The Project would include WTGs and other necessary structures needed to bring power generated by the WTGs onshore and interconnect to the regional electric grid at a point of interconnection (POI). The Project Design Envelope includes up to 121 WTGs, up to four OSSs, one Met Tower, and up to four new 230-275 kV offshore export cables. The offshore export cable is expected to include four cables, making landfall within Delaware Seashore State Park either at 3R’s Beach and proceeding through the Indian River Bay to the POI or at Tower Road proceeding to one of three points of interconnection via upland right-of-ways. The electric grid south of the proposed POI is of insufficient capacity to accept power from the Project.

The WTGs, OSSs, Met Tower, and associated inter-array cables would be located within federal waters. The offshore export cables would be installed within both federal and Delaware state waters. The Lease area is approximately 80,000 acres and is located approximately 18.5 km (11.5 miles) off the coast of Maryland (Figure 1-1). Up to four offshore export cables would connect the OSSs to the onshore export cables via horizontal directional drilling (HDD) at two potential

[1] The White House, “Tackling the Climate Crisis at Home and Abroad,” E.O. 14008 (Jan. 27, 2021); see also White House Statement: Biden Administration Jump Starts Offshore Wind Energy Projects to Create Jobs (March 29, 2021) at https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

[2] US Wind’s current contracts with the state of Maryland are for delivered ORECs, which are equivalent to megawatt hours (MWh) of electricity. In US Wind’s best professional judgement, projects of approximately 300 MW and 808 MW would generate 913,845 and 2,513,753 MWh per year, respectively, with a high degree of certainty based on the presumed wind speeds and WTG availability.

offshore export cable landfall locations at 3R's Beach or Tower Road on the coast of Delaware in Delaware Seashore State Park.

Project elements include offshore structures, inter-array and export cables, and onshore infrastructure. Below the in-water components are summarized. US Wind proposes a Project Design Envelope (PDE) to present reasonable maximum impacts so that impacts to resources are not underrepresented. A detailed description of the PDE can be found within US Wind's Construction and Operations Plan (COP) (US Wind 2022).

- **Wind Turbine Generators (WTGs)**
  - Up to a maximum of 121 WTGs are proposed in the Lease area under the PDE, spaced 0.77 (nautical mile) NM east to west and 1.02 NM north to south.
    - US Wind includes in the COP a proposed mitigation measure of a 1 NM setback from the Traffic Separation Scheme from Delaware Bay, removing 7 WTG locations from the PDE. US Wind assumes the mitigation measure will be adopted and requests take based on 114 WTGs.
  - The PDE maximum size is a WTG with a 250-m rotor diameter and 18 MW nameplate capacity[3].
  - Foundations for the wind turbines will be monopiles: up to 11-m (36-ft) diameter coated steel tubes driven into the seabed using an impact hammer. Layers of rock will be used for scour protection around the foundations.
  - Use of a staging facility at Sparrows Point in the Greater Baltimore area to receive WTGs and other components. One or more facilities at Sparrows Point could also supply monopile foundations, fabricate and assemble Project elements, as well as support the equipment needs of other offshore wind projects.
  - Use of the best commercially-available technology suitable for the site.

- **Offshore Substations (OSSs)**
  - Up to 4 OSSs are included in the PDE.
  - OSS foundations would be monopiles (8-11 m [26-36 ft]), jackets on skirt piles 2-4 m [7-13 ft]), or jackets on suction buckets (10-15 m [33-49 ft]; see Figure 1-6). Jacket structures may have three, four, or six legs. Rocks for scour protection will be placed around the monopile and piled jacket foundations. Jackets on suction buckets include scour protection built in. A four-leg OSS foundation is the most likely design and is the basis for modelling in the LOA Application.
  - Fabrication of the OSSs may be completed at Sparrows Point or other suitable locations.

- **Meteorological Tower (Met Tower)**
  - Consists of a 100 m (328 ft) steel mast on a 279 sq. m deck atop a braced caisson foundation.
  - The foundation would consist of a 1.8 m (72 in)-diameter main caisson and two bracing caissons 1.5 m (60 in) in diameter. For the LOA Application the Met Tower foundation piles are all considered as 1.8 m "pin piles".
  - Includes measurement devices to record weather conditions such as winds and waves.

[3] The 18 MW WTG referred to here is a configuration on a 250-m rotor diameter platform, inclusive of nameplate capacities other than 18 MW.

- **Inter-Array Cables**
    - Submarine inter-array cables designed for 66 kV will connect the WTGs in strings of 4-6 to the OSSs.
    - Inter-array cables will be buried in the seabed, at a depth between 1.2 m (3.3-6.6 ft), but no more than 4 m (13.1 ft). The cable ends will be installed in cable protection systems (CPS) close to the WTG foundations where burial may not be possible. Scour protection rocks will later stabilize these CPS systems.

- **Offshore Export Cables**
    - Up to 4 offshore export cables are included in the PDE. Export cables consist of an offshore portion, the Offshore Export Cables, from the Lease area to the landing location, through a transition vault to the onshore portion, and the Onshore Export Cables that connect to the POI.
    - Offshore Export Cables are planned as 230 kV 3/C submarine cable. Offshore Export Cables would run from the OSS to a planned landfall in the vicinity of the Indian River Inlet.
    - Offshore Export Cables will be buried in the seabed, at a depth between 1-3 m (3.3-9.8 ft), but no more than 4 m (13.1 ft). Concrete mattresses will be installed at areas with insufficient burial depth if needed.
    - Cable corridors offshore have been sited to avoid conflicts with existing uses, such as active sand borrow areas used for beach nourishment and storm resiliency projects along the Delmarva Peninsula.
    - Two potential landing locations are included in the PDE, both in Delaware Seashore State Park parking lots at 3R's Beach and Tower Road. It is anticipated all four cables would land at the same location, but it is possible the four cables would be distributed between the two landing locations.
    - The proposed Onshore Export Cable Corridor 1 traverses Indian River Bay after landfall at 3R's Beach and connects to onshore substations next to the POI at Indian River Substation. Transition from water to land, and land to water, would be accomplished by HDD. HDD will minimize impacts to sensitive shore areas.

Figures 1-1, 1-2, and 1-3 illustrate the current configuration of the Project; revisions may be made to the locations of the WTGs and OSSs, offshore export cables and inter-array cables during BOEM's review of the COP.

The Project, shown in Figure 1-1, depicts the wind farm and the boundaries of the Project, which would consist of:

- Lease area (Figure 1-2): area which includes the WTGs, OSSs, Met tower, indicative inter-array cables, and portions of the offshore export cables;
- Offshore Export Cable Corridor (Figure 1-3): area in which up to four export cables would be installed from the OSSs in the Lease area to the landing location at 3R's Beach or Tower Road;
- Onshore Export Cable Corridor 1 (Figure 1-1): area in which up to four export cables would be installed from 3R's Beach through Indian River Bay, including the landfall location and POI; and
- Onshore Export Cable Corridors 1a, 1b, 1c, 2, 3, and 4 (Figure 1-1): potential terrestrial cable corridors for up to four export cables from the landfall location at 3R's Beach or Tower Road to POI.

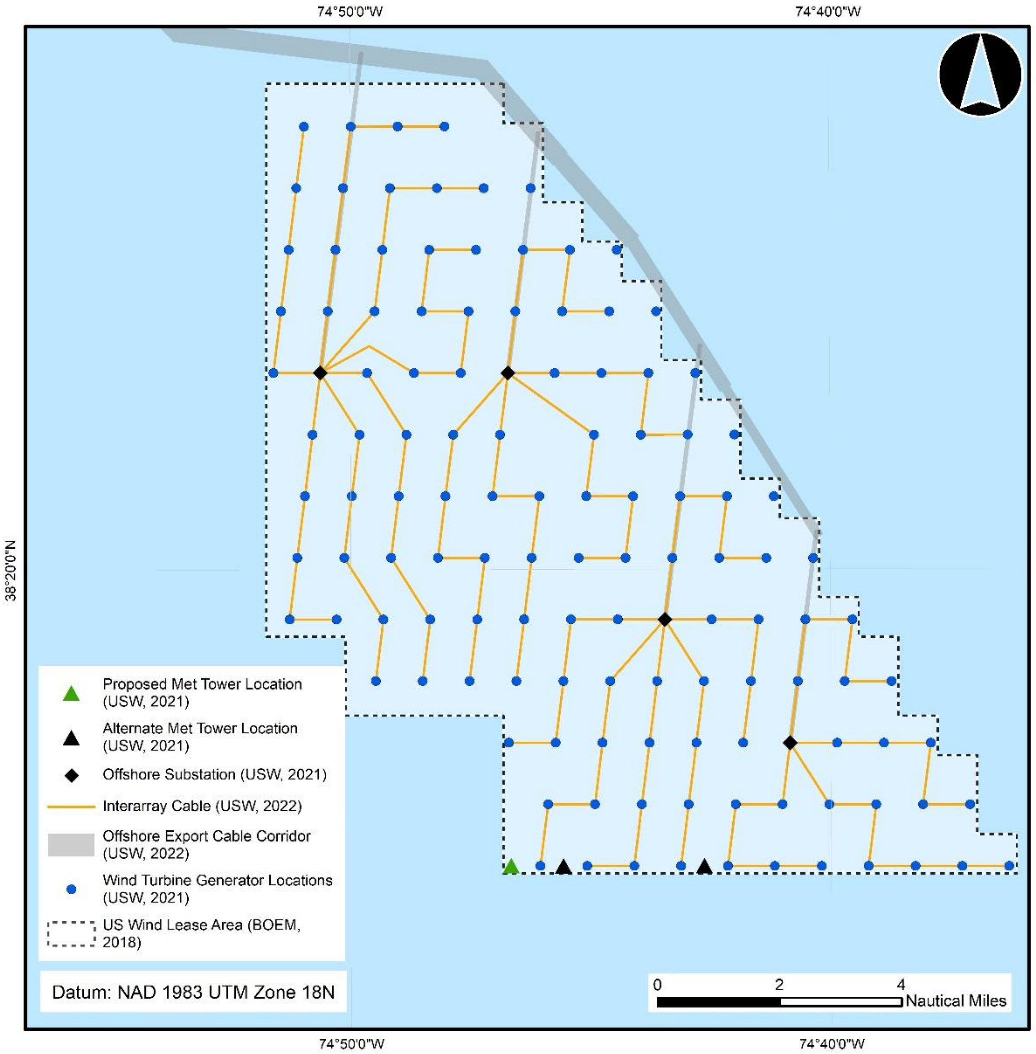

Figure 1-2. Lease Area with Project Components[4]

[4] Inter-array cable layout is indicative.

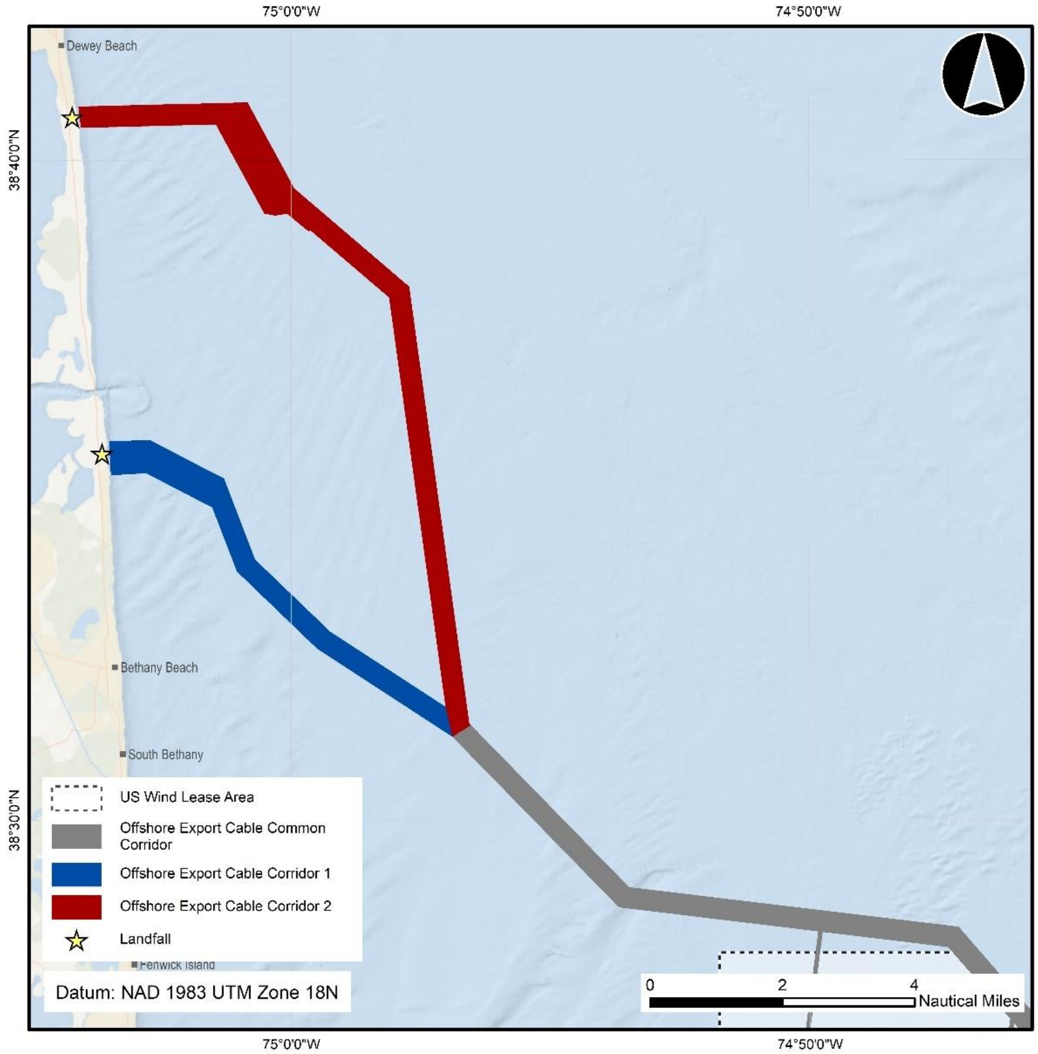

Figure 1-3. Offshore Export Cable Corridors

US Wind would install the Project over three discrete construction campaigns, although cable landing infrastructure such as the HDDs and installation of the onshore export cables would coincide with the first construction campaign. See Table 1-1 for an overview of the reasonably anticipated construction campaigns. The Commercial Operations Date for each construction campaign is planned for December 31 of the year of construction.

Table 1-1. Overview of Anticipated Construction Campaigns

Construction campaign	Associated project[5]	Construction Year	Approximate # of WTGs	Onshore Export Cables	Offshore Export Cables	Offshore Substations
First	MarWin	Year 1 (est. 2025)	21	4	1	1

[5] As noted in Section 1.2 the Maryland Offshore Wind Project (the Project) consists of subprojects MarWin, Momentum Wind, and future development.

Construction campaign	Associated project[5]	Construction Year	Approximate # of WTGs	Onshore Export Cables	Offshore Export Cables	Offshore Substations
Second	Momentum Wind	Year 2 (est. 2026)	55	0[6]	2	2
Third	Future development	Year 3 (est. 2027)	38	0	1	1

US Wind's awards from the state of Maryland stipulate that construction of MarWin, the first campaign, be constructed in the eastern-most portion of the Lease area, and that Momentum Wind, the second campaign, be constructed immediately to the west of MarWin. The future development, therefore, would be constructed in the western portion of the Lease area. The final layout of each campaign will depend on review and approval of the COP and other federal permits that US Wind must secure.

The PDE includes WTGs in up to 121 locations; however, the COP includes a proposed mitigation measure of a 1 NM setback from the Traffic Separation Scheme from Delaware Bay which would remove seven WTG locations along the eastern edge of the Lease area. Given this and other anticipated mitigation measures that may remove WTG locations during the NEPA process, US Wind believes it is prudent to request an LOA for a maximum of 114 WTGs which is reflected in the LOA Application.

US Wind continues to evaluate and refine the Project design and works with suppliers to select the Project components, equipment fabrication and assembly locations, as well as the transport and installation strategies for the Project. Aspects of construction and installation would be refined during BOEM's review of the COP. As noted in Section 2.0 the installation schedule may shift based on the availability of components (e.g., WTGs, OSSs, cables) and installation vessels.

1.4 Activities Not Considered in LOA Request

US Wind reviewed Project activities to assess the potential for harassment of marine mammals, under 50 CFR § 216.104. Activities considered include the installation of the offshore export cables via jet plow and horizontal directional drilling (HDD); the use of vessels for all Project activities; additional scientific surveys; the potential conduct of HRG surveys; the installation of monopiles for the WTG foundations via impact pile driving; the installation of monopiles or jacket foundations for OSS foundations; and the installation of pin piles for the Met Tower.

Sound from the potential use of HRG survey equipment, the impact driving of piles for the WTG and OSS foundations, and the installation of pin piles for the Met Tower, and could potentially impact marine mammals through acoustic disturbance during Project construction. Activities which may incidentally harass small numbers of marine mammals as defined within the MMPA of 1972 (amended in 2007, 16 USC 31) are described in detail in Section 1.5. Cable lay activities, construction vessel activities, and additional scientific surveys, described in the following sections, would have negligible impacts to marine mammals, i.e., no long-term or population level effects to marine mammal stocks, and are not included in the request for take. Potential UXOs identified would be avoided by micro-siting the affected Project components and, therefore, take related to UXO detonation is not requested.

[6] US Wind intends to install up to four onshore export cables in the first construction campaign to minimize disruption. Weather, contractor and component availability, or other unforeseen factors, may cause onshore export cable construction to extend over two construction seasons.

1.4.1 Cable Lay Activities

Electricity generated by the WTGs would be transmitted by cables buried below the seafloor, or bay bottom for Onshore Export Cable Corridor 1 through Indian River Bay. Specialized vessels for cable installation, laying, and burial would be used to install the four offshore export cables. Vessel activities due to cable installation are considered in Section 1.4.2. This section describes the types of cables used and the installation processes.

The Project includes inter-array cables, offshore and onshore export cables. The export cables would be comprised of an offshore component, the offshore export cables, located on the OCS and in state waters and an inshore component, the onshore export cables, located solely in state waters or on land. The export cable corridor from the Lease area to US Wind's onshore substations would span between 65-97 km (40-60 miles) in length, dependent on the location of the OSS and the final routing through Indian River Bay or on land to the POI. Additional information about cable installation can be found in US Wind's COP (US Wind Inc. 2022).

1.4.1.1 Inter-Array Cables

Inter-array cables (or inter-turbine) collect and transmit the power from the WTGs to the offshore substations. In US Wind's proposed design all WTGs would connect to an OSS in strings of 4-6 WTGs via inter-array cables. Inter-array cables would be 66 kV three-core, solid dielectric (XLPE[7] or EPR[8]) construction. The sizes of the cables would vary depending on the distance of a WTG from the OSS and the number of WTGs on a given string, generally 200-300 mm in diameter. The strings converge at the OSS(s), where the voltage is stepped-up and delivered ashore via one or more high voltage alternating current (AC) submarine export cables. The OSS platforms may also be linked by additional 66 kV cables of similar dimensions to inter-array cables to provide a level of redundancy.

1.4.1.2 Offshore Export Cables

Export cables from the OSSs to the landing location and on the POI would complete the circuit to the regional electric grid. Up to four offshore export cables would be located among up to two 600-m (1,968-ft) corridors from the OSSs and connect to the planned landfall at either 3R's Beach or Tower Road, as shown in Figure 1-1. When the cables reach the landfall, they would be pulled into a cable duct that routes the cables under the existing beach to subterranean transition vaults. The transition vaults would be located in existing developed areas such as parking areas.

The main elements of offshore export cable installation are:

- Installation of HDD ducts at landfall.
- Route clearance including a pre-installation survey and grapnel run.
- Jet plow installation trial.
- Installation and simultaneous jetting of cable.
- Pull-in of the cables through HDD ducts into jointing/transition vaults.
- Cable pull-in at the OSS.
- Post-lay burial and mattressing, if needed.

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[7] Cross-linked polyethylene
[8] Ethylene Propylene Rubber

HDD operations will be employed for the Project to install cable ducts that allow for the installation of the export cables at the transition points between water and land. The primary HDD drilling equipment will be located on land and will consist of a drilling rig, mud pumps, drilling fluid cleaning systems, pipe handling equipment, excavators, and support equipment such as generators and trucks. Water side HDD equipment will vary based on the installation location but will generally consist of a work platform (either a barge or small jack-up) and associated support vessels (such as tugs and small work boats). The work platform will be equipped with a crane, excavator, winches, and auxiliary equipment including generators and lights. The limited water depth in Indian River Bay is expected to require in-water operations to be based on a barge equipped with spuds for positioning. An anchor spread may be employed if required, where the anchor lines would be under tension to ensure proper positioning of the vessel and reducing the risk of marine mammal entanglement. The offshore (ocean based) HDD works may be supported by either a jack-up vessel or barge depending on the final design and installation requirements.

HDD works will follow industry practice and will utilize detailed operating procedures including fluids containment plans. Lubrication of the HDD drill bit and sealing of the HDD bore hole will be provided through the use of a non-toxic bentonite water-based drilling mud. Containment of the drilling materials and excavated soils would be achieved using a gravity cell at the in-water termination of the HDD bore. US Wind evaluated cofferdams at the HDD locations and has opted for a gravity cell to avoid use of a vibratory hammer for the cofferdam walls that can create underwater sound. A gravity cell is lowered onto the seafloor and does not require the walls of the cell to be driven into the seabed. Use of gravity cells in HDD locations is standard industry practice and US Wind determined gravity cell use would be appropriate for the soil conditions.

The HDD drill rig would be set up onshore in an excavated area and the drill advanced to the offshore exit point. When the required borehole diameter is achieved (expected to be 60 cm per cable duct), a pulling head is attached to the drill string at the in-water end of the bore. Prefabricated sections of duct are attached to the drilling head and pulled into the borehole. The duct sections are expected to be fabricated on shore and floated to the barge or jack-up for installation.

The cable installation process would commence with the offshore cable pull in through the HDD duct into the cable jointing/transition vault at the landfall location. Upon completion of this phase the cable installation vessel would commence the direct laying of the cable on the seabed along the prescribed route to the OSS. Based on the sandy seabed observed along the Offshore Export Cable Corridors, it is expected that a jet plow would be employed to bury the cable to target depths of approximately 1 to 3 m (3.3 – 9.8 ft), not more than 4 m (13.1 ft). The jet plow uses a combination of high-pressure water to temporarily fluidize the sediment and the cable subsequently settles into the area opened by the jets through a combination of its own weight and a depressor arm. The displaced sediment settles back over the cable effectively burying the cable. If needed, a trenching tool may be employed in areas with harder bottoms. At the offshore end in the Lease area, the cable would be pulled into the OSS, tested, and terminated.

1.4.1.3 Onshore Export Cables

For the proposed Onshore Export Cable Corridor 1, the onshore export cables would be installed in Indian River Bay between the 3R’s Beach landfall and the US Wind substations adjacent to Indian River Substation. Prior to installation in Indian River Bay, route clearance activities would be conducted including maintenance dredging along the existing federal navigation channel or in shallow construction areas, with pre-installation surveys and debris removal and disposal, as needed.

Dredging, if needed and conducted by US Wind, could occur within Onshore Export Cable Corridor 1. Should the onshore export cables be located within the limits of the existing federal navigation channel that extends through Indian River Bay from the Indian River Inlet to Millsboro, Delaware, dredging of the channel to the maintenance depth may be conducted such that the cables could be buried below any future dredging of the navigation channel by the U.S. Army Corps of Engineers or by the Delaware Division of Natural Resources and Environmental Control. Limited dredging to allow access by the cable lay barge in shallow areas in the eastern portion of Indian River Bay could also occur.

The cable would be fed to the HDD ducts using small boats and floatation where it would subsequently be pulled through the ducts into the jointing/transition bays. If necessary, a temporary cable roller highway would be pre-installed in shallow water, and cable pulling towards the HDDs would be assisted by a tracked excavator. The cable barge would lay and bury the cable between the two end points maneuvering along the cable route using its anchoring system and positioned using spuds as required. Based on the sediments observed along Onshore Export Cable Corridor 1, US Wind assumes that a barge mounted vertical injector, which fluidizes the soil, would be the primary burial tool for the cable. The use of a cable plough or barge mounted excavator may be required in some areas. In shallow water, a self-driving or towed post-lay cable burial tool may be used.

1.4.1.4 Summary

Impacts from cable installation activities assessed included those associated with water quality, including sediment suspension, underwater sounds from the cable laying and burial, and the deployment of laying and drilling equipment in the water column. Vessel impacts are discussed in Section 1.4.2. Due to negligible impacts, no take of marine mammals is requested from cable installation activities.

Water quality impacts associated with jet plow operations and other bottom-disturbing activities related to cable installation are expected to be minor and temporally limited and are not anticipated to directly impact marine mammals. Impacts to marine mammal prey species due to bottom disturbing activities are also expected to be minor. The average modelled deposition thickness for the Offshore Export Cables and the inter-array cables is 0.04 inches (1 mm) (see COP Volume II Appendix II-B2 Offshore Sediment Transport Modelling). Though direct bottom disturbance and sediment deposition will result in localized mortality of benthic organisms, impacts to communities of benthic crustacean and shellfish species which may serve as prey for marine mammals are expected to be negligible (see COP Volume II, Section 7.2.1). Therefore, impacts to marine mammals due to sediment suspension are not anticipated to result from bottom-disturbing activities related to Project construction.

Noise during cable laying is expected to primarily be caused by the vessel installing the cable (Matthews and Parks 2021). An assessment of a similar activity (dredging) was completed in Robinson et al. (2011). The assessment determined that sound generated during dredging activities is similar to sound generated by transiting merchant vessels (Robinson et al. 2011). Vessels are likely to be passing through or by the Project area using nearby shipping lanes, and therefore the additional noise from cable laying vessels is not expected to significantly alter the background noise levels (see Section 1.4.2). Any dredging required for the onshore export cable installation is expected to conform with this noise assessment as well. Impacts to marine mammals due to noise are not anticipated to result from cable installation related to Project construction.

Horizontal directional drilling and cable laying activities have the potential to harm marine mammals if equipment comes into direct contact with the animals. US Wind will brief vessel operators and crew regarding vessel strike avoidance measures (see Appendix B) and for vessels engaged in HDD and cable laying the briefing will include the following avoidance measures to ensure marine mammals are not physically harmed by HDD and cable laying equipment. Vessel operators and crew would keep watch for marine mammals and, prior to commencement of deploying equipment such as the jet plow sled or gravity cell components, will ensure no marine mammals are sighted within 10 m of equipment. If a marine mammal is sighted, equipment deployment would be delayed until the animal is sighted 10 m or further from the deployment location.

US Wind is not requesting take for impacts to marine mammals from cable laying activities because the potential impact to marine mammals is negligible. Water quality impacts are anticipated to be minor and localized. Noise from the cable laying equipment would be similar to ambient sound levels from transiting vessels. Direct impacts due to interaction with equipment would be avoided by maintaining watch for marine mammals and delaying equipment deployment if marine mammals are within 10 m of the proposed deployment location. Cable installation activities are not considered further in the LOA application.

1.4.2 Construction-Related Vessel Activity

Numerous vessels would support activities carried out during the development, construction, and operation phases of the Project. Vessels are required for surveying, foundation installation, OSS installation, cable installation, WTG installation, and support activities. The vessels would vary in size and complexity based on their function on the Project. Table 1-2 describes the types of vessels and the associated construction phase for each in addition to vessels associated with operations and maintenance during the effective term of the requested rule. Table 1-3 summarizes the number of vessel trips for each activity. Project vessels would follow vessel strike mitigation measures discussed in Section 11.0 to reduce the potential for marine mammals to be struck (see also Appendix B).

The following port facilities along the Atlantic coast are currently under consideration to host various Project components and roles:

- Baltimore, Maryland: Primary port for WTG delivery, storage, pre-assembly and load-out; foundation fabrication, assembly, and load-out; OSS fabrication assembly, and load-out; and offshore and onshore export cable storage and load-out.
- Norfolk, Virginia: Alternate port for WTG delivery, storage, pre-assembly and load-out; alternate port for foundation fabrication, assembly, and load-out; and alternate port for support services and crew transfer
- Ocean City, Maryland: Primary port for support services and crew transfer.
- Port Norris, New Jersey: Alternate port for support services and crew transfer.
- Lewes, Delaware: Alternate port for support services and crew transfer.
- Cape Charles, Virginia: Alternate port for assembly of components and load-out.

The vessels employed on the Project would be required to comply with applicable USCG and Jones Act regulations for conducting operations in US waters. All foreign flag vessels employed on the Project would, in addition to USCG and Jones Act requirements, be required to meet International Maritime Organization (IMO) and International Marine Contractors Association (IMCA) requirements. Vessels would remain on site during construction activities, reducing the number of transits between the Project area and port, and vessels would transit to and from port at relatively slow speeds.

The majority of the vessels are expected to have conventional propeller- or thruster-based propulsion systems. Smaller vessels designed primarily for crew transfer applications are expected to employ water jet-drive based systems.

Where possible and if there is interest among the fishers in the Ocean City region, US Wind would employ fishing vessels for support activities such as scout vessels looking for fishing gear, to host Protected Species Observers (PSOs) to monitor clearance and/or shutdown zones during pile driving, or for other monitoring activities.

The specific vessels selected to perform the required tasks during development and construction will be dependent upon availability at the commencement of each activity. US Wind will secure vessel supply in advance to prevent any delays to the construction schedule.

To maintain position during construction and installation activities, Project vessels may utilize dynamic positioning (DP) thrusters to hold position or move slowly. Noise resulting from the use of DP thrusters is similar to that produced by vessels in transit and is typically only used for short intervals. This noise would follow the noise associated with a transiting vessel, making any marine mammals in the vicinity aware of the vessels presence and reduce the likelihood of startling marine mammals present. Due to the Project's proximity to Delaware Cape Henlopen Traffic Lane, existing vessel traffic in the area is relatively high and the additional noise from Project vessels is not expected to significantly increase the existing noise level. Previous analyses have shown that the use of DP thrusters has not resulted in an observable reaction in marine mammals to this noise source (83 FR 14417).

Vessel activity related to construction is not expected to result in the take of marine mammals due to the use of dynamic positioning and implementation of vessel strike avoidance measures. US Wind does not request any take for these activities. Vessel activities are not analyzed further in the LOA application.

Table 1-2. Types of Vessels to be Used during Construction

Vessel Class	Vessel Role	Foundations	Cables	OSSs	WTGs	Support	Operations	Approx. Length	Approx. Displacement	Approx. Crew Size	Est. # of Fuel Tanks	Estimated Max Fuel Storage Capacity
Utility boat, Fishing Vessel	• Marine Mammal Observers • Environmental Monitors • Guard Vessels • Acoustic Monitoring	X		X		X		15 - 25 m (45 - 80 ft)	20 - 250 t	2 - 10	2 - 6	8,000 L (2,110 gal)
Fall Pipe	Installation of scour protection	X		X				120 - 170 m (400 - 550 ft)	15,000 - 25,000 t	20 - 60	10 - 20	260,000-1,800,000 L (68,680-475,510 gal)
Heavy Lift and General Cargo	Delivery of project components from manufacturing location to staging/assembly port	X	X	X	X			120 - 223 m (394 - 735 ft)	15,000 - 200,000 t	15 - 25	10 - 20	260,000-1,800,000 L (68,680-475,510 gal)
Jack-up Crane or Floating Crane	• Installation of project components • Foundation • WTGs • OSS	X		X	X			120 - 225 m (400 - 740 ft)	20,000 - 80,000 t	25 - 220	10 - 20	260,000-1,800,000 L (68,680-475,510 gal)
Multipurpose Offshore Supply	• Supply of materials and consumables	X	X	X	X	X		65 - 90 m (210 - 295 ft)	500 - 3,000 t	8 - 25	10 - 20	378,000 L (100,000 gal)

Vessel Class	Vessel Role	Foundations	Cables	OSSs	WTGs	Support	Operations	Approx. Length	Approx. Displacement	Approx. Crew Size	Est. # of Fuel Tanks	Estimated Max Fuel Storage Capacity
	• Pre lay grapnel run boulder clearance • Noise Mitigation • Foundation Grouting • Refueling • Cable Burial											
Anchor Handling	Anchor positioning for installation vessels	X		X				20 - 80 m (65 - 262 ft)	50 - 2,500 t	5 - 20	5 - 15	284,000 L (75,000 gal)
Crew Transfer Vessel	Crew Transfer	X	X	X	X	X	X	10 - 30 m (30 - 100 ft)	50 - 1,500 t	2 - 5	3 - 8	8,000 (2,110 gal)
Cargo Barge	Feeder Vessel: Delivering components from staging port to Project site	X		X	X			75 - 120 m (250 - 400 ft)	9,600 - 17,000 t	N/A		N/A
Tugs	Movement and general support	X		X	X	X		16 - 35 m (75 - 115 ft)	250 - 2000 t	5 - 10	3 - 8	215,000 L (56,800 gal)
Jack-up or Accommodation vessel	Housing for offshore workers during construction			X	X			55 - 100 m (180 - 328 ft)	750 - 5,000 t	50 - 200	8 - 12	215,000 L (56,800 gal)
Survey	Pre-Installation and Verification Surveys Geophysical and Geotechnical	X	X	X	X			13 - 112 m (45 - 350 ft)	400 - 3,000 t	5 - 70	5 - 12	8,000 – 52,000 L (2,110 – 13,800 gal)
Cable Laying	Cable Installation		X					80 - 150 m (262 - 492 ft)	1,200 - 1,5000 t	15 - 45	10 - 20	120,000 L (31,700 gal)

Vessel Class	Vessel Role	Foundations	Cables	OSSs	WTGs	Support	Operations	Approx. Length	Approx. Displacement	Approx. Crew Size	Est. # of Fuel Tanks	Estimated Max Fuel Storage Capacity
Rock/ Mattress Placement	Placement of Scour Protection, Concrete Mattresses		X					130 - 170 m (427 - 558 ft)	25,000 t	20 - 60	10 - 20	260,000-1,800,000 L (68,680-475,510 gal)
Dredging	Seabed preparation/ leveling			X				75 - 120 m (250 - 400 ft)	2,000 - 7,000 t	15 - 25	10 - 20	284,000 L (75,000 gal)
Service Operation	Commissioning Activities			X	X			80 m (262 ft)	5,500 t	20 - 50	8 - 12	284,000 L (75,000 gal)
Cable barge	In shore cable installation		X					30.5 m (100 ft)		2 - 4	1	3,785 L (1,000 gal)
Anchor handling tug	In shore cable installation		X					7.6 – 15 m (25 – 50 ft)		1 - 4	1 - 2	3,785 L (1,000 gal)

Table 1-3. Maximum Number of Vessel Round Trips per Year*

Port During Construction	Vessel Type	Year 1	Year 2	Year 3	Year 4	Year 5
Foundation Installation						
Europe or Offshore East Coast, USA	Installation	2	1	1	0	0
Ocean City, Maryland, or Norfolk, Virginia	Support	56	146	100	0	0
Baltimore, Maryland	Scour Protection	2	4	4	0	0
Baltimore, Maryland	Transport/Feeder (4 tugs)	13	32	22	0	0
WTG Installation						
Europe or Offshore East Coast, USA	Installation	1	1	1	0	0
Baltimore, Maryland	Transport/Feeder (3 tugs)	25	62	43	0	0
WTG Commissioning						
Ocean City, Maryland	Support (3 crew transfer)	198	512	346	0	0
Offshore Substation Installation and Commissioning						
Europe or Offshore East Coast, USA	Installation	1	2	1	0	0
Norfolk, Virginia, or Baltimore, Maryland	Support (2 offshore supply)	12	23	12	0	0
Baltimore. Maryland	Transport/Feeder (3 tugs)	3	6	3	0	0
Inter-Array Cable Installation						
Baltimore, Maryland	Installation	3	7	5	0	0
Ocean City, Maryland or Baltimore, Maryland	Support	121	287	205	0	0
Offshore Export Cable Installation						
Baltimore, Maryland	Installation	2	3	2	0	0
Lewes, Delaware, Port Norris, New Jersey, or Baltimore. Maryland	Support	18	34	18	0	0
Europe	Transport/Feeder	1	1	1	0	0
Port During Operations	**Vessel Type**					
Baltimore, Maryland	Support (4 crew transfer)	0	59	59	59	59
Ocean City, Maryland	Support	0	764	764	764	764

* Vessel information, number of round trips, and timing of activities are presented as best estimates at this time. Shifts of timing and changes to ports and vessels could occur due to weather, contractor and vessel availability, and other unforeseen circumstances.

1.4.3 Additional Scientific Surveys

US Wind has partnered with the University of Maryland Center for Environmental Science (UMCES) for the research programs described below. Additional information on the hypothesis justification, approach, data analysis, and deliverables can be made available upon request. The scientific surveys described in the following sections are not expected to result in the take of marine mammals; therefore, US Wind does not request any take for these activities. Scientific surveys are not analyzed further in the LOA application.

1.4.3.1 Passive Acoustic Monitoring Array

This research effort, in partnership with UMCES, will support a passive acoustic monitoring array to detect large whales, such as North Atlantic right whales, and dolphins. Two types of listening devices will be deployed: 1) Rockhopper recorders designed by Cornell University to determine the occurrence and position of large whales and dolphins, and 2) F-POD devices to detect the tonal echolocation clicks of small cetaceans including porpoises. Additionally, this project will deploy Innovasea (previously known as VEMCO) receivers for acoustically tagged fish that would be attached at up to four of the mooring sites to provide additional information on the spatiotemporal pattern of tagged fish occurrence (such as endangered Atlantic sturgeon, white sharks and sand tiger sharks).

UMCES will use a before-during-after-gradient design (2 years of monitoring in each of the periods before, during and after; from 2023-2029) to characterize underwater ambient noise levels and detect vocalizing marine mammal species in and surrounding the US Wind Lease area to evaluate if and how marine mammals respond to the construction and operation of an offshore wind facility. UMCES proposes using two types of archival sound recording devices, the Rockhopper designed by Cornell University that will sample at 200 kHz for baleen whales and dolphins (n=10) and the F-POD, which is a tonal click detector for small cetaceans including porpoises (n=4). The Rockhopper recorders will be designed to include a localization array within the US Wind Lease area that will allow UMCES to determine the positions of calling critically endangered North Atlantic right whales, humpback whales, and dolphins. The design of the study is intended to build upon a similar baseline survey conducted in what is now the Lease area from 2014 through 2017 for the Maryland Department of Natural Resources and BOEM (Bailey et al. 2018). Using the data from this project, and the previously collected acoustic data in the study area, UMCES will determine the marine mammal response to the wind turbine installation and operation, including changes in occurrence, calling behavior, and/or patterns of spatial habitat use. By leveraging this extensive survey effort across many years, UMCES anticipates being able to distinguish changes in marine mammal behavior due to natural inter-annual variation versus behaviors influenced by wind facility operations.

A metocean buoy deployed in May 2021 during the site assessment term of US Wind's Lease is collecting acoustic recordings of marine mammals through at least 2023. UMCES is currently analyzing marine mammal detections from the buoy-collected data as a first step of the research effort.

Ten Rockhopper units and four F-PODs will be deployed within and outside the Lease area in April 2023. The units are bottom-mounted with an acoustic release for recovery. Following deployment, the project team will recover and re-deploy the acoustic recorders every six months through April 2029 when the recorders will be recovered and removed. Deployment and subsequent recovery/redeployment efforts will be conducted from the UMCES R/V Rachel Carson which uses dynamic positioning.

The Rockhopper units will be deployed approximately 4 km apart to allow for localization of North Atlantic right whales, humpback whales, and dolphin calls. The Rockhopper units will be closer to one another than the 2014-2017 survey, when the units were 7 km apart, due to the high level of ambient sound encountered due to the nearby shipping lanes and other transiting vessel traffic which made localization during the prior survey challenging. F-PODS will be deployed at four sites to detect dolphin and porpoise calls.

The acoustic recording devices deployed for the passive acoustic monitoring program will be bottom-mounted to be recovered by triggering an acoustic release to allow for recovery of the units. No mooring lines will be present during operations; therefore, there is little risk of entanglement of marine mammals from the acoustic recorders and no risk of entanglement with vessel anchoring lines because the R/V Rachel Carson uses dynamic positioning. The captain and other observers on the vessel will watch for marine mammals and sea turtles and will abide by the vessel strike avoidance measures described in Appendix B.

1.4.3.2 Commercial and Recreational Fisheries Monitoring

The fishery resource monitoring project will focus on black sea bass (*Centropristis striata)*, an important species for both the commercial and recreational fishing industries within the mid-Atlantic region. The fishery monitoring project will include a commercial (pot survey) and recreational charter fisheries (recreational survey). For the pot survey, UMCES will be utilizing ropeless gear technology. Field deployments for all monitoring projects will utilize Ocean City commercial fishing and recreational charter vessels, as well as the UMCES R/V Rachel Carson.

The goal of this fishery monitoring program is to evaluate the extent that commercial and recreational charter fisheries will be impacted by changed black sea bass aggregation behaviors between 2-year periods — before, during and after construction. The program includes a trial baseline year to test deployments and collect baseline data throughout the project area, and a data synthesis year to complete database distribution, data analysis, and reporting.

Black sea bass are structure-oriented with large aggregations occurring on artificial reefs and wrecks. Turbine foundations will add three-dimensional structure within the Lease area where little currently exists. Under these new conditions, UMCES expects highly aggregated distributions centered on turbines and increased accessibility to commercial and recreational fisheries. Still, black sea bass are sensitive to the percussive and vessel noise associated with turbine construction, which could cause short-term avoidance of turbines and wind farm regions. Both the pot survey and recreational survey will employ before-after-gradient (BAG) or before-after- control- impact (BACI) designs.

Operating off a commercial fishing vessel, the pot survey will consist of sets (trawls) of 15 commercial pots each that will be spaced proximate and distant to turbine structures to capture both turbine- and project-scaled changes in black sea bass relative abundance. For the initial trial baseline year under the pot survey, on March 21, 2022, UMCES received from the National Marine Fisheries Service Greater Atlantic Regional Fisheries Office, Sustainable Fisheries Division, a Scientific Letter of Acknowledgement for black sea bass collection research using two commercial fishing vessels (*FV Sea Born* and *FV Integrity*). This initial Scientific Letter of Acknowledgement allowed for pots to be deployed for up to 2 days duration but UMCES refined operations such that pots would only be set for a 1-day duration. UMCES will apply for a Scientific Letter of Acknowledgement to conduct 9 monthly pot surveys (March through November) each year using ropeless gear to collect data on pot catches and sizes of black sea bass and other fauna.

Edgetech ropeless systems will be used to avoid marine mammal entanglement. The ropeless gear will allow trawls of 15 pots to be set for the 1-day duration without the presence of any rope in the water column. UMCES will have a release pot attached at the end of each trawl. Following the 1-day trawl set, UMCES will retrieve the pot trawls by sending a release command from the on-site research vessel to activate an acoustic release on the release pot. Upon activation, the floatation with attached rope will ascend to the water surface. UMCES would recover the floatation connected to the release pot and then recover the rest of the pots for that trawl.

The recreational survey will employ a BACI design comparing two artificial reef/wreck sites (control) to two turbine sites. Angling techniques such as drop bottom fishing and jigging will be used to collect catch data for black sea bass and other fauna. In the event a marine mammal enters the confined in-water fishing space of the anglers onboard the vessel, fishing activity will cease until the marine mammal has departed the fishing area. For the recreational survey UMCES will be using a recreational charter vessel based in Ocean City (*FV Fin Chaser*). UMCES will conduct six monthly recreational surveys (May through October) per year of the control and treatment sites within a 2-day window using consistent angling methods tested during the trial baseline year.

The ropeless technology that UMCES will use during the pot survey for only 1-day soak times presents little risk of marine mammal entanglement. For the recreational survey there will be little risk of marine mammal entanglement with angler gear given UMCES will implement measures to immediately cease fishing activities if a marine mammal enters the specific area being fished by the anglers aboard the research vessel. In addition, UMCES will have the captains and other observers aboard the vessels conducting the research for the pot survey and recreational survey to watch for marine mammals and sea turtles and to abide by the vessel strike avoidance measures described in Section 11.0.

1.4.4 Potential UXO and Cable Pre-Construction HRG Surveys

US Wind may conduct HRG surveys prior to one or more construction campaigns to identify potential UXO for avoidance, to confirm previously surveyed site conditions prior to cable installation, and/or to meet BOEM or other agency requirements for additional survey. UXO identified through HRG surveys as being co-located with a WTG location would be avoided via micro-siting. Surveys will occur within the Lease area, focused on the indicative inter-array cable layout, and along the offshore export cable corridors, if needed. Survey equipment for the activities may include use of some or all of the following:

- Multibeam bathymetry (echosounder) to provide water depth data and general bottom topography information;
- Marine magnetometer measurements to detect ferrous/magnetic targets that may be present on or below the seafloor;
- Sidescan sonar seafloor imaging to provide information about the characteristics and morphologies of the seafloor;

Table 1-4 summarizes the purpose of the UXO identification and pre-construction cable route surveys, the associated equipment spread, and anticipated timing of each survey. Operating frequencies of side scan sonar and multibeam echosounders are above relevant marine mammal hearing thresholds (180 kHz), while magnetometers do not have an acoustic output (87 FR 64868). Therefore, no sound sources with the potential to harass marine mammals will be used during potential UXO surveys or cable pre-construction surveys and these surveys are not included in the request for take of marine mammals.

Table 1-4. Planned HRG Surveys not Considered in Take Request

Survey	Purpose	Equipment	Operating Frequencies (kHz) *	Expected Timeframe
Potential UXO survey	If additional survey is required beyond 2021/2022 survey to identify potential UXO	• Multibeam echosounder • Magnotometer • Sidescan sonar	• 200 / 300 / 400 • N/A • 445 / 900	March to April prior to construction
Cable pre-construction survey	Planned prior to all cable installations; route confirmation and pre-clearance	• Multibeam echosounder • Sidescan sonar	• 200 / 300 / 400 • 445 / 900	March to April prior to construction

* Data from (Crocker and Fratantonio 2016).

1.5 Activities Considered in LOA Request

US Wind has evaluated Project activities to determine potential harassment as required under 50 § CFR 216.104. Sound generated by survey equipment used during the micro-siting HRG, the impact installation of the WTG and OSS foundations, and the installation of bracing piles for the Met Tower could potentially impact marine mammals through acoustic disturbance during Project construction. These activities are described in the following sections.

1.5.1 Micro-siting HRG Surveys

US Wind may conduct HRG surveys prior to one or more construction campaigns to refine the locations of project elements such as construction footprints, WTG and OSS foundations, and cables, and/or to meet BOEM or other agency requirements for additional survey. Micro-siting HRG surveys may include use of some or all of the following:

- Multibeam bathymetry (echosounder) to provide water depth data and general bottom topography information;
- Marine magnetometer measurements to detect ferrous/magnetic targets that may be present on or below the seafloor;
- Sidescan sonar seafloor imaging to provide information about the characteristics and morphologies of the seafloor;
- Ultra-short baseline system (USBL) for acoustic positioning of equipment;
- Shallow-penetration sub bottom profiler (SBP) to map near-surface geologic structures and sediment stratigraphy (down to generally < 20 meters [65.6 feet] below the seafloor); and,

- Medium-penetration SBP to map deeper geologic structures and sediment stratigraphy (down to 100 meters [328 feet] below the seafloor).

Table 1-5 summarizes the purpose of the additional survey for micro-siting inter-array cables or project elements, the associated equipment spread, and anticipated timing of each survey. Section 2.1 includes the potential timing and duration of survey activities in relation to the construction campaigns.

Table 1-5. Planned Micro-siting HRG Surveys

Purpose	Equipment	Expected Timeframe
If WTG layout changes during COP/agency review, additional survey may be needed to evaluate site conditions or review potential impacts to cultural resources	• Multibeam echosounder • Magnetometer • Sidescan sonar • USBL • Sub bottom profilers	April to June prior to construction

Operating frequencies of side scan sonar and multibeam echosounders are above relevant marine mammal hearing thresholds (180 kHz). USBLs were not used for the consideration of take based on NOAA Fisheries guidance, dated July 22, 2020, that, due to the characteristics and usage of the sound sources, shallow- and medium-penetration SBPs are the primary acoustic sources for micro-siting HRG surveys. Representative sound sources to be used during micro-siting HRG surveys, which have the potential to result in harassment of marine mammals, are presented in Table 1-6. These sound sources operate within the hearing range of marine mammals and may cause behavioral changes in species occurring within the Lease area (anticipated location of micro-siting HRG surveys). Impacts may include changes in foraging behavior, communication masking, and avoidance of the survey area (see Section 7.2). The evaluation of potential take resulting from these activities is discussed in detail in Section 6.4.

Table 1-6. Operating Parameters of Micro-siting HRG Survey Equipment

<table>
<tr><th>HRG System</th><th>Survey Equipment</th><th>Operating Frequencies (kHz)</th><th>Peak Source Level (dB_{peak})</th><th>RMS Source Level (dB_{RMS})</th><th>Pulse Duration (ms)</th><th>Repetition Rate (Hz)</th><th>Beamwidth (degrees)</th></tr>
<tr><td rowspan="4">USBL</td><td>Sonardyne Mini Ranger 2 USBL</td><td>19 - 34</td><td>-</td><td>194</td><td>8 - 16</td><td>0.5 - 1</td><td>180</td></tr>
<tr><td rowspan="2">USBL Wideband Mini Transponder</td><td rowspan="2">19 - 34</td><td rowspan="2">-</td><td>omni-directional: 184</td><td rowspan="2">8 - 16</td><td rowspan="2">0.5 - 1</td><td>omni-directional: 120</td></tr>
<tr><td>directional: 193</td><td>directional: 40</td></tr>
<tr><td>USBL Wideband Nano Transponder</td><td>19 - 34</td><td>-</td><td>184</td><td>8 - 16</td><td>0.5 - 1</td><td>130</td></tr>
<tr><td>Shallow-penetration SBP</td><td>Innomar SES 2000 Std</td><td>high frequency operation: 85 - 115</td><td>-</td><td>240</td><td>0.7 - 1.5</td><td>60</td><td>2</td></tr>
</table>

HRG System	Survey Equipment	Operating Frequencies (kHz)	Peak Source Level (dB_{peak})	RMS Source Level (dB_{RMS})	Pulse Duration (ms)	Repetition Rate (Hz)	Beamwidth (degrees)
		low frequency operation: 2 - 22					
Medium-penetration SBP	Applied Acoustics S Boomer (AA252)[1]	0.1 - 5	211	205	0.6	3	80
	Geo-spark 2000 (2 x 400 tip)	0.3 - 4	222	219	4	2	100

"-" indicates not applicable.
[1] The equipment listed above was used during US Wind's previous HRG surveys within the Project area and the information has been verified by multiple contractors. Information obtained from manufacturer specifications, except for the Applied Acoustics S Boomer. Crocker and Fratantonio (2016) provide AA S Boomer measurements from Tables 6 and 7. Frequency and repetition rate of the AA S Boomer verified by the survey contractor.

1.5.2 WTG, OSS, and Met Tower Foundation Installation Activities

1.5.2.1 WTG Foundation Installation

US Wind proposed foundation types in the COP that not only meet technical and economic feasibility thresholds, but also have proven manufacturing and deployment histories in the offshore wind industry or comparable oil and gas deployments. The intent of this approach is to reduce overall Project risk. The foundation options that US Wind rejected or otherwise identified as infeasible in the COP have significant flaws under current market conditions, Project design considerations, and/or company risk tolerance.

US Wind evaluated the technical and economic viability of a range of foundation types for the WTGs based upon several inputs, including the Project technical characteristics (e.g., WTG sizes), site conditions (including preliminary geotechnical and geophysical conditions), the state of the U.S. and global supply chains, and Project economics. Based upon this review, as well as subsequent information collected from the site, US Wind determined that monopile foundations for the WTGs are technically and economically feasible and that other options are not.

WTG foundations would be monopiles which are appropriate to the water depth and seabed conditions in the Lease area.

The maximum diameter of the monopile foundation in the Project Design Envelope would be 11 m and would penetrate up to 50 m below the seafloor. Monopile foundations would consist of a monopile with integrated or separate transition piece (TP) as shown in Figure 1-4. TP-less monopiles can be effectively used in shallower water although not in the deeper, eastern portion of the Lease area associated with the first construction campaign. US Wind would install scour protection around the base of the foundations to reduce or eliminate scour around the monopiles.

The top of the monopile typically consists of a flanged connection that allows for a bolted connection between the TP or turbine tower. A foundation TP acts as an interface between the monopile and WTG tower. The TP commonly incorporates space for switch gear, dehumidification equipment and control systems while also providing boat landing, access and service platforms, and these components are constructed onshore so that the TP is complete when brought offshore for installation. If a monopile foundation without a separate TP is selected, the switch gear, dehumidification equipment and control systems would be installed in a suspended structure inside the monopile, with the boat landing, access, and service platform attached to the exterior of the foundation. Installation of a TP-less monopile, sometimes referred to as an extended monopile, would result in one fewer heavy lifts offshore because the tower would be connected directly to the monopile, however, the internal and external platforms as well as the boat landing/access would be installed offshore. US Wind anticipates that for the first construction campaign, or MarWin, foundations would include a monopile and TP. For the second and third construction campaigns, TP-less monopiles may be used at some or all of the installation locations depending on technical and commercial feasibility. The installation procedure in this section describes both monopiles with and without TPs.

US Wind would include scour protection in the form of rock around the base of the monopile foundation, an area of approximately three times the diameter of the foundation. Following installation of the monopile and scour protection a specialized WTG installation vessel would lift and install the WTG towers, nacelles, and blades.

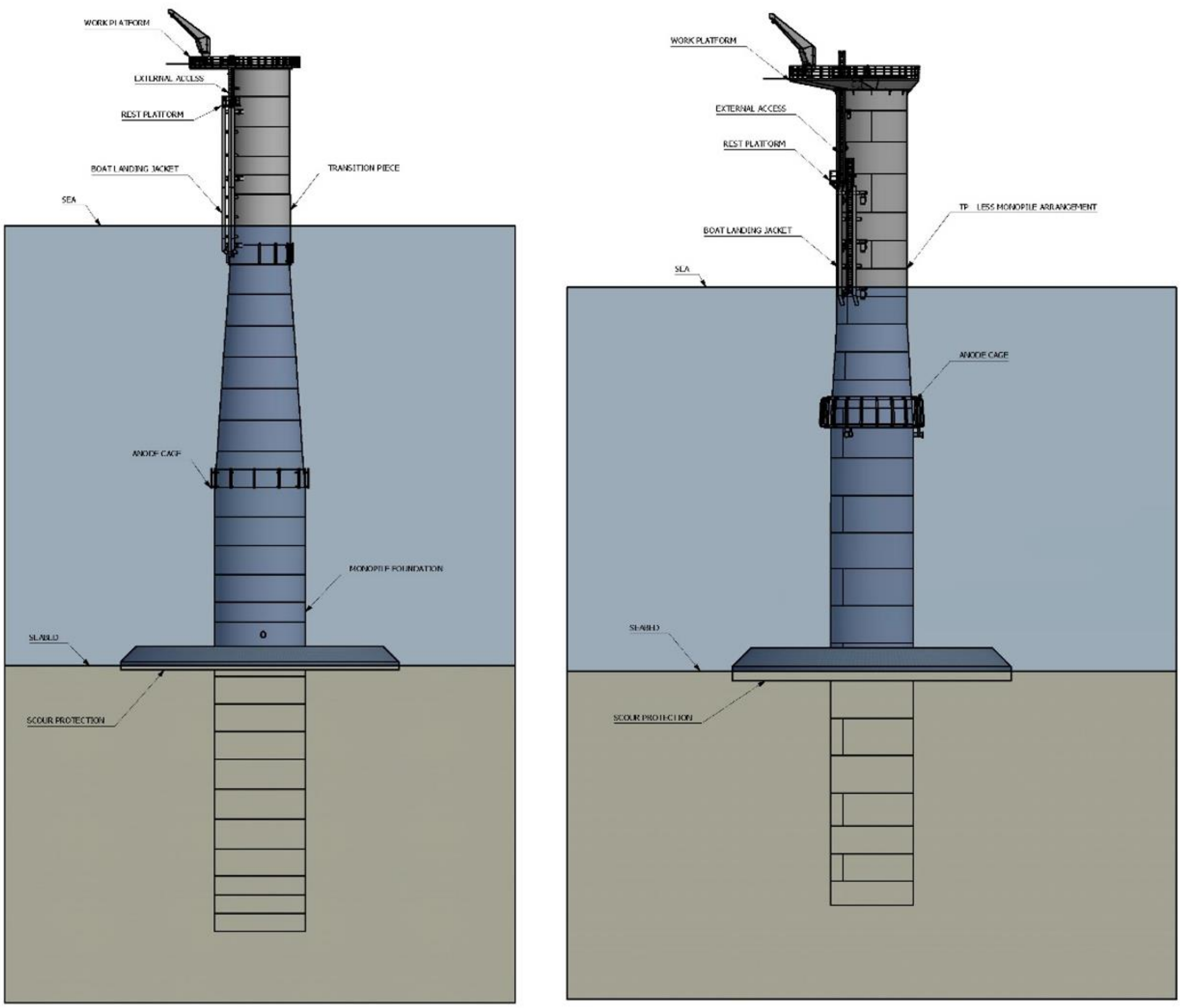

Figure 1-4. Monopile Foundations with and without Transition Pieces

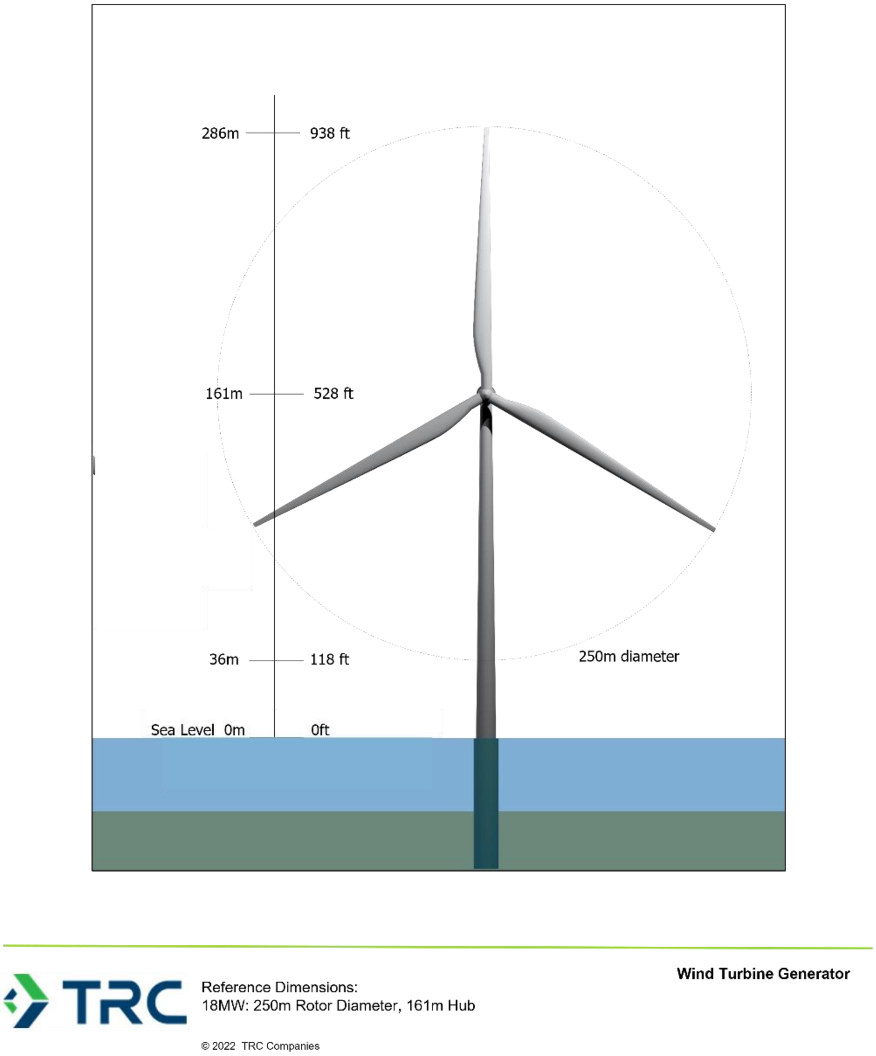

Figure 1-5. Dimensions for PDE Maximum 18 MW

The foundation installation process would begin by transporting the monopiles to the installation site by floating the monopiles without a vessel, using feeder vessels (a vessel, typically a barge, that delivers or receives cargo from another vessel), or employing direct installation vessels (i.e., jack-up crane or floating crane vessel).

US Wind assumes feeder vessels would be used during foundation installation. The number of feeder vessels employed will be determined based on foundation size and installation rate. US Wind assumes that up to four feeder vessels could be employed to support monopile installation. The feeder vessels may be jack-up vessels or tug and barge units. The feeder vessels may employ anchors for positioning. If anchors are employed, US Wind will utilize mid-line anchor buoys.

Installation of the monopile foundations offshore would be conducted using either a dynamically positioned crane vessel and/or a jack-up style installation vessel equipped with a hydraulic impact hammer to drive the monopiles into the seabed. Thrusters on the dynamically positioned vessels could be as large as 5 m in diameter. An anchored vessel may be used for monopile installation but is not anticipated due to the commercially available vessels in the market which typically use dynamic positioning. If anchors are employed, US Wind will utilize mid-line anchor buoys. If anchors are used to position foundation installation vessels the anchor line would be taut to hold the vessel in position and would not pose an entanglement risk for marine mammals.

US Wind intends to employ both near-field and far-field underwater sound mitigation technologies while the monopile is driven into the seabed. Near-field sound abatement technologies could include an AdBm Technologies Noise Mitigation System and using a damper between the hammer and sleeve to prolong the impact pulse. Far-field technologies could include a large double bubble curtain, deployed by a separate vessel mobilized to the installation location. The installation procedures will be refined as the design process continues and installation equipment is selected.

Prior to or following installation of a monopile into the seabed, the first layer of scour protection rocks would be deployed in a circle around the pile location. This layer of small rocks, the filter layer, will stabilize the sandy seabed, avoiding the development of scour holes. The rocks will be placed by a specialized rock dumping vessel with a layer thickness of up to 0.5 m (2 ft). Once the inter-array cables have been pulled into the monopile, a 1-2 m (2-7 ft) thick second layer of larger rocks, the armor layer, would be placed to stabilize the filter layer.

Typical monopile foundation installation procedures are as follows, including the potential sequence of implementation of mitigation measures described in Section 11.0:

- Foundation location is verified, any obstructions are avoided or physically removed, and leveled, if required. No drilling to remove obstructions is anticipated.

- Feeder or installation vessel transports foundation to site; alternatively, monopiles are self-floating and towed to site.

- Installation vessel positions itself at foundation location including jacking and preloading as required. The use of anchors may be required in some instances.

- Monopile delivered to installation vessel, lifted from feeder vessel, upended and installed in pile gripper frame or temporary template placed on the seabed. Near-field noise mitigation would be implemented using AdBm or HSD noise suppression system integrated into the monopile gripper frame and would be lowered around the pile.

- Monitoring of clearance zone for marine mammals and other protected species is conducted for at least 60 minutes prior to beginning the impact hammering.

- Monopile verticality verified and pile allowed to penetrate seabed under its own weight.

- Far-field noise mitigation procedures implemented. US Wind anticipates using a double bubble curtain, which is a weighted hose with small holes. The hoses would be laid in circles around the monopile location and filled with compressed air to create a wall

- Pile hammer placed on monopile and soft start process commenced. (See Section 11.0 for detailed mitigation measures including the soft start process.)

- Pile driven to target penetration depth, using as low impact energy as possible and no more than 4,400 kJ.

- Monitoring of the shutdown zone for marine mammals and protected species would continue throughout the pile driving process. If a protected species enters the shutdown zone, pile driving would be halted unless there are safety or technical considerations that require completion of driving the pile to target penetration depth.

- In the unlikely event that pile meets refusal prior to the embedment depth, relief drilling of the pile may be required. “Relief drilling” would be conducted using a trailing suction hopper dredger which would suction soils from the area creating sound similar to dredging operations (see Section 1.4.1.4 for a discussion on the noise impacts from dredging). Any soils removed during relief drilling will remain at the foundation location and will be placed in the general area where scour protection will be later installed.

- If a TP is included in the foundation design, the TP lifted from installation vessel or feeder vessel and installed. If a TP-less monopile is used this step would be omitted from the installation procedure.

- For the TP-less monopile installation process, the internal and external platforms and boat landing would be lifted from feeder vessel and installed on monopile.

- If a jack-up vessel is used the installation vessel jacks down and moves to next foundation position.

- Installation of scour protection as required.

Pile run can occur during pile installation where weak soils, or even worse weak soils below thin layers of hard soil, are present. If a pile run occurs the pile penetrates weak soil uncontrollably which can cause a shock load to the crane due to the hook attached to the hammer on the monopile not being lowered quickly enough. Based on the sandy seabed and subsurface conditions in the Lease area (Wood Thilsted 2022), pile run is a low risk for installation of monopiles (for WTGs), skirt piles (for OSSs), or pin piles (piles for Met Tower foundation). Installation contractors will conduct a pile run risk analysis prior to mobilization and should pile run risk mitigation measures be deemed necessary, a longer sling between the hammer and crane hook would be used. US Wind does not intend to use a vibratory hammer to install WTG monopile foundations.

Installation of monopile foundations requires impact hammering to achieve the appropriate penetration depth in the seabed. Impact hammering is an intermittent sound source that has the potential to affect marine mammals and potentially result in harassment or injury. The potential acoustical impacts of impact pile driving for WTG monopile installation on marine mammals have been assessed in the Underwater Acoustic Assessment of Pile Driving during Construction at the Project included as Appendix A and discussed in the Section 6.

US Wind assumes an MHU 4400 impact hammer would be used for the Project with a maximum energy of 4,400 kJ. Before modelling, the source spectra and the associated hammer energies must be determined, which are then used to derive broadband source levels for each source. However, no source spectra were available for the combination of pile diameter and hammer strike energy planned for use in the Project. Surrogate spectra had to be developed from available literature and information. These surrogate spectral values were then scaled by the US Wind pile diameters and hammer energies to predict the associated broadband source levels for each pile driving scenario. This scaling factor is the sound level offset. Acoustic modeling of the predicted sound fields for each hammer sound source was then used to determine the ranges to regulatory isopleths (i.e., acoustic ranges) for marine mammals.

US Wind estimates using hammer energies of 1100, 2200, and 3300 kJ during the installation of the monopiles (see Table 6-4); this allows for maximum operational flexibility should a higher hammer energy be necessary than predicted. To account for the lower strike energies being proposed in the pile installation, the spectrum was scaled using the relationship presented in von Pein (2022). The resulting broadband SEL source level at 4,400 kJ is 224 dB re 1µPa2-m2-s (Table 6-6). The broadband SEL source levels at hammer energies of 1100 kJ, 2200 kJ, and 3300 kJ are 218 dB re 1µPa2-m2-s, 221 dB re 1µPa2-m2-s, and 223 dB re 1µPa2-m2-s, respectively (Table 1-7). The sound level offsets were used when calculating the cumulative SEL sound field to assess against the acoustic guidance. Section 6.3.4 calculates the potential take from monopile installation activities. Section 2.1 describes the schedule and duration of monopile installation. Section 11.0 and Appendix B describe US Wind's planned mitigation measures to reduce impacts to marine mammals.

Table 1-7. SEL Source Levels for the WTG Monopile Foundation (single strike)

Hammer Energy (kJ)	Broadband SL (dB re 1µPa^2-m^2-s)	Sound Level Offset (dB) from Modeled Energy
1100	218	-6
2200	221	-3
3300	223	-1
4400	224	0

* The modelled difference between the maximum hammer energy (4,400 kJ) and the intended hammer energy (1,100 kJ, 2,200 kJ, and 3,300 kJ).

Only one monopile per day will be installed during daylight hours, with installation activities extending for up to 2 days. US Wind anticipates active pile driving time of 2 hours based on analysis of site conditions. A detailed explanation of the piling schedule can be found in Section 2.1.

1.5.2.2 OSS Foundation Installation

US Wind determined that monopile or jacket foundations for the OSSs are technically and economically feasible while other options are not, based on the unique design configurations and customized approaches to OSS foundations. Up to 4 OSSs[9] for the Project, one for each grouping of approximately 300 to 400 MW of WTG capacity, would be installed atop monopile or jacket foundations. US Wind is evaluating a modular configuration of the OSS topsides, each of which are anticipated to contain medium-voltage ("MV") switch gear (66 kV), HV transformer (66 kV to 230 kV), Supervisory Control and Data Acquisition (SCADA) interface, control systems and a connection to the export cables, a generator, as well as the associated safety and ancillary equipment. As an alternative, US Wind is also evaluating the combination of some or all substation

[9] The term offshore substation (OSS) refers to the same structure and Project components referenced elsewhere in the industry as the electric service platform (ESP), offshore transformer module (OTM), and similar names.

components onto one or two larger platforms. For this approach, equipment serving two or more arrangements of 300 to 400 MW (up to the full capacity of the Project) would be combined onto one or two large jacket foundations. If larger combined OSSs are selected, these would be located in the interior positions of the layout in Figure 1-2.

Foundations under consideration for the OSSs would be installed using varied procedures and installation methods. Monopile foundations for an OSS have a separate transition piece (TP) with a number of J-tubes for the installation of inter-array cables and the offshore export cable.

Jacket foundations (see Figure 1-6) are typically installed in two ways: pre-piled (piles preinstalled in the seabed using a template) or post-piled (piles driven through jacket skirts, or “skirt piles”). Although a final installation method has not been finalized, the installation of the jacket skirt piles is assumed to be post-piled in the noise assessment. The 3-m skirt pile source spectrum used in the modeling was based on the measured spectra of a 6-m pile reported by Bruns et al. (2014) and a 3.5-m FINO2 pile reported by Matuschek and Betke (2009) (see Section 6.4.3.2 and Appendix A, Section 4.4.2). The broadband SEL source level is 210 dB re 1µPa^2-m^2-s. Skirt piles would be up to 3 m in diameter and installed using an impact hammer up to 1,500 kJ. Driving of each pile is estimated to span 2 hours, with all four piles anticipated to be installed over the course of one day.

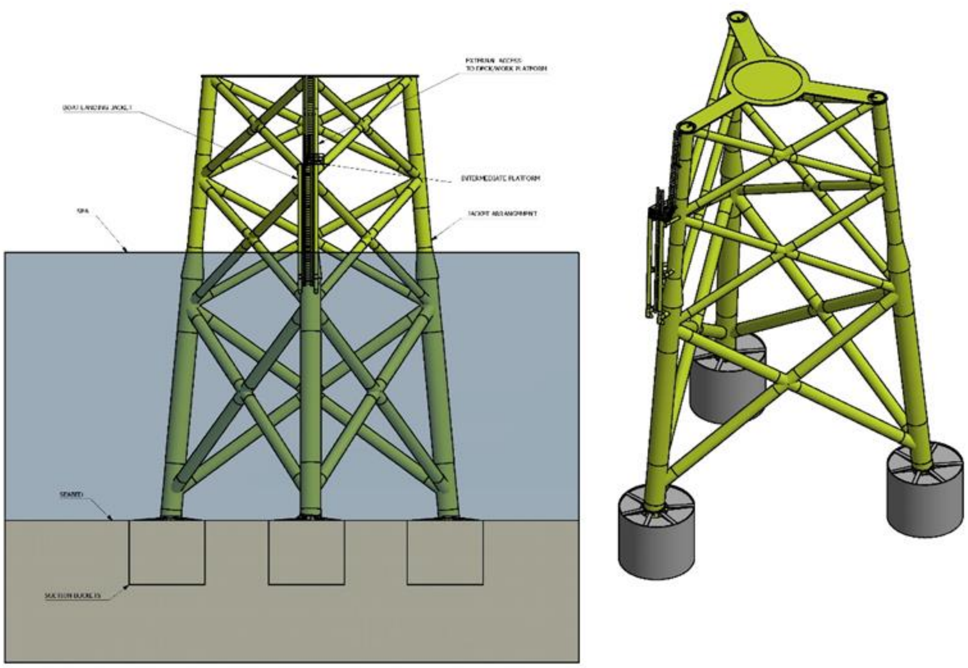

Figure 1-6. Jacket Foundations on Suction Buckets

If seabed preparation is needed to provide a level surface for the post-piled jacket or jacket on suction buckets, dredging equipment from a vessel would remove disturbed soil to create a firm and level base in the footprint of the foundation. Based on the analysis of the seabed conditions, preparatory work is not necessary for foundations.

As discussed in Section 1.4.1, Robinson et al. (2011) assessed the noise impacts from dredging activities. Overall, noise levels were similar to typical merchant vessels, radiating at frequencies less than 500 Hz (Robinson et al. 2011). While extracting material, it is possible for the noise generated by dredging vessels to be louder than that of merchant vessels. Robinson et al. (2011) reported that the noise level was dependent on the type of material being dredged, with gravel being noisier to extract than sand. Because the predominant sediment type within the Project area is sand (see COP Volume II, Section 3.1.2), impacts on marine mammals from noise due to dredging are not anticipated to occur.

Typical pre-piling installation procedures are as follows:

- Feeder or installation vessel transports foundation to site; if anchors are employed for positioning of vessels these may be installed ahead of vessel arrival.
- Monitoring of clearance zone for marine mammals and other protected species is conducted for at least 60 minutes prior to soft start of the impact hammering.
- Far-field noise mitigation procedures implemented. US Wind intends to use bubble curtains during installation.
- Monitoring of the shutdown zone for marine mammals and protected species would continue throughout the pile driving process. If a protected species enters the shutdown zone, pile driving would be halted unless there are safety or technical considerations that require completion of driving the pile to target penetration depth.
- Piling template lifted from crane vessel deck and lowered to seabed. The piling template is adjusted using the hydraulically actuated template legs to provide a level frame for pile installation.
- Pile is lifted from the feeder vessel and lowered into the piling frame and pile is allowed to penetrate seabed under its own weight.
- Noise mitigation procedures are implemented. US Wind anticipates using a double bubble curtain during pile driving for the OSS skirt piles.
- Pile driven to initial embedment depth with impact pile hammer.
- Remaining piles lowered into piling frame and driven to initial depth.
- All piles driven to target embedment depth.
- In the unlikely event the pile meets refusal prior to the embedment depth, removal of the soil plug or relief drilling of the pile may be required. Any soils removed during relief drilling would remain at the foundation location and would be placed in the general area where scour protection would be later installed.
- Soil plugs removed from piles to ensure adequate depth for jacket stabbing mechanism.
- Pile heights above seabed are verified and piling template removed.

Typical jacket installation procedures are as follows:

- Feeder or installation vessel transports foundation to site, if anchors are employed for positioning of the vessels, these are installed ahead of vessel arrival.
- Pre-installed piles inspected by remote operated vehicle (ROV) to ensure that sufficient soil is removed to allow engagement of jacket stabbing mechanism and cleaned to ensure appropriate bonding surface for grout adhesion.
- Jacket lifted from feeder vessel and lowered onto piling.
- Jacket gripper and leveling system engaged to level and secure jacket, if required.
- Grouting process commenced to permanently attach jacket to piling.

In case of a post-piled jacket, the jacket would be placed on the seabed and piles would be stabbed into the jacket pile guides (skirts). An underwater hammer would be used to drive the skirt piles to target penetration. The jacket would then be leveled, if needed, and the top of the piles rigidly connected to the pile guides of the jacket.

Typical jacket on suction bucket foundation installation procedures are as follows:

- Feeder or installation vessel transports foundation to site; if anchors are employed for positioning of the vessels, these are installed ahead of vessel arrival.
- Jacket on suction buckets delivered to installation vessel, lifted from feeder vessel, and lowered in the target area on the seabed.
- Verify correct orientation of the jacket.
- Activate and test the suction bucket dewatering pumps. Dewatering process commenced, drawing suction buckets to design embedment depth.
- Jacket verticality monitored during lowering, and suction pressure adjusted per bucket, if needed.
- Once the buckets have reached their target penetration, the suction pumps would be disconnected from the buckets by ROV and recovered to the vessel.
- Deploy scour protection, if applicable.

The potential acoustical impacts on marine mammals of impact pile driving of skirt piles for a jacket foundation have been assessed in the Underwater Acoustic Assessment of Pile Driving during Construction at the Project included as Appendix A and discussed in the LOA Application.

1.5.2.3 Met Tower Installation

The Project includes a Met Tower which would serve as a permanent metocean monitoring station. The data collected will be used to support project operations and long-term monitoring. The Met Tower is a bottom-fixed structure consisting of a steel, lattice mast fixed to a steel deck supported by a steel Braced Caisson style foundation as shown in Figure 1-7. The Met Tower is planned to include a robust suite of monitoring, data logging, and remote communications equipment, as well as associated power supply, lighting, and marking equipment. Figure 1-2 depicts three potential locations of the Met Tower along the southern edge of the Lease area.

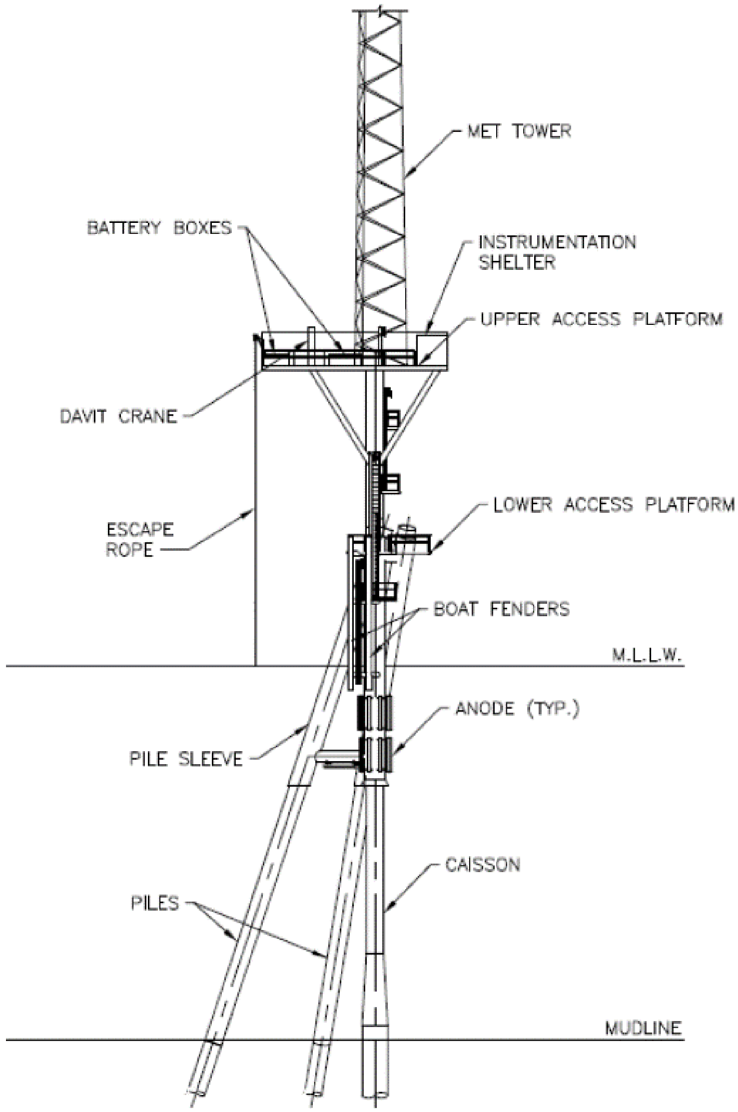

Figure 1-7. Met Tower Rendering[10]

Representative Met Tower installation activities are summarized below, based upon installation with a US-flagged lift boat. Actual installation activities and sequencing would be updated based upon final design, timing of installation, and selected vessels and equipment.

- Prior to jacking into position at site, a brief bottom visual survey would be carried out to ensure the area is free of debris or any other impediments to the vessel legs.

[10] The piles and main caisson indicated in Figure 1-5 are collectively referred to as pin piles for the underwater acoustic modelling described in Section 6.

- After ensuring the site is clear of debris, the lift-boat would jack up until it is in a secure and correct position to commence operations.

- Monitoring of clearance zone for marine mammals and other protected species is conducted for at least 60 minutes prior to soft start of the impact hammering.

- Far-field noise mitigation procedures implemented which is anticipated to be a double bubble curtain.

- Monitoring of the shutdown zone for marine mammals and protected species would continue throughout the pile driving process. If a protected species enters the shutdown zone, pile driving would be halted unless there are safety or technical considerations that require completion of driving the pile to target penetration depth.

- The main 183-cm (72 in) diameter main caisson would be lifted into place from the materials barge to an alignment frame ready for piling. The alignment frame is a structure attached to the vessel designed to hold the caisson in place.

- Once the caisson is penetrated in the seabed, it would be driven to its design depth or refusal using either a hydraulic or diesel driven impact hammer rated at approximately 500 kilojoules (kJ).

- With the main caisson installed, the bracing pile guide structure would be lifted from the materials barge and set onto the caisson.

- The two bracing piles, each 152 cm (60 in) in diameter, would then be driven through the guide structure using the 500 kJ impact hammer to design depth or refusal.[11]

- The steel deck and boat landing appurtenances would then be installed onto the braced caisson configuration.

- Once the deck has been checked for level and is secure in place, the met mast and all ancillary equipment shall be installed.

2.0 Dates, Duration, and Specified Geographic Region

2.1 Dates and Durations of Construction Activities

US Wind proposes construction of the Project in three construction campaigns. Construction is anticipated to begin with receipt of all permits and COP approval. US Wind requests the LOA permit term beginning January 2025 and extend five years through December 2029, which would include the timeframe of activities associated with potential take.

US Wind plans continuous development and construction to efficiently develop the Project and fulfill existing and potentially future obligations. The construction approach is a result of various factors, such as varying permitting timelines, manufacturing timelines and component availability,

[11] For the acoustic modelling discussed in Section 6.0, all three piles used in the Met Tower foundation are collectively referred to as "pin piles" and assumed to be 1.8 m (5.9 ft).

vessel availability, supply chain dynamics, technological adjustments, and seasonal restrictions. This approach would also ensure that construction impacts are minimized and streamlined.

US Wind proposes construction of the Project in three construction campaigns. Construction is anticipated to begin with receipt of all permits and COP approval. US Wind requests the LOA permit term beginning January 2025 and extend five years through December 2029, which would include the timeframe of activities associated with potential take.

In this section US Wind provides the reasonably anticipated construction schedule for each campaign. Due to uncertainty around vessel availability, component availability, weather windows, regional electric grid interconnection approval and timing, the dates may shift. Therefore, US Wind requests a 5-year effective term to accommodate these uncertainties. Time of year estimates for foundation installation using pile driving would be confined to May 1 through November 30. Other activities, such as cable installation, WTG and OSS commissioning, and HRG surveys, could shift due to some or all of the factors listed above.

As noted in Section 1.2, the Project includes MarWin, Momentum Wind, and future development in the Lease area and these developments align with the proposed construction campaigns as described below. MarWin would be the first construction campaign of approximately 300 MW and approximately 21 WTGs and one OSS to be located in the southeastern portion of the Lease area. The target commercial operation date of MarWin is December 2025. Momentum Wind represents the second construction campaign of approximately 808 MW to be built west of MarWin. Momentum Wind is estimated to include 55 WTGs, two OSSs, and the Met Tower. The target commercial operation date is December 2026. The third construction campaign is the future development of approximately up to 680 MW. The size and generation capacity of the campaign depends on the size of future power offtake contracts as well as the number of WTG locations in the PDE that are approved in the COP. For the LOA Application, US Wind estimates a maximum of 38 WTGs and one OSS with a target commercial operation date of December 2027.

In this section US Wind provides the reasonably anticipated construction schedule for each campaign. Due to uncertainty around vessel availability, component availability, weather windows, regional electric grid interconnection approval and timing, the dates may shift. Therefore, US Wind requests a 5-year permit term to accommodate these uncertainties. Figure 2-1 depicts the estimated construction schedule for the Project over the 5-year period. Filled bars on the schedule show the expected construction window and the unfilled bars indicate the potential construction periods due to the uncertainties described above. Activities for which US Wind is requesting take (see Section 1-5) are highlighted in orange and activities that are part of US Wind's construction plan, but for which take is not requested, are in dark blue.

Micro-siting HRG surveys deemed necessary to provide additional seafloor information would occur prior to the associated construction campaign. All HDD installation activities would occur in a single construction campaign.

All pile driving would be confined to May 1 to November 30 to minimize potential impacts to the endangered North Atlantic right whale. Pile driving would occur during daylight hours with operations beginning after sunrise and ending before dusk, unless a situation occurs where prematurely ending pile driving may cause a safety hazard or compromise the feasibility of the foundation installation. US Wind committed to driving no more than one monopile per day and no pile driving at night in the COP and in applications to the state of Maryland for power offtake contracts; therefore, a maximum of one monopile per day is assumed and no pile driving will occur during nighttime hours.

WTG and OSS foundation installation could extend up to 2 days, consisting of navigation and set up of the installation vessel spread, lifting and positioning of the monopile, implementation of mitigation measures (see Section 11.0), impact hammering, verification of installation, and demobilization from the installation location. The impact pile driving portion of the installation process is anticipated for approximately 2 to 4 hours. For acoustic modelling, the assumptions listed in Table 6-3 were used (see Section 6.3.2). Periods between pile driving installation for monopiles are anticipated to be less than 72 hours. Periods between driving the skirt piles are assumed to be approximately one hour. No simultaneous installation, or installation within the same 24-hour period, of monopiles for the WTG foundations and skirt piles for the OSS foundations is anticipated.

Pile driving for the Met Tower foundation using pin piles (Scenario 3 in Section 6.3.2) is anticipated to span approximately 2 days, with the pile driving anticipated to span 2 to 4 hours. For acoustic modelling, the assumptions listed in Table 6-3 were used (see Section 6.3.2). No simultaneous installation, or installation within the same 24-hour period, of monopiles for the WTG foundations and pin piles for the Met Tower foundation is anticipated.

Figure 2-1 summarizes the reasonably expected dates and durations of Project construction activities by construction campaign. The expected time periods are shown in colored areas, with alternate time periods shown as bold outlines. Table 2-1 shows the estimated pile driving schedule by year for each of the three construction campaigns, which was used to estimate marine mammal exposures.

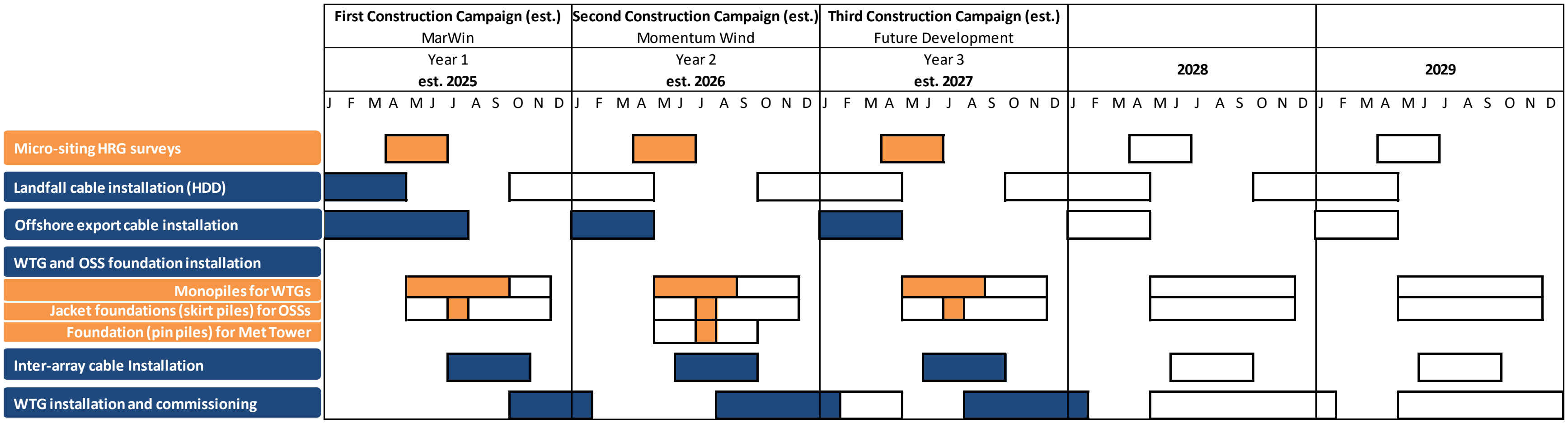

Figure 2-1. Reasonably Anticipated Construction Schedule[12]

[12] Activities included in the take request are shown in orange. Where no take is requested, activities are shown in blue. Unshaded areas represent alternative times when activities may occur due to schedule changes from contractor availability, weather delays, or other unforeseen schedule adjustments.

Table 2-1. Estimated Piling Schedule by Year for the Three Construction Campaigns

	Year 1*		Year 2			Year 3	
	Monopiles[1]	Skirt piles[2]	Monopiles[1]	Skirt piles[2]	Pin piles[3]	Monopiles[1]	Skirt piles[2]
May	0	0	**16**	0	0	0	0
June	**8**	0	**16**	0	**3**	**15**	0
July	0	**4**	**16**	**8**	0	**10**	**4**
Aug	0	0	**7**	0	0	**13**	0
Sept	**13**	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0
Total piles	**21**	**4**	**55**	**8**	**3**	**38**	**4**
Total piling days	**21**	**1**	**55**	**2**	**1**	**38**	**1**

[1] Monopiles = WTG foundations
[2] Skirt piles = OSS foundations
[3] Pin piles = Met Tower foundation
* The anticipated two-month gap in Year 1 monopile installation is based on expected vessel and contractor availability.

2.2 Specified Geographical Region of Activity

The Lease area is 79,707 acres and is located approximately 18.5 km (11.5 miles) off the coast of Maryland. The edge of the Lease area is 16.3 km (10.1 miles) from the closest point to shore. The Project falls within the Northeast U.S Continental Shelf Large Marine Ecosystem, which covers approximately 260,000 km^2 stretching from the Gulf of Maine to Cape Hatteras, North Carolina (87 FR 79072).

Construction activities will occur within the Lease area in federal waters and along the offshore export cable corridors in federal and state waters to the landfall location on the Delaware coast, as shown in Figure 1-1. The water depth in the Lease area ranges from a minimum of approximately 13.0 meters (42.6 feet) (re: Mean Lower Low Water (MLLW) datum), along the western lease-border, to a maximum of about 41.5 meters (136.1 feet) at the southeast corner of the Lease area (Figure 2-2). The water depth, however, is typically between about 18 and 32 meters (59 and 105 feet) in most of the Lease area.

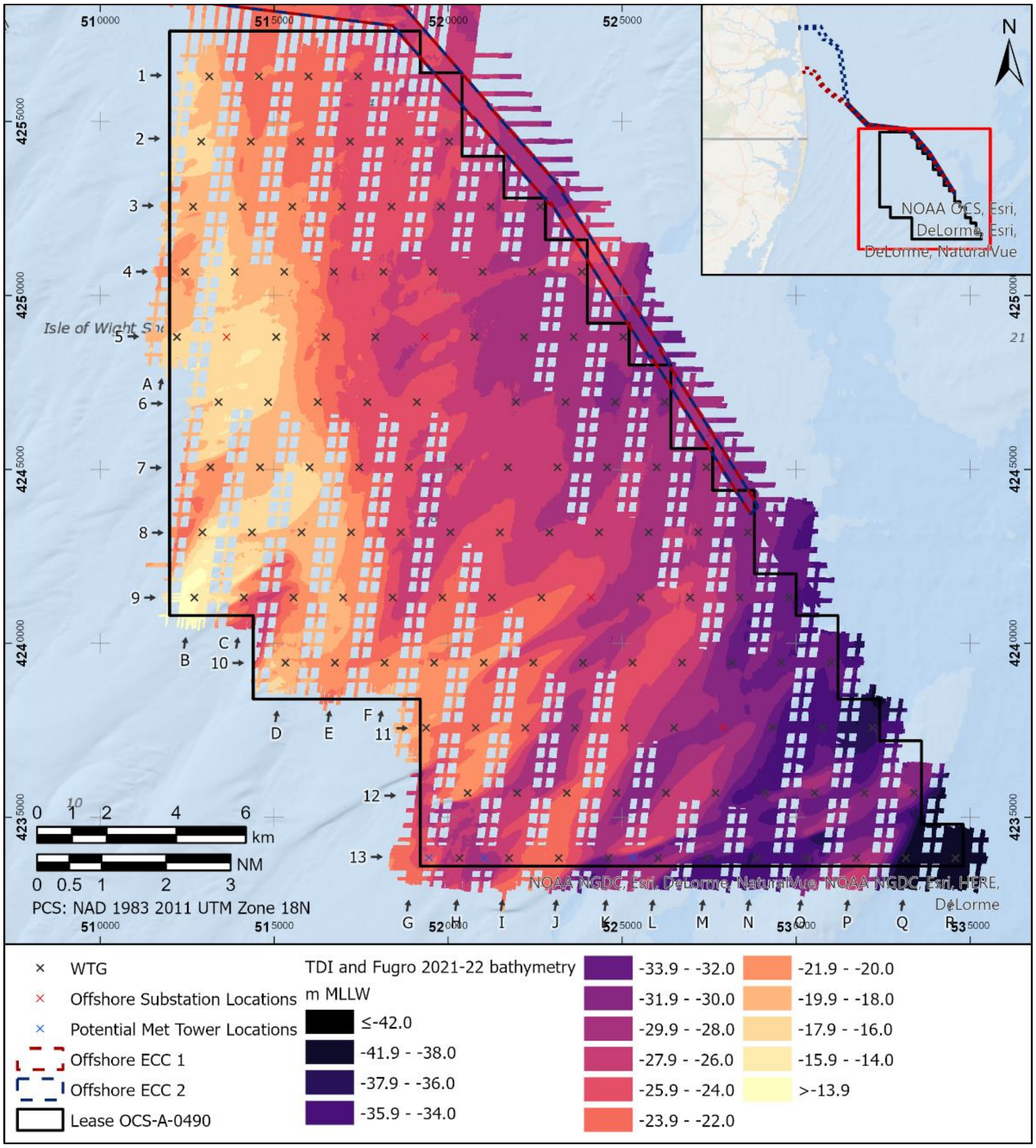

Figure 2-2. Bathymetry within the Lease Area.

Sediment throughout the Project area is primarily sand with other components also present depending on the location. The Lease area consists mostly of medium coarse-grained sand with some fine-grained sand and gravel. The offshore export cable corridors consist of fine to coarse-grained sand with gravel and occasional cobble. The nearshore Atlantic landfall and HDD location consists mostly of fine to coarse-grained sand with areas of cobble, gravel, and shell hash.

The slope within the Lease area slopes west to east with a 1° gradient, with steep slopes (approaching 10°) throughout the western and southern portion. Moving east from the coastline, the slope dips downward 1° along the offshore export cable corridors.

Water levels and currents in the Project area are produced by storms and tidal conditions as well as the other associated oceanographic processes. Along the coast, currents are driven by strong, reversing, semidiurnal tides (tidal current) and the prevailing wind direction (wind currents) and vary seasonally. The mean tidal ranges at Ocean City, Maryland and Indian River Inlet, Delaware are approximately 0.64 meters[13] and 0.76 meters (2.10 and 2.51 feet), respectively. NOAA Coast Pilot[14] publication for the Delmarva Peninsula notes that "currents have considerable velocity in the inlets and in the narrow channels connecting the inlets with adjacent bays and sounds. Surface current velocities of as much as 3 knots may be encountered at times."

The habitat within the Project area comprises of open ocean or nearshore coastal habitat. Primary productivity is driven by seasonal stratification, with the highest levels of chlorophyll-*a* near the mouths of Delaware Bay and Chesapeake Bay (Williams et al. 2015c). These estuarine systems are high in nutrients (i.e., nitrogen and phosphorus) which, coupled with the mixing of salt and fresh waters that occurs year round and the sunlight penetrating shallow waters, leads to high primary productivity in coastal areas that varies from year to year and seasonally (Williams et al. 2015c).

Various species use the habitat throughout the year, including but not limited to zooplankton, copepods, squid, herring, capelin, and crustaceans, which may serve as prey species for marine mammals. Essential Fish Habitat (EFH) also occur within this area. Specific species and a detailed discussion of EFH can be found in COP Appendix II-E1 Information to Support Essential Fish Habitat Assessment.

Additional information concerning the environmental conditions within the Project area can be found within COP Volume II (US Wind 2022).

3.0 Species and Number of Marine Mammals

There are approximately 41 species of marine mammals known to occur in the waters of the Atlantic OCS (B.o.O.E.M. BOEM 2012, 2014). Species that may potentially occur in the waters of the Project area are presented in Table 3-1. This Table identifies relevant stocks, provides information from NOAA Fisheries stock assessment reports including abundance estimates, potential biological removal (PBR) and annual mortality/serious injury (M/SI) values, and includes protection status information. All marine mammal species are protected under the Marine Mammal Protection Act (MMPA), and species or stocks may be identified as strategic or depleted if population size is below the optimum sustainable population[15]. Additionally, certain species are further protected under the ESA.

Abundance estimates, PBR values, and M/SI values were sourced from the most recent NOAA Marine Mammal Stock Assessment Report issued for each species and stock (88 FR 4162, Hayes et al. 2022, 2021, 2020, 2019; Waring et al. 2015). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Annual M/SI values represent annual levels of human-caused mortality plus serious injury from all sources combined (e.g., commercial fisheries, ship strike). The expected occurrence of each species in the Project area is based on site-specific studies and marine mammal observation data

[13] Datums for NOAA station 8570283, Ocean City Inlet MD, https://tidesandcurrents.noaa.gov/datums.html?datum=MLLW&units=1&epoch=0&id=8570283&name=Ocean+City+Inlet&state=MD
[14] NOAA, US Coast Pilot 3, Chapter 8, p. 251, 07 November 2021, https://nauticalcharts.noaa.gov/publications/coastpilot/files/cp3/CPB3_C08_WEB.pdf
[15] A strategic stock is defined by the MMPA as a stock for which the level of direct human-caused mortality exceeds the potential biological removal, is declining and is likely to be listed as threatened under the ESA in the foreseeable future or is currently listed as threatened or endangered under the ESA of designated as depleted under the MMPA.

in and around what is now the Project area. These studies and sources of information are briefly summarized below.

- The Atlantic Marine Assessment Program for Protected Species (AMAPPS) is a multi-agency research program that provides information about the abundance, distribution, ecology, and behavior of marine mammals from Maine to the Florida Keys. Marine mammal observation data from 2021 field activities, including aerial and shipboard surveys, are incorporated into species profiles below (NEFSC and SEFSC 2021).
- The Mid-Atlantic Baseline Studies Project (MABS, Williams et al. 2015a) documented marine mammal, bird, and sea turtle distributions, densities, and movements using aerial and boat-based surveys on the mid-Atlantic outer continental shelf from 2012 through 2014. Additional funding provided by the Maryland Department of Natural Resources allowed for expanded MABS data collection efforts in Maryland state waters in 2013 and 2014 (Williams et al. 2015b).
- Site-specific data provided by Barco et al. (2015) documented marine mammal and sea turtle occurrence in the Maryland Wind Energy Area (which is now the Lease area) and surrounding waters via aerial surveys conducted between July 2013 and June 2015.
- A three-year acoustic monitoring study conducted by Bailey et al. (2018) within and around the Maryland Wind Energy Area collected marine mammal acoustic data from 2014 through 2017. The PAM array study described in Section 1.4.3 is a continuation of this study.
- A near real-time passive acoustic monitoring buoy, part of a series of digital acoustic monitoring instruments along the U.S. East Coast deployed by the Woods Hole Oceanographic Institution, was deployed by UMCES in the Lease area in May 2021. The near real-time whale monitoring buoy collects acoustic data for low frequency whales: North Atlantic right whales as well as fin, sei and humpback whales. Funding for the first year of deployment was provided by the Maryland Energy Administration and Maryland Department of Natural Resources and the second year of deployment (May 2022 through May 2023) funding is provided by US Wind.

Table 3-1. Stock Information for Marine Mammal Species Potentially Occurring within the Project Area

Common Name	Scientific Name	Stock	ESA/MMPA Status[a]	Stock Abundance[b]	PBR[c]	M/SI[d]	General Occurrence within the Project Area
Order Cetacea							
Baleen Whales (Mysticeti)							
Fin whale	*Balaenoptera physalus*	Western North Atlantic	E/DS	6,802	11	1.8	Common
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	Not Listed/Not Strategic	1,396	22	58	Common
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	Not Listed/Not Strategic	21,968	170	10.6	Common
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	E/DS	338	0.7	8.1	Common
Sei whale	*Balaenoptera borealis*	Nova Scotia	E/DS	6,292	6.2	0.8	Rare
Toothed Whales (Odontoceti)							
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	Not Listed/Not Strategic	39,921	320	0	Uncommon
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	Not Listed/Not Strategic	93,233	544	27.2	Uncommon
Bottlenose dolphin	*Tursiops truncatus*	W. N. Atl. Northern Migratory Coastal	Not Listed/DS	6,639	48	12.2 - 21.5	Common
		Western North Atlantic Offshore	Not Listed/Not Strategic	62,851	519	28	
Clymene dolphin	*Stenella clymene*	Western North Atlantic	Not Listed/Not Strategic	4,237	21	0	Rare
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	Not Listed/Not Strategic	5,744	43	0.2	Rare

Common Name	Scientific Name	Stock	ESA/MMPA Status[a]	Stock Abundance[b]	PBR[c]	M/SI[d]	General Occurrence within the Project Area
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	Not Listed/Not Strategic	7,750[e]	46	0	Rare
False killer whale	*Pseudorca crassidens*	Western North Atlantic	Not Listed/Not Strategic	1,791	12	0	Rare
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	Not Listed/Not Strategic	UNK	UNK	0	Rare
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/ Bay of Fundy	Not Listed/Not Strategic	95,543	851	164	Uncommon
Killer whale	*Orcinus orca*	Western North Atlantic	Not Listed/Not Strategic	UNK	UNK	0	Rare
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	Not Listed/Not Strategic	39,215	306	9	Uncommon
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	Not Listed/Not Strategic	UNK	UNK	0	Rare
Blainville's beaked whale	*Mesoplodon densirostris*	Western North Atlantic	Not Listed/Not Strategic	10,107[f]	81[f]	0.2	Rare
Gervais' beaked whale	*Mesoplodon europaeus*	Western North Atlantic	Not Listed/Not Strategic	10,107[f]	81[f]	0	Rare
True's beaked whale	*Mesoplodon mirus*	Western North Atlantic	Not Listed/Not Strategic	10,107[f]	81[f]	0.2	Rare
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	Not Listed/Not Strategic	UNK	UNK	0	Rare
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	Not Listed/Not Strategic	6,593	44	0	Uncommon
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	Not Listed/Not Strategic	7,750[e]	46	0	Rare

Common Name	Scientific Name	Stock	ESA/MMPA Status[a]	Stock Abundance[b]	PBR[c]	M/SI[d]	General Occurrence within the Project Area
Risso's dolphin	*Grampus griseus*	Western North Atlantic	Not Listed/Not Strategic	35,215	301	34	Rare
Rough-toothed dolphin	*Steno bredanensis*	Western North Atlantic	Not Listed/Not Strategic	136	0.7	0	Rare
Short-beaked common dolphin	*Delphinus delphis*	Western North Atlantic	Not Listed/Not Strategic	172,974	1452	390	Common
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	Not Listed/Not Strategic	28,924	236	136	Uncommon
Sperm Whale	*Physeter macrocephalus*	North Atlantic	E/Strategic	4,349	6.9	0	Rare
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	Not Listed/Not Strategic	4,102	20	0	Rare
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	Not Listed/Not Strategic	67,036	529	0	Rare
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	Not Listed/Not Strategic	536,016	4,153	0	Rare
Order Carnivora							
Earless seals (Phocidae)							
Harbor seal	*Phoca vitulina*	Western North Atlantic	Not Listed/Not Strategic	61,336	1729	339	Rare
Gray seal	*Halichoerus grypus*	Western North Atlantic	Not Listed/Not Strategic	27,300	1458	4453	Rare

[a]All species are protected under the MMPA, DS = Depleted and Strategic under the MMPA, E = Endangered under the ESA, T= Threatened under the ESA
[b]Source: most recent NOAA Stock Assessment Report for each stock (Hayes et al. 2022, 2021, 2020, 2019, 2014; Waring et al. 2015).
[c] PBR: Potential biological removal.
[d] M/SI: Annual mortality/serious injury
[e]Estimated abundance includes both dwarf and pygmy sperm whales
[f]Estimated abundance/PBR for all *Mesoplodon* beaked whales
UNK = unknown due to lack of data

4.0 Affected Species Status and Distribution

Several of the marine mammal species presented in Table 3-1 are known to occur only rarely in the mid-Atlantic OCS region and are modeled to occur at very low densities in the Project area (MGEL 2022). Due to the habitat preferences and distributions of these species, they are not likely to be affected by project activities (no take of these species is requested).

Pygmy and dwarf sperm whales (*Kogia* spp.) were not observed or detected during recent site-specific visual and acoustic surveys of the Lease area (Bailey et al. 2018, Barco et al. 2015, Williams et al. 2015b) and are modeled to occur at very low densities within the Project area (MGEL 2022). Though passive acoustic monitoring data indicates that *Kogia* spp. are more abundant in Western North Atlantic waters than suggested by visual survey data, detections of these species are concentrated along the Atlantic shelf break and slope waters (Hodge et al. 2018), in deeper and more offshore habitats than those within the Lease area. Therefore, no take of *Kogia* spp. sperm whales is requested.

Additionally, no take of killer whales (*Orcinus orca*) is requested. Though killer whales can be found in temperate and tropical regions, this species is most abundant at higher latitudes (Jefferson, Webber, and Pitman 2015). Killer whales are uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al. 1988) and recent visual and acoustic surveys (Bailey et al. 2018, Barco et al. 2015, Williams et al. 2015b) did not yield any confirmed sightings or detections of killer whales in the region of the Lease area.

Though rough-toothed dolphins (*Steno bredanensis*) have been observed in a wide range of depths, from shallow nearshore areas to oceanic waters, most sightings occur in waters deeper than 305 m (1,000 ft) (Hayes et al. 2019). Because this species is not likely to be found in the shallower waters of the Lease area, and rough-toothed dolphin sightings in the Mid-Atlantic are rare (Barco et al. 2015; Williams et al. 2015a; Williams et al. 2015b; Williams et al. 2015a), no takes of rough-toothed dolphins are requested.

Similarly, no take of striped dolphins (*Stenella coeruleoalba*) or sperm whales (*Physeter macrocephalus*) is requested, as both of these species are found in deeper waters than those present in the Lease area. From Cape Hatteras to the southern margin of Georges Bank, striped dolphins are generally found along the continental shelf edge at depths of approximately 1000 m (3280.8 ft) (S.A. Hayes et al. 2020b). Similarly, sperm whales generally occur in mid-ocean regions, over the continental slope, and along the continental shelf edge (S.A. Hayes et al. 2020b). A juvenile sperm whale was found stranded in Ocean City, Maryland, in September of 2019 (Bay Bulletin 2019), and two sperm whales stranded along the East Coast between December 2022 and February of 2023 (NOAA Fisheries 2023b); however, this species is rare in the Project area, and no take of sperm whales is requested.

Additional species excluded from further consideration include the Clymene dolphin, false killer whale, Fraser's dolphin, melon-headed whale, and spinner dolphin, which are generally found in deep offshore habitats in tropical and subtropical waters (Jefferson and Curry 2003; Jefferson, Webber, and Pitman 2015; Hayes et al. 2020a). No takes of *Mesoplodon* beaked whales (Blainville's, Gervais', and True's) are requested. Though the ranges of these species can include warm temperate regions, these whales typically inhabit deeper waters than are present in the Project area (Hayes et al. 2020a; Jefferson, Webber, and Pitman 2015). Takes of northern bottlenose whale and the white-beaked dolphin are also not requested, as these species inhabit deep cold temperate +and subarctic waters to the north of the Project area (Whitehead and

Hooker 2012; S.A. Hayes et al. 2020b; CeTAP 1982; Waring et al. 2015). Additionally, take of white-sided dolphin is not requested, as this species typically occurs from the outer continental shelf to the 100-m isopleth and has not been sighted in Maryland waters since 1995 (Hayes et al. 2021).

Marine mammals which are likely to be affected due to potential presence in the area during Project activities are described in detail below. A total of fifteen marine mammal species, including five baleen whales, eight toothed whales, and two seals, are discussed below. Three of these species are listed as federally endangered under the ESA; the North Atlantic right whale (NARW) (*Eubaelena glacialis*), the fin whale (*Balaenoptera physalus*), and the sei whale (*Balaenoptera borealis*).

Discussion of the affected species in this section includes references to site-specific studies and marine mammal observation data in and around what is now the Project area, which are summarized in Section 3.0.

Opportunistic Protected Species Observer (PSO) records of marine mammal sightings collected during HRG and geotechnical surveys conducted by US Wind in 2015, 2016, 2017, 2021, and 2022 were reviewed to inform the potential presence of species. Notable PSO sightings are included in this section as well.

4.1 Mysticetes

4.1.1 Fin Whale *(Balaenoptera physalus)*

Fin whales are the second largest whale species, ranging in length up to 27 m (88 ft) (Mizroch, Rice, and Breiwick 1984). Fin whales typically feed on swarms of small crustaceans or fish (Mizroch, Rice, and Breiwick 1984). Fin whales are fast swimmers and the average group size is 1.5 individuals, although they have been observed feeding in larger groups of mixed species (NEFSC and SEFSC 2018; Hayes et al. 2022; Hayes et al. 2021). Fin whales exhibit two distinct types of dives: foraging dives and traveling dives (D.A. Croll et al. 2001). Fin whale foraging dives tend to be deeper and longer in duration than traveling dives, and are punctuated by vertical excursions called lunges, presumably to feed (D.A. Croll et al. 2001). Fin whales dive up to approximately 98 m (322 ft) when foraging and 60 m (197 ft) when traveling (D.A. Croll et al. 2001).

Fin whales in the Project area are expected to be part of the Western North Atlantic stock, which is comprised of fin whales off the eastern coast of the United States, Nova Scotia, and the southeastern coast of Newfoundland. The best abundance estimate available for the Western North Atlantic fin whale stock is 6,802 individuals and the average annual human-caused mortality and serious injury for fin whales between 2015 and 2019 was 1.85 (Hayes et al. 2022). The status of the Western North Atlantic stock relative to Optimum Sustainable Population (OSP) in the U.S. Atlantic Exclusive Economic Zone (EEZ) is unknown, and a population trend analysis has not been performed (Hayes et al. 2022). The Western North Atlantic population is listed as a strategic stock under the MMPA because it is listed as an endangered species under the ESA. Like most other whale species present along the U.S. east coast, ship strikes and fisheries entanglements are perennial causes of serious injury and mortality to fin whales, though contaminants and climate-related changes may impact this population as well (Hayes et al. 2022).

The range of the Western North Atlantic stock of fin whales extends from the Gulf of Mexico and Caribbean Sea, to the southeastern coast of Newfoundland in the north (Hayes et al. 2022). Fin whales generally migrate from Arctic and Antarctic coastal feeding areas in the summer to deeper tropical breeding and calving areas in the winter (Hayes et al. 2022). During migration, fin whales travel in open seas away from coastal areas (Mizroch, Rice, and Breiwick 1984; Hayes et al. 2022). However, calving, mating, and wintering locations are unknown for most of the fin whale population and data from the north Pacific indicates that fin whales may not undergo large-scale annual migratory movements (Hayes et al. 2022). Biologically important areas (BAIs) for fin whale feeding have been identified in the Gulf of Maine and east of Montauk Point (LaBrecque et al. 2015). However, no critical habitat areas have been designated for fin whales in the western Atlantic.

Fin whales are in the Low Frequency Cetaceans hearing group (NOAA Fisheries 2018). No direct measurement of fin whale hearing sensitivity has been made, although these whales are known to respond to anthropogenic sound sources such as shipping vessel noise, airguns, and small vessel noise (Jahoda et al. 2003; Castellote, Clark, and Lammers 2012). Cranford and Krysl (2015) used finite element modelling based on skull structure to determine that fin whales are sensitive to low frequency sounds. Fin whales produce a variety of low frequency sounds ranging from 10 to 200 Hz (Watkins, Tyack, and Moore 1987; Watkins 1981; Edds 1988). Fin whales produce well-known “20 Hz pulses” and most of their vocalizations are below 100 Hz (Watkins, Tyack, and Moore 1987). Males can produce these pulses in a repeated pattern that functions as song, a presumed reproductive display (Morano et al. 2012).

Recent AMAPPS aerial surveys conducted by the Southeast Fisheries Science Center (SEFSC) in June and July of 2021 did not document any sightings of fin whales between Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). However, four fin whale sightings were recorded off the coast of Maryland and Virginia during shipboard surveys conducted in June and July of 2021 (NEFSC and SEFSC 2021). Less recent but more location-specific acoustic and visual surveys conducted between 2015 and 2018 indicate that fin whales are present in the region of the Lease area in all seasons, and are relatively abundant in the region, compared to other baleen whale species (Williams et al. 2015a; Bailey et al. 2018a; Barco et al. 2015). Though this species was not observed in Maryland waters during the Williams et al. (2015a) study, fin whales were the most frequently observed whale species during the Barco et al. (2015) surveys and were one of the most frequently detected large whale species during the Bailey et al. (2018a) study. This species was most abundant in the region of the Lease area during the winter and early spring (Williams et al. 2015d; Barco et al. 2015), but is present in the area during all seasons, with lowest abundances likely occurring in summer and early fall (Bailey et al. 2018a). These findings align with those of other passive acoustic surveys conducted to the south of the Lease area in North Carolina, Georgia, and New Jersey, which detected fin whale presence year-round (Rice et al. 2014; Geo-Marine 2010).

Fin whales were frequently acoustically detected by the UMCES near real-time monitoring buoy in the Lease area between late September 2021 and mid-March 2022, and again from mid-August 2022 through January 2023 (WHOI 2023, 2022). The highest frequency of detection occurred in late February 2022 (WHOI 2022).

MGEL (2022) indicates that the highest average density of fin whales in the buffered Lease area occurs in January and is estimated to be 0.00214 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of fin whales to occur in the Project area is high.

4.1.2 Humpback Whale *(Megaptera novaeangliae)*

Humpback whales are a cosmopolitan species that reach a length of about 15.6 m (51 feet) and weigh about 34 metric tons (J.H. Johnson and Wolman 1984). This species is primarily dark gray in coloration, but individuals have variable and distinctive patterns on their pectoral fins, belly, and flukes that can be used to identify individuals (Clapham 2000). These baleen whales feed on small prey that is often found in high concentrations, including krill and fish such as herring and sand lance (R.D. Kenney and Vigness-Raposa 2009). Humpback whales use unique behaviors including bubble nets, bubble clouds, and flickering of their flukes and fins, to herd and capture prey (NMFS 1991). Humpback whale group size in the mid-Atlantic is not well documented, but in the northwest Atlantic they tend to travel in groups of 1 to 10 individuals (Whitehead 1983). Humpback whales exhibit diurnally variable dive behavior (Calambokidis et al. 2019). During nighttime hours they are more vulnerable to vessel strikes as they tend to spend more time near the water surface and exhibit more directional travel (average night-time dive depth for humpback whales was 12.5 m [41 ft]) (Calambokidis et al. 2019). During the day, humpback whales spend more time at depth feeding on krill (average day-time dive depth was 34.2m [112 ft]) and their movements are more localized (Calambokidis et al. 2019).

In the North Atlantic, six separate humpback whale subpopulations have been identified by their consistent matrilineally determined fidelity to different feeding areas (Clapham and Mayo 1987). The six humpback whale subpopulations can be found in the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and Norway (S.A. Hayes et al. 2020b). Humpback whales in the Project area would most likely be part of the Gulf of Maine stock.

The best abundance estimate for the Gulf of Maine stock of humpback whales is 1,396 individuals (S.A. Hayes et al. 2020b). For the period of 2013 through 2017, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 12.15 individuals per year (S.A. Hayes et al. 2020b). The Gulf of Maine stock of humpback whales has been recently characterized by an upward trend in population size (S.A. Hayes et al. 2020b). Humpback whales were previously listed as endangered under the ESA throughout its range. However, in September 2016 NOAA Fisheries identified fourteen Distinct Population Segments of humpback whale worldwide and revised the ESA listing for this species (81 FR 62259). All humpback whales living along the North American Atlantic coast, including the Gulf of Maine Stock, belong to the West Indies Distinct Population Segment (DPS), which is not at risk and has been delisted from the ESA (81 FR 62259). The Gulf of Maine stock of humpback whales is currently not classified as depleted and is not considered a strategic stock. However, as observed humpback whale mortalities are estimated to account for only 20 percent of all mortality, the uncertainties associated with the population assessment may have produced an incorrect determination of strategic status (S.A. Hayes et al. 2020b). Human impacts, including vessel collisions and fishing gear entanglements, may be slowing the population recovery of the humpback whale (S.A. Hayes et al. 2020b). Humpback whales are currently experiencing an unusual mortality event (UME) along the Atlantic coast; elevated humpback whale mortalities have occurred from Maine to Florida since January 2016 (NOAA Fisheries 2022a). Though more research is needed to determine the cause of this UME, evidence of human interactions (vessel strikes or entanglement) has been found on approximately 50 percent of the stranded whales examined (NOAA Fisheries 2022a).

Humpback whales in the Gulf of Maine stock typically feed in the waters between the Gulf of Maine and Newfoundland during the spring, summer, and fall, but have been known to feed over a range that encompasses the entire U.S. east coast (S.A. Hayes et al. 2020b). Areas of the Gulf of Maine, Stellwagen Bank, and the Great South Channel have been identified as a feeding BAI for humpback whales (LaBrecque et al. 2015). Humpback whales from most feeding areas, including the Gulf of Maine, migrate to the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands, and Puerto Rico) in the winter, where they mate and calve their young (S.A. Hayes et al. 2020b). However, not all humpback whales from the Gulf of Maine stock migrate to the West Indies every winter, because significant numbers of animals can be found in mid- and high-latitude regions at this time (Swingle et al. 1993). Humpback whales utilize the mid-Atlantic as a supplemental winter feeding ground and migration pathway (S.A. Hayes et al. 2020b). There are currently no critical habitat areas designated for the Gulf of Maine DPS of humpback whales, as this DPS is not listed under the ESA (S.A. Hayes et al. 2020b).

Humpback whales are in the Low Frequency Cetaceans hearing group (NOAA Fisheries 2018). Though the auditory sensitivity of humpback whales has not been measured, models indicate that this species is likely sensitive to frequencies ranging from 700 Hz to 10 kHz, with greatest sensitivity to sounds between 2 and 6 kHz (Houser, Helweg, and Moore 2001). Humpback whales produce various vocalizations, including “social sounds” as well as the characteristic songs produced by males (Au et al. 2006). Vocalizations range from 10 Hz to more than 24 kHz (Au et al. 2006; Frankel et al. 1995; Zoidis et al. 2008), but most of energy is concentrated below 2 kHz (Au et al. 2006; Frankel et al. 1995; Zoidis et al. 2008). Humpback whales are known to react to anthropogenic sound (Frankel and Clark 2000; Fristrup, Hatch, and Clark 2003; Dunlop et al. 2018). Like some other whale species, they have shown the ability to at least partially compensate for increases in masking noise by increasing the source levels of their vocalizations (Dunlop et al. 2014).

Recent passive acoustic surveys conducted between 2015 and 2019 as part of the AMAPPS program reported frequent detections of humpback whales along the U.S. Atlantic coast, with the highest presence found at sites north of Wilmington Canyon offshore of Maryland (NEFSC and SEFSC 2021). Aerial surveys conducted in June and July of 2021 as part of the AMAPPS program indicate that humpback whale presence in the mid-Atlantic varies seasonally; humpback whales were not observed between Delaware Bay and southern Florida during these surveys conducted by the SEFSC (NEFSC and SEFSC 2021). However, one humpback whale sighting was recorded off the coast of Maryland during shipboard transect surveys conducted between June and September of 2021 (NEFSC and SEFSC 2021). Less recent but more location-specific acoustic surveys indicate that humpback whales are present in the region of the Lease area in all seasons (Williams et al. 2015c; Bailey et al. 2018a). These findings align with previous studies conducted to the south of the Lease area in North Carolina and Georgia, and in New Jersey, which detected humpback whale presence year round (Rice et al. 2014; Geo-Marine 2010). In the mid-Atlantic and the region of the Lease area, humpback whales were most frequently visually observed in the winter months (Williams et al. 2015b; Williams et al. 2015d; Barco et al. 2015). Acoustic monitoring revealed that humpback whale presence was lowest from June to September, increased through the winter, and peaked in April (Bailey et al. 2018a).

Humpback whales were acoustically detected by the UMCES near real-time monitoring buoy in the Lease area between July 2021 and May 2022 (WHOI 2022). Sparse detections occurred between August 2022 and January 2023 (WHOI 2023), and the highest frequency of detection was reported in between February and April 2022 (WHOI 2022).

MGEL (2022) indicates that the highest average density of humpback whales in the buffered Lease area occurs in April and is estimated to be 0.00187 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of humpback whales to occur in the Project area is high.

4.1.3 Minke Whale *(Balaenoptera acutorostrata)*

Minke whales are the smallest baleen whale species found in North America waters, with females reaching an average of 9 m (30 ft) in length and males reaching an average of 8.5 m (28 ft) in length (W. F. Perrin, Mallette, and Brownell Jr. 2018). Their diet is primarily composed of crustaceans, small schooling fish like herring, and plankton (Gavrilchuk et al. 2014). Some studies indicate that minke whales adjust their diet in response to local prey abundances (Skaug et al. 1997). In the 2018 Atlantic Marine Assessment Program for Protected Species report, the average minke whale group size was approximately 1.6 individuals (NEFSC and SEFSC 2018). Minke whale diving behavior has not been extensively studied. However, a study conducted on related Antarctic minke whales (*Balaenoptera bonaerensis*) identified three distinct types of foraging dive performed by the species: short surface dives, long shallow dives, and long deep dives (Friedlaender et al. 2014). Shallow dives accounted for 73 percent of all dives observed; average Antarctic minke whale foraging dives reached a depth of 18 m (59 ft) and were 1.4 minutes in duration (Friedlaender et al. 2014). Compared to other, larger whale species, Antarctic minke whales tend to have higher feeding rates and shallower dives (Friedlaender et al. 2014), characteristics which may be shared by the minke whale.

In the North Atlantic, there are four recognized populations of minke whale: Canadian East Coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan 1991). Until better information becomes available, minke whales off the eastern coast of the United States have been classified as part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45°W) to the Gulf of Mexico (Hayes et al. 2022). The current estimate of the size of Canadian East Coast stock is 21,968 individuals (Hayes et al. 2022). Between 2015 and 2019, the average annual minimum human-caused mortality and serious injury to the Canadian East Coast stock of minke whales was 10.55 individuals per year (Hayes et al. 2022). A population trend analysis has not been conducted for the Canadian East Coast stock due to imprecise abundance estimates (Hayes et al. 2022). Minke whales are not currently listed as threatened or endangered under the ESA and the Canadian East Coast stock is not considered strategic under the MMPA (Hayes et al. 2022). Minke whales are currently experiencing an unusual mortality event along the Atlantic coast; elevated mortalities have occurred from Maine through South Carolina since January 2017 (NOAA Fisheries 2022b; Hayes et al. 2022). Preliminary findings have found evidence of human interaction or infectious disease, but further research is needed (NOAA Fisheries 2022b; Hayes et al. 2022).

Minke whales have a cosmopolitan distribution, as they can occur in temperate, tropical and high latitude waters in most seas worldwide (Hayes et al. 2022). Due to their small size, inconspicuous behavior, and frequent presence in remote waters, the seasonal distribution of minke whales is not well understood (Risch et al. 2019). Sightings data suggest that minke whale distribution is largely centered in the waters of New England and eastern Canada (Hayes et al. 2022). However, though minke whales are relatively widespread and abundant in New England waters in spring and fall, they are largely absent from this area in the winter (Risch et al. 2013). Passive acoustic monitoring data aligns with sightings data and indicates that minke whales generally begin a southward migration along the continental shelf in mid-October through early November, leaving their summer feeding areas (located north of 40° N) for winter grounds offshore of the southeastern U.S. shelf break and in the Caribbean (south of 30° N, (Risch, Castellote, et al. 2014). Mating and calving most likely take place during the winter months, potentially offshore of the southeastern U.S. (Risch, Castellote, et al. 2014). Minke whales likely begin to migrate northward to their summer feeding grounds from March through April (Risch, Castellote, et al. 2014). Critical habitat areas have not been designated for minke whales as this species is not listed under the ESA (Hayes et al. 2022).

Minke whales are in the Low Frequency Cetaceans hearing group (NOAA Fisheries 2018). Although the hearing sensitivity of minke whales has not been directly measured, models of their middle ears predict that their best hearing range overlaps with their vocalization frequency range (Tubelli et al. 2012). Minke whales produce a variety of sounds, primarily moans, clicks, downsweeps, ratchets, thump trains, grunts, and boings in the 80 Hz to 20 kHz range, and the signal features of their vocalizations consistently include low frequency, short-duration downsweeps from 250 to 50 Hz (Edds-Walton 2000; Mellinger, Carson, and Clark 2000; Risch, Gales, et al. 2014). Minke whales have been shown to be significantly affected by anthropogenic sound sources. Minke whales have been observed to respond to mid-frequency active sonar and other training activities by reducing or ceasing calling and by exhibiting avoidance behaviors (Harris et al. 2019; Martin et al. 2015). Additionally, studies have shown up to an 80 percent loss in communication space for minke whales due to vessel noise (Cholewiak et al. 2018). However, due to their noise sensitivity, minke whales are very responsive to acoustic deterrent devices that have been used for mitigation during construction activities (McGarry et al. 2017).

Recent aerial and shipboard transect surveys conducted by the SEFSC in June and July of 2021 as part of the AMAPPS program did not indicate any sightings of minke whales between Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). However, less recent but more location-specific surveys detected minke whales in the mid-Atlantic and the region of the Lease area (Barco et al. 2015; Bailey et al. 2018a; Williams et al. 2015a, 2015b). Though this species was the most frequently identified whale species within Maryland waters during the Williams et al. (2015c) (2015b), minke whales were only observed a total of four times. Similarly, the Barco et al. (2015) surveys only identified one minke whale, and this species was infrequently acoustically detected in the region of the Lease area (Bailey et al. 2018a). Minke whales are likely most abundant in the region during the fall, winter, and spring months, as sightings and detections occurred in November, January, February, and April (Bailey et al. 2018a; Barco et al. 2015; Williams et al. 2015b). These findings roughly align with the conclusions of an earlier study to the north of the Lease area, which detected minke whales in New Jersey waters in winter (February) and spring (June) (Geo-Marine 2010).

One minke whale was sighted in March 2022 during surveys of the Lease Area and offshore export cable corridors.

MGEL (2022) indicates that the highest average density of minke whales in the buffered Lease area occurs in May and is estimated to be 0.00750 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of minke whales occurring in the Project area is high.

4.1.4 North Atlantic Right Whale *(Eubalaena glacialis)*

North Atlantic right whales (NARW) are among the rarest of all marine mammal species. These whales weigh an average of 35,635 kg (35 tons) when fully mature and average approximately 13.62 m (45 ft) in length (Fortune et al. 2021). However, a recent study has shown that average NARW length decreased by approximately 7.3 percent between 1981 and 2019 (Stewart et al. 2021). NARW have large, round bodies with a large head and narrow bowed jaw, do not have a dorsal fin, and are generally black with white patches on the belly and chin and coarse patches of skin on their heads called callosities (Kraus and Rolland 2009). Right whales are slow moving grazers that feed on dense concentrations of prey, primarily zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera (88 FR 4162), anywhere in the water column from the surface to the seafloor (M.F. Baumgartner, Wenzel, et al. 2017). Research suggests that NARW must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of spring, summer, and fall NARW habitats (R.D. Kenney et al. 1986; R.D. Kenney, Winn, and Macaulay 1995).

NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs, though larger groups of actively socializing right whales, known as "surface active groups", may be observed in feeding or breeding areas (Jefferson, Webber, and Pitman 2008). Diving and feeding behavior of right whales varies seasonally and latitudinally. North of the Project area in Cape Cod Bay, NARW tend to swim and feed near the water surface where zooplankton is abundant, putting them at increased risk of vessel collision (Mayo and Marx 1990; Baumgartner, M.F., et al. 2017; Parks et al. 2012). During summer months, NARW tends to forage deeper in the water column, putting them at a greater risk of entanglement with fisheries equipment (M.F. Baumgartner and Mate 2003; M.F. Baumgartner, Wenzel, et al. 2017; Hamilton and Kraus 2019). A recent study conducted by Dombroski et al. (2021) determined that lactating female NARW in the southeast U.S. calving ground, located approximately 600 km (373 miles) to the south of the Project area, spent up to 80 percent of the time in surface waters at depths of 3.5 m (11.5 ft) or less. In contrast, non-lactating whales (including juveniles and pregnant females) occupied surface waters for a smaller percentage of time (30% and 32% of time on average, respectively; (Dombroski, Parks, and Nowacek 2021).

The NARWs occurring in U.S. waters belong to the western Atlantic stock. The size of this stock is considered to be extremely low relative to its Optimum Sustainable Population (OSP) in the U.S. Atlantic Exclusive Economic Zone (EEZ). The most recent official estimate of minimum NARW population size was 338 individuals, which was presented in the 2022 NOAA draft stock assessment report and reflects estimated abundance as of November 2020 (88 FR 4162) (Hayes et al. 2022). This agrees with other recent estimates, which indicate that the NARW population has fallen to 340 individuals (Pettis, Pace, and Hamilton 2022). Historically, the NARW population suffered severely from commercial overharvesting. Based on carrying capacity in the North Pacific, the estimate of the pre-whaling population of the western Atlantic stock is between 9,075 and 21,328 individuals (Monserrat et al. 2015). Whaling activities killed an estimated 5,500 right whales in the western North Atlantic between 1634 and 1950, although records are incomplete (Reeves, Smith, and Josephson 2007). Back calculations indicate that the western Atlantic NARW stock was as low as 100 individuals by 1935, before international protection for right whales was established (Hain 1975; Reeves, Breiwick, and Mitchell 1992; R.D. Kenney, Winn, and Macaulay 1995).

Although the NARW population grew by approximately 2.8 percent per year from 1990 to 2011, population size has notably decreased between 2011 to 2020 (88 FR 4162).The minimum rate of annual human-caused mortality and serious injury to right whales averaged 5.56 individuals per year for the period of 2012 through 2016 (Hayes et al. 2019), 8.15 individuals per year for the period of 2014 through 2018, and 8.1 individuals per year for the period of 2016-2020 (88 FR 4162). In the period of 2016-2020, incidental fishery entanglement mortality and serious injury averaged 5.7 individuals per year, and vessel strike mortality and serious injury averaged 2.4 individuals per year (88 FR 4162). NARW are currently experiencing an unusual mortality event (UME); elevated numbers of dead or seriously injured NARW have been recorded in Canada and the United States since 2017 (NOAA Fisheries 2023a). Throughout this time period, 35 NARW deaths have been reported, as well as 22 serious injuries, and 37 sublethal injuries and illnesses (NOAA Fisheries 2023a). Human interaction, through vessel strikes and entanglements, is the leading cause of this UME (NOAA Fisheries 2023a). Due to the small NARW population size, it is estimated that human sources of mortality have a disproportionately large effect on population growth (88 FR 4162). A stochastic model of North Atlantic right whale population growth from 1980 to 1996 showed a declining population growth rate attributed to a decrease in survival probability and an increase in the calving interval (Caswell et al. 1999). Additionally, changes to right whale habitat have caused migration into new territory, which has exposed right whales to new anthropogenic threats (M.F. Baumgartner, Wenzel, et al. 2017). The NARW is a strategic stock and is listed as endangered under the ESA (88 FR 4162).

Surveys have demonstrated the existence of seven areas where Western North Atlantic right whales congregate seasonally: the coastal waters of the southeastern United States; the Great South Channel; Jordan Basin; Georges Basin along the northeastern edge of Georges Bank; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Roseway Basin on the Scotian Shelf (Hayes et al. 2019). The Project area does not include any of the areas listed above where NARW are known to congregate, however the Project area is within a migratory corridor for NARW as they travel between calving grounds off the coast of Jacksonville, Florida and feeding grounds near Cape Cod Bay, Massachusetts (Firestone et al. 2008).

NOAA Fisheries has designated two critical habitat areas for the NARW: the Northeastern U.S. Foraging Area in the Gulf of Maine/Georges Bank region, and the Southeastern U.S. Calving area in coastal waters from North Carolina to Florida (81 FR 4837). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada’s final recovery strategy for the North Atlantic right whale (Brown et al. 2009). The Project area is located approximately 600 km (373 miles) southwest of the Northeast U.S. Foraging Area critical habitat, and approximately 600 km (372 miles) northeast of the Southeastern U.S. Calving Area critical habitat.

The NARW is a strongly migratory species that undertakes well-defined seasonal movements. However, this species exhibits condition-dependent partial migration; though all NARW have the potential to migrate each winter to the southeastern United States, only a portion of the NARW population migrates in any given year (Gowan et al. 2019). Migration behavior and habitat use varies between years and across different demographic groups (Gowan et al. 2019). Gowan et al. (2019) found that juvenile NARW were more likely to migrate than adults, and males were more likely to migrate to the southeastern U.S. than non-calving females. Generally, NARW occupy feeding grounds in New England waters, the Canadian Bay of Fundy and Scotian Shelf, and the Gulf of St. Lawrence in spring, summer, and fall, and travel to their sole known calving and wintering grounds in the waters of the southeastern U.S. (R.D. Kenney and Vigness-Raposa 2009). Mid-Atlantic waters are a primary migration corridor during these seasonal movements (Knowlton, Ring, and Russel 2002; Firestone et al. 2008). An acoustic detection study conducted over an 11-month period in 2012 and 2013 in nearshore waters of North Carolina and Georgia did not detect a bi-modal pattern of NARW occurrence during predicted migratory periods (Hodge et al. 2015). Mapped migration routes along the Atlantic coast are close to both major ports and shipping lanes (Hayes et al. 2022). Recently, North Atlantic right whales have been observed increasingly in the mid-Atlantic region (G.E. Davis et al. 2017).

Several Biologically Important Areas (BIAs) have been designated for the North Atlantic right whale, one of which overlaps with the Project area (LaBrecque et al. 2015). This BIA is a migratory corridor extending along the length of the U.S. east coast (LaBrecque et al. 2015) and is further discussed in Section 7 below.

Right whales are in the Low Frequency Cetaceans hearing group (NOAA Fisheries 2018). Their predicted hearing sensitivity ranges from 20 Hz to 22 kHz (L.P. Matthews and Parks 2021). Right whales produce a variety of vocalizations, including low frequency moans, groans, pulses, upcalls, and gunshots (J.N. Matthews et al. 2001; L.P. Matthews and Parks 2021). Most of the energy of NARW vocalizations is below 2,000 Hz (Parks, Johnson, et al. 2011). NARW of all ages and sexes produce a distinctive contact vocalization called an upcall, which ranges in frequency from 50 Hz to 200 Hz (L.P. Matthews and Parks 2021). NARWs have the capacity to produce sound signals for up to 10 seconds, but and have also been observed to produce short duration signals less than 0.5 seconds in duration (L.P. Matthews and Parks 2021). These shortest vocalizations, known as gunshots, range from 20 Hz to 20 kHz in frequency and occur more frequently during peak breeding season between October and December (L.P. Matthews and Parks 2021). A study conducted in the Bay of Fundy indicated that call rates are higher when right whales are socializing or traveling at the surface, and lower when whales are foraging or resting (Parks, Searby, et al. 2011). The characteristics of NARW vocalizations have also been shown to change in response to increased noise (Parks, Johnson, et al. 2011; Parks, Clark, and Tyack 2007).

Recent aerial and shipboard surveys conducted by the SEFSC in June and July of 2021 for the AMAPPS program did not indicate any sightings of NARW between Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). However, observations from less recent but more location-specific aerial and acoustic surveys indicate that NARW are present in the region of the Lease area (Williams et al. 2015d; Bailey et al. 2018a). This species was visually observed in the mid-Atlantic in February and March (Williams et al. 2015d), and in the Lease area from January to March (Williams et al. 2015d; Barco et al. 2015). Acoustic data indicate that NARW are present in the vicinity of the Lease area throughout the year, with maximum abundance reported during the late winter and early spring (Bailey et al. 2018a). These findings align with observations from North Carolina and Georgia waters, where NARW were acoustically detected in all seasons (Hodge et al. 2015). These observation patterns suggest that though pulses of NARW travel through mid-Atlantic waters during seasonal migrations, the region may also be a destination for non-breeding individuals (Barco et al. 2015).

Four sightings of NARW were recorded during surveys of the Lease area and offshore export cable corridors conducted in 2021 and 2022. A sighting of one individual was reported in December 2021, two sightings (of one and two individuals) were reported in January 2022, and one sighting of two individuals was reported in March 2022. Confirmed NARW acoustic detections by the UMCES near real-time monitoring buoy in the Lease area occurred on one day in both September and November 2021, then frequently in December 2021 to January 2022 and sporadically through March 2022 (WHOI 2022). Confirmed detections also occurred in November and December of 2022, and January of 2023 (WHOI 2023). The highest frequency of confirmed detections occurred in December and January (of 2021-2022 and 2022-2023; (WHOI 2022) which coincides with sightings during US Wind survey activities.

MGEL (2022) indicates that the highest average density of NARW in the buffered Lease area occurs in February and is estimated to be 0.00076 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, while NARW are a rare species due to the small population size the likelihood of North Atlantic right whales to occur in the Project area is high.

In order to protect this species, Seasonal Management Areas (SMAs) for reducing ship strikes of NARWs have been designated in the U.S. and Canada. Vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 10 knots or less within these areas during specified time periods (NOAA Fisheries 2022e). The closest SMA is located approximately 13 km (7 NM) from the northwestern portion of the Lease area and is active between November 1 and April 30 each year (NOAA Fisheries 2022e). Dynamic Management Areas (DMAs) or Right Whale Slow Zones may also be established by NOAA Fisheries in response to sightings of NARW, and vessels are encouraged to reduce speeds to 10 knots or avoid these areas (NOAA Fisheries 2022e).

NOAA Fisheries is currently proposing changes to vessel speed regulations to reduce the risk of mortality or serious injury to NARW due to vessels strikes. The proposed rule would replace SMAs with expanded Seasonal Speed Zones (SSZs), approximately doubling the coastal area under speed restriction (87 FR 46921). Unlike current SMAs, speed regulations (limiting operating speed to 10 knots or less) would apply to most vessels greater than 10.7 m (35 ft) in length within active SSZs (NOAA Fisheries 2022e). This proposed rule would also allow for the establishment of discrete and temporally limited mandatory Dynamic Speed Zones (DMZs) to protect NARW outside of active SSZs (NOAA Fisheries 2022e).

4.1.5 Sei Whale *(Balaenoptera borealis)*

Sei whales are large sleek-bodied baleen whales that can reach 15 to 20 m (49 to 66 ft) in length and are dark-bluish gray to black in color, with a pale underside and a tall dorsal fin (Horwood 2009). In U.S. Northwestern Atlantic coastal waters, average sei whale group size was 1 individual based on aerial surveys, and 1.1 individuals based on shipboard surveys (Palka 2011). Sei whales are largely planktivorous, feeding primarily on euphausiids and copepods, but will also feed on small schooling fishes and cephalopods (Prieto et al. 2012). These prey species generally exhibit diel vertical migrations within the water column and are found in deeper waters during the day and shallower waters at night. Research suggests that sei whales maximize foraging efficiency by feeding on near-surface aggregations of their prey during nighttime hours (Baumgartner, M. F., and Fratantoni 2008). Sei whales capture maneuverable prey (e.g., fish and euphausiids) in surface and subsurface waters using an intermittent form of filter feeding called lunge feeding, during which an individual rapidly accelerates then engulfs large volumes of prey-containing water (Segre et al. 2021). Sei whales also exhibit continuous filter feeding (skim feeding) in surface waters; individuals swim with their rostrum above the water surface and mouth open while continuously filtering slower moving prey (e.g., copepods) from the water (Segre et al. 2021).

Sei whales found in US Mid-Atlantic waters belong to the Nova Scotia stock, which includes the continental shelf waters north to Newfoundland (Hayes et al. 2022). The best abundance estimate available for the Nova Scotia sei whale stock is 6,292 individuals (Hayes et al. 2022). Between 2015 - 2019, the average annual minimum human-caused mortality and serious injury to the Nova Scotia stock of sei whales was 0.8 individuals per year (Hayes et al. 2022). A population trend analysis has not been conducted for the Nova Scotia stock due to imprecise abundance estimates (Hayes et al. 2022). The Nova Scotia sei whale stock is listed as a strategic stock under the MMPA because this species is listed as endangered under the ESA.

In U.S. waters, sei whales are generally found in the Gulf of Maine and in the region of George’s Bank (Hayes et al. 2022). The sei whale is often observed in deeper waters characteristic of the continental shelf edge region (Hain et al. 1985), though they have been observed to make episodic and unpredictable incursions into shallower inshore waters (Hayes et al. 2022). The distribution and movement patterns of the sei whale are not well known, but this species is believed to migrate from temperate and subpolar summer feeding grounds to wintering grounds in tropical and subtropical latitudes (NMFS 2021b, 2021a). Sei whales are most commonly observed in U.S. waters near George's bank in the spring (Hayes et al. 2022). Recently collected passive acoustic monitoring data indicate distinct seasonal patterns in sei whale presence in the western North Atlantic (Davis et al. 2020). Sei whales were most commonly detected in northern areas, including feeding grounds from southern New England to the Scotian Shelf, during late summer and fall (Davis et al. 2020). During this time period, sparse sei whale detections south of the New York bight were recorded (Davis et al. 2020). In winter months, sei whale acoustic detections were recorded along the entire U.S. coastline, though detections in the Southeastern U.S. were generally limited to offshore areas (Davis et al. 2020). Sei whales mate and give birth during the winter, though specific breeding locations are currently unknown (Prieto et al. 2012). There are currently no critical habitat areas established for the sei whale.

Sei whales are in the Low Frequency Cetaceans hearing group (NOAA Fisheries 2018). The auditory sensitivity of sei whales has not been measured and information about sei whale vocalizations is sparse. Observations from the Great South Channel indicate that Sei whales produce low frequency vocalizations that sweep from 82 to 34 Hz over 1.4 seconds (Baumgartner et al. 2008; Baumgartner, M. F., and Fratantoni 2008). Similar calls, ranging from 34 to 38 Hz, were also reported in the Southern Ocean (Calderan et al. 2014). Tonal and broadband calls from 200 and 700 Hz, likely used for short-distance communication between sei whales, have also been documented west of the Antarctic Peninsula (McDonald et al. 2005). Additional observations of sei whale vocalizations describe higher frequency bursts of metallic pulses with peak energy at 3 kHz (Thompson, Winn, and Perkins 1979a, 1979b) and 1.5 to 3.5 kHz sweeps (Knowlton, Clark, and Kraus 1991). This reported variability in call characteristics may reflect population-specific acoustic behavior variations, but more research is needed (Prieto et al. 2012).

Recent aerial and shipboard transect surveys conducted by the SEFCS in June and July of 2021 as part of the AMAPPS program did not indicate any sightings of sei whales between Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). These findings align with less recent but more location-specific visual and acoustic surveys, which did not yield any confirmed sightings or detections of sei whales in the region of the Lease area (Barco et al. 2015; Bailey et al. 2018a; Williams et al. 2015c). However, sei whales were sighted once during surveys of the Mid-Atlantic in December of 2012 (Williams et al. 2015d), and a single confirmed acoustic detection of this species in the Lease area by the UMCES near real-time monitoring buoy occurred in October 2021 (WHOI 2022), and two possible detections occurred in late December 2022 (WHOI 2023).

MGEL (2022) indicates that the highest average density of sei whales in the buffered Lease Area and adjacent waters occurs in April and is estimated to be 0.00061 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of sei whales occurring in the Project area is high.

4.2 Odontocetes

4.2.1 Atlantic Spotted Dolphin (*Stenella frontalis*)

Two species of oceanic spotted dolphins can occur within the northwestern Atlantic: the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*, see section 4.2.7). *Stenella* species in the Atlantic can be difficult to distinguish at sea, and hybrids have been documented (Kingston, Adams, and Rosel 2009). Information contained in this section is specific to the Atlantic spotted dolphin. Atlantic spotted dolphins are relatively small (generally less than 2.3 m [7.5 ft] long) and accumulate dark spots, especially on their dorsal surfaces, as they age (W.F. Perrin 2009; W.F. Perrin, Caldwell, and Caldwell 1994). This species feeds upon a variety of organisms, including small fish, cephalopods, and benthic invertebrates (W.F. Perrin, Caldwell, and Caldwell 1994). Based on a 2011 shipboard and aerial study, the group size for Atlantic spotted dolphins in U.S. Northwestern Atlantic coastal waters is expected to be 23.9 individuals (Palka 2011). Atlantic spotted dolphin dives usually range from two to six minutes in duration and reach less than 9 m (30 ft), though this species can dive to depths of 60 m (196 ft; (W.F. Perrin 2009).

Atlantic spotted dolphins in U.S. Atlantic waters belong to Western North Atlantic stock. The best available abundance estimates for Atlantic spotted dolphins in the western North Atlantic is 39,921 individuals (S.A. Hayes et al. 2020b). Total annual estimated fishery-related mortality and serious injury to Atlantic spotted dolphins between 2013 and 2017 was presumed to be zero as no reports of mortalities or serious injury were submitted. Based on three population estimates from 2004, 2011, and 2016, there has been a statistically significant decrease in Atlantic spotted dolphin abundance (S.A. Hayes et al. 2020b). However, several confounding factors, including spatial distribution, add uncertainty to this abundance trend (S.A. Hayes et al. 2020b). The Western North Atlantic stock of Atlantic spotted dolphins is not classified strategic, and this species is not listed as threatened or endangered under the ESA (S.A. Hayes et al. 2020b). Threats to this species include vessel strikes and fishing gear entanglements, as well as habitat loss or degradation (S.A. Hayes et al. 2020b).

Atlantic spotted dolphins are found in the tropical and warm-temperate waters of the Western Atlantic Ocean (S.A. Hayes et al. 2020b). In the western Atlantic, this species ranges from southern New England, through the Gulf of Mexico and the Caribbean, to at least Venezuela (S.A. Hayes et al. 2020b; W.F. Perrin, Caldwell, and Caldwell 1994). Atlantic spotted dolphins are separated into two ecotypes, which may be distinct sub-species, based on habitat preference and appearance (S.A. Hayes et al. 2020b). The large, heavily spotted ecotype inhabits the continental shelf and is usually found inside or near the 200 m (656 ft) isobath south of Cape Hatteras. The smaller, less spotted island and offshore ecotype occurs more commonly in continental slope waters north of Cape Hatteras (S.A. Hayes et al. 2020b). Based on a study conducted on the west Florida continental shelf, Atlantic spotted dolphins occur in lower abundances from June to October and in higher abundances from November to May (Griffin and Griffin 2004). A genetic study indicated that though the Atlantic spotted dolphin is a highly mobile species with a largely continuous distribution, distinct genetic populations were found in different habitats (based on variables including depth and sea surface temperature; (Viricel and Rosel 2014). The seasonal migration patterns of Atlantic spotted dolphins are poorly understood, although hypotheses include inshore-offshore movements relative to season and prey abundance, or alongshore migration to warmer waters during cold seasons (Mills and Rademacher 1996). Although the lifespan of Atlantic spotted dolphins is unknown, they reach sexual maturity at approximately eight to fifteen years of age (D. L. Herzing 1997), and females reproduce at a rate of one calf every one to five years (W.F. Perrin 2009). Information on specific habitat areas used for mating and calving is not readily available for the Western North Atlantic stock of Atlantic spotted dolphins. No critical habitat has been designated for this species, as Atlantic spotted dolphins are not listed under the ESA.

Atlantic spotted dolphins are in the Mid Frequency Cetaceans hearing group (NOAA Fisheries 2018). This species produces a variety of sounds, including whistles, buzzes, barks, screams, squawks, tail slaps, and echolocation clicks (D.L. Herzing 1996). Their echolocation clicks have bi-modal frequencies, with the low-frequency peak between 40 and 50 kHz and the high-frequency peak between 110 and 130 kHz (W.W. Au and Herzing 2003). Atlantic spotted dolphins produce signature whistles with a frequency range of 4 to 18 kHz for a duration of 0.5 to 8 seconds (D.L. Herzing 1996). These whistles are associated with mother/calf reunions, alloparental care, and courtship (D.L. Herzing 1996). Excitement vocalizations, which have the same frequency range as the signature whistle, are burst-pulsed vocalizations overlapped with the signature whistle and are often associated with bubbles emitted from the blowhole (D.L. Herzing 1996). Atlantic spotted dolphin squawks, screams, and barks range in frequency from 0.2 kHz to 15 kHz (D.L. Herzing 1996).

Recent aerial surveys conducted by the SEFSC in June and July of 2021 as part of the AMAPPS program indicated 27 sightings of 452 individual Atlantic spotted dolphins between Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). Shipboard surveys conducted between June and September of 2021 also indicated 21 sightings of Atlantic spotted dolphins in this region, concentrated between the coast of Maryland and the coast of North Carolina (NEFSC and SEFSC 2021). Less recent but more location-specific visual and acoustic surveys conducted by Barco et al. (2015), Williams et al. (2015a, 2015b), and Bailey et al. (2018a) indicate that spotted dolphins have a limited presence in the region of the Lease area but are most likely to be present in the summer months. Barco et al. (2015) observed one group of 45 spotted dolphins (*Stenella* sp.) east of the Lease area in July 2014, and Williams et al. (2015d) sighted four individuals during a shipboard survey outside of Maryland waters in June 2013. No Atlantic spotted dolphins were detected during a two-year acoustic survey of the Lease area and surrounding region (Bailey et al. 2018a).

MGEL (2022) indicates that the highest annual density of Atlantic spotted dolphins in the buffered Lease area occurs in August and is estimated to be 0.01505 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of spotted dolphins occurring in the Project area is high.

4.2.2 Bottlenose Dolphin (*Tursiops truncatus*)

Bottlenose dolphins reach lengths of 1.9 to 3.8 m (6.3 to 12.5 ft) and range in color from light gray to black on their dorsal surface, with light grey to white coloration on their ventral surface (Jefferson, Webber, and Pitman 2015). In nearshore waters, bottlenose dolphins are often smaller and lighter in color compared to offshore individuals (Wells and Scott 1999). Bottlenose dolphins commonly travel alone or in groups, and groups frequently break apart and re-form during travel (Mann et al. 2000). Bottlenose dolphins are considered generalist feeders and consume a wide variety of organisms, including fishes, squids, and shrimps and other crustaceans (Jefferson, Webber, and Pitman 2008). Bottlenose dolphins use the full water column for feeding and have been found to dive on a regular basis, although they spend the majority of their time near the water surface (Hastie, Wilson, and Thompson 2014). A study conducted on offshore populations of bottlenose dolphins found that they regularly dove up to 450 m (1476 ft) during the night, with almost half of all night-time dives lasting 5 minutes or more (Klatsky, Wells, and Sweeney 2007). This same study found that during the day, offshore bottlenose dolphins tend to take shallower, shorter dives with 96 percent of dives occurring within 50 m (164 ft) of the surface and over half the dives lasting less than one minute (Klatsky, Wells, and Sweeney 2007).

Common bottlenose dolphins in U.S. Atlantic waters are divided into multiple offshore, estuarine, and coastal stocks. Within the western North Atlantic there are two distinct bottlenose dolphin forms, or ecotypes: coastal and offshore. The two forms are genetically and morphologically distinct, though regionally variable (Jefferson, Webber, and Pitman 2008). In areas north of Cape Hatteras, North Carolina, the coastal form is likely restricted to waters less than 25 m (82 ft) deep (R. D. Kenney 1990). Bottlenose dolphins in waters off the Maryland coast belong to one of two stocks: the Western North Atlantic offshore stock or the Western North Atlantic northern migratory coastal stock. The best available population estimate for the offshore stock of bottlenose dolphins in the Western North Atlantic is 62,851 (S.A. Hayes et al. 2020b). The best available estimate for the northern migratory coastal stock of bottlenose dolphins in the Western North Atlantic is 6,639 (Hayes et al. 2021). Generally, bottlenose dolphin population density appears to be higher within inner shelf areas than offshore (Jefferson, Webber, and Pitman 2008). For the period of 2013 to 2017, the estimated mean annual fishery-related mortality and serious injury to the Western North Atlantic offshore bottlenose dolphin stock was 28 (S.A. Hayes et al. 2020b). For the Western North Atlantic northern migratory coastal bottlenose dolphin stock, mean annual fishery-related mortality and serious injury ranged between 12 and 21 for the period of 2014 to 2018 and is likely an underestimate due to missing data (Hayes et al. 2021). Bottlenose dolphins from New York to Florida experienced an Unusual Mortality Event (UME) from July 2013 to March 2015 caused by cetacean morbillivirus infections (Hayes et al. 2021; NOAA Fisheries 2021a). The Western North Atlantic northern migratory coastal stock is classified as depleted under the MMPA and is also classified as a strategic stock (Hayes et al. 2021). The Western North Atlantic offshore stock is not listed as depleted under the MMPA and is not classified as a strategic stock (S.A. Hayes et al. 2020b). Neither stock is classified as threatened or endangered under the ESA (Hayes et al. 2021; S.A. Hayes et al. 2020b).

Bottlenose dolphins are distributed worldwide in temperate and tropical waters, ranging from coastal estuaries and rivers to the deep ocean (Wells and Scott 2018). Coastal bottlenose dolphins are primarily found in shallower coastal and estuarine waters (Hayes et al. 2021). Bottlenose dolphins of the offshore morphotype are distributed primarily along the outer continental shelf and continental slope in the northwest Atlantic Ocean from Nova Scotia to the southern Florida peninsula but have been documented to occur relatively close to shore south of Cape Hatteras, North Carolina (Hayes et al. 2021). Coastal form bottlenose dolphins are continuously distributed along the Atlantic Coast from south of New York to around the Florida peninsula and may overlap with the offshore form off the southeastern U.S. (S.A. Hayes et al. 2020b). Torres et al. (2003) found a statistically significant break in the distribution of coastal and offshore morphotypes at 34 km from shore based upon genetic analysis of tissue samples collected from New York to Florida. The offshore bottlenose dolphin morphotype was found exclusively seaward of 34 km (18.4 NM) and in waters deeper than 34 m (111 ft), and all animals were of the coastal morphotype within 7.5 km (4.1 NM) of the shore (Torres et al. 2003). However, offshore morphotype dolphins have been found in waters as shallow as 13 m (42 ft) and as close to shore as 7.3 km (4 NM) (Garrison 2003). Therefore, bottlenose dolphins of both the offshore and coastal stocks may be present in the region of the Lease area. The Western North Atlantic northern migratory coastal stock occupies waters between Virginia and Long Island during the warm water months and migrates in late summer and fall to waters off the coast of North Carolina (Hayes et al. 2021). Migratory patterns of the western North Atlantic offshore stock are not well understood (S.A. Hayes et al. 2020b).

Common bottlenose dolphins can live up to 40 years (T. Evans et al. 2021). Based on a study of bottlenose dolphins in the southwestern Atlantic Ocean, Females begin to reproduce when they are a minimum of eight years of age and give birth approximately every three years (Fruet et al. 2015). Gestation likely lasts for 12 months, and mothers nurse their calves for 18 months (Cockcroft and Ross 1990). Little information is available on the mating and calving habitats of bottlenose dolphins in the western north Atlantic. Critical habitat areas have not been designated for bottlenose dolphins off the U.S. Atlantic coast as this species is not listed under the ESA.

Bottlenose dolphins are in the Mid Frequency Cetaceans hearing group (NOAA Fisheries 2018). The underwater hearing range of bottlenose dolphins is 150 Hz to 135 kHz (C.S. Johnson 1967; Ljungblad, Scoggins, and Gilmartin 1982). Their best underwater hearing occurs between 15 and 110 kHz, and threshold levels range from 42 to 52 dB RL (W.W.L. Au 1993). Nachtigall et al. (2000) more recently measured the bottlenose dolphin range of highest hearing sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz. Bottlenose dolphins produce a variety of whistles, echolocation clicks, low-frequency narrow, “bray” and burst-pulse sounds with frequencies as low as 50 Hz and as high as 150 kHz with dominant frequencies at 0.3 to 14.5 kHz, 25 to 30 kHz, and 95 to 130 kHz (Janik 2000).

Recent aerial surveys conducted by the SEFSC in June and July of 2021 as part of the AMAPPS program indicated 137 sightings (1,325 individuals) of bottlenose dolphins between Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). Shipboard surveys conducted between June and September of 2021 indicated 75 sightings of bottlenose dolphins in this region (NEFSC and SEFSC 2021). Similarly, bottlenose dolphins were the most frequently observed marine mammal species during less recent, but more location-specific surveys of the Lease area and surrounding waters (Bailey et al. 2018a; Barco et al. 2015; Williams et al. 2015b). This species was observed primarily in warmer months; the number of sightings was greatest in spring, and group size and individual abundance was highest in summer (Barco et al. 2015). This pattern suggests that bottlenose dolphins arrive in or migrate through the study area in spring, remain in the region during summer, and begin to vacate the region with the arrival of cold weather in the late fall. Bottlenose dolphins were observed in groups ranging from one to 230 individuals (Barco et al. 2015), and were most acoustically active in the evening and early morning hours (Bailey et al. 2018a). Generally, detections of bottlenose dolphins occurred more frequently to the west of the Lease area during spring, summer, and fall, and further offshore (to the east of the Lease area) during the winter (Barco et al. 2015). Williams et al. (2015c) states that bottlenose dolphins are the species that is most likely to be exposed to construction activities in the Lease area during the spring, summer and fall.

MGEL (2022) indicates that the highest average density of both stocks of bottlenose dolphins in the buffered Lease area occurs in August and is estimated to be 0.49274 and 0.11052 individuals per 1 km (0.54 NM) grid square for the Western North Atlantic Northern Migratory Coastal and Western North Atlantic Offshore stocks, respectively.

According to the available data and site-specific information summarized above, the likelihood of bottlenose dolphins occurring in the Project area is high.

4.2.3 Harbor Porpoise (*Phocoena phocoena*)

The Harbor porpoise is a small, stocky cetacean with a blunt, short-beaked head, a dark gray back, and a light gray to white underside (Bjørge and Tolley 2009). Harbor porpoises reach a maximum length of 1.8 m (6 ft) and feed on a wide variety of small fishes and cephalopods (R.D. Kenney and Vigness-Raposa 2009; Reeves, Stewart, and Clapham 2002). Most harbor porpoise groups are small, usually between five and six individuals, although they may aggregate in large groups (Jefferson, Webber, and Pitman 2008). A study conducted on two harbor porpoises off the coast of Japan documented continuous diving behavior, with maximum dive depths ranging from 70 to 98 m (230 to 322 ft), and 70 percent of diving time spent at depths of 20 m (66 ft) or less (Otani et al. 1998). Studies have also indicated that mean dive depths and durations for harbor porpoises range from 14 ± 16 to 41 ± 32 m, and from 44 ± 37 to 103 ± 67 s, respectively (Westgate et al. 2011).

There are four distinct populations of harbor porpoise in the Western Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Hayes et al. 2022). Harbor porpoises observed off the U.S. mid-Atlantic coast are considered to be part of the Gulf of Maine/Bay of Fundy stock. The current best abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 95,543 individuals (Hayes et al. 2022). The total annual estimated average human-caused mortality to this stock is 164 harbor porpoises per year, 163 of which are fisheries-related (Hayes et al. 2022). A population trend analysis has not been conducted for this stock (Hayes et al. 2022). The Gulf of Maine/Bay of Fundy stock of harbor porpoises is not classified as strategic, and harbor porpoises are not listed as threatened or endangered under the ESA.

Harbor porpoises are usually found in shallow waters of the continental shelf, though they occasionally occur in deeper offshore waters (Hayes et al. 2022). Harbor porpoises are generally concentrated along the continental shelf within the northern Gulf of Maine and southern Bay of Fundy region during the summer months, generally in waters less than 150 m (492 ft) deep (July-September; (Hayes et al. 2022). During fall (October-December) and spring (April-June), harbor porpoises are more widely dispersed from New Jersey to Maine (Hayes et al. 2022). During winter (January-March), they are found in lower densities off the coast of New York to New Brunswick and in higher densities off the coast of New Jersey and North Carolina (Hayes et al. 2022). Off the coast of Maryland, harbor porpoises have been regularly acoustically detected between January and May (Hayes et al. 2022). There are no known seasonal migration routes or temporally coordinated migration for harbor porpoises in and out of the Bay of Fundy region, although studies suggest that there are seasonal inshore-offshore movements that may be influenced by prey availability or sea ice (Hayes et al. 2022). Specific locations used for mating and calving of harbor porpoises are poorly documented. No critical habitat areas have been designated for harbor porpoises as this species is not listed under the ESA.

Harbor porpoises are in the High Frequency Cetaceans hearing group (NOAA Fisheries 2018). Based on a study that examined a two-year-old harbor porpoise, the range of best hearing for this species is between 16 and 140 kHz, with a reduced sensitivity around 64 kHz and a maximum sensitivity between 100 and 140 kHz (R.A. Kastelein, Bunskoek, and Hagedoorn 2002). This maximum frequency corresponds with the peak frequency of harbor porpoise echolocation clicks, which range between 120 and 130 kHz (R.A. Kastelein, Bunskoek, and Hagedoorn 2002). Harbor porpoises are high frequency hearing specialists and produce narrowband high-frequency echolocation clicks (Madsen et al. 2006b, 2006a). Despite their high frequency hearing, harbor porpoises are well known for exhibiting sometimes strong behavioral reactions to low frequency sounds (Tougaard et al. 2009; R. Kastelein 2013; R. A. Kastelein et al. 2017; Graham et al. 2017; Graham et al. 2019). Several studies have been conducted to evaluate the hearing sensitivity of harbor porpoises to different anthropogenic sounds. One study found that exposure to impulsive low-frequency sounds, such as those produced by pile driving, can reduce hearing in harbor porpoises at higher frequencies (R.A. Kastelein et al. 2015). However, this hearing damage was not within the frequency range of their echolocation signals (R.A. Kastelein et al. 2015). A simulation approach also indicated that the simultaneous implementation of a combination of soft start protocols, SEL_{ss} regulation, and previous deterrence could limit the risk of TSS exposure in harbor porpoises during wind energy development (Schaffeld et al. 2020).

Recent aerial and shipboard transect surveys conducted by the SEFSC in June and July of 2021 as part of the AMAPPS program did not indicate any sightings of harbor porpoises between

Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). Similarly, less recent multi-year visual and acoustic surveys specific to the Lease area and surrounding waters indicate that harbor porpoises are present but uncommon in the region. Though this species was not observed during the Barco et al. (2015) study, acoustic monitoring indicates that harbor porpoises are present in the vicinity of the Lease area, primarily between January and May (Bailey et al. 2018a). These findings align with observations from the Williams et al. (2015c) survey, which observed one porpoise in the Maryland Wind Energy Area in March of 2013. Harbor porpoise presence is likely variable between years, and this species was most acoustically active during the evening and early morning hours (Bailey et al. 2018a).

MGEL (2022) indicates that the highest average density of harbor porpoises in the buffered Lease area occurs in January and is estimated to be 0.03653 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of harbor porpoises occurring in the Project area is high.

4.2.4 Pilot Whales (*Globicephala* spp.)

Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale (*Globicephala melas*) and the short-finned pilot whale (*G. macrorhynchus)*. Though these species differ in size and coloration patterns, they are difficult to differentiate at sea and cannot be reliably identified during most surveys (Hayes et al. 2022; Rone and Pace 2012). Therefore, some of the information below refers to both pilot whale species (*Globicephala* spp.).

Pilot whales have bulbous heads, are dark gray or black in color, with a robust body and thick tailstock (Olson 2009). Short-finned pilot whales range in length from 5.5 to 7.2 (18 to 23.6 ft), and long-finned pilot whales range in length from 5.7 to 6.7 m (18.7 to 22 ft) (Jefferson, Webber, and Pitman 2015). Pilot whales are very social and are generally found in groups of 20 to 90 individuals called schools or pods (Olson 2009). A study off the coast of Cape Hatteras in 2022 determined that both short- and long-finned pilot whales adapt their foraging strategies, and thus their diet, based on their environment (Shearer et al. 2022). Stomach contents examined from stranded pilot whales indicate that both short-finned and long-finned pilot whales have a diverse diet, primarily feeding on small-bodied fish and squid, and often following fishing vessels to depredate bait and catch (Shearer et al. 2022). In the western north Atlantic, pilot whales are often found in the continental shelf break where steep slopes are present (Shearer et al. 2022). Dive behavior of short-finned pilot whales off the U.S. continental slope is not well characterized, although dive behavior of short-finned pilot whales near volcanic islands such as Hawai'i indicate that they exhibit diurnal dive patterns, with deep foraging dives up to 20 minutes long and 1000 feet deep during the night and occasional deep dives during the day (Shearer et al. 2022). When foraging for highly mobile prey, short-finned pilot whales may make short "sprints" with speeds up to 3 meters per second, although this rarely occurs during nighttime hours (Shearer et al. 2022). Long-finned pilot whales can dive to depths of 600 m (1,968 ft) for up to 7-9 minutes to feed on fish (L.D Sivle et al. 2012). However, when not foraging, long-finned pilot whales are typically found at shallower depths of up to 50 m (164 ft; (L.D Sivle et al. 2012). Long-finned pilot whales are sometimes aerially active, and often display various behaviors at the water surface including spyhopping and rafting (Jefferson, Webber, and Pitman 2015). One study found that short-finned pilot whales typically engage in shallow dives, rest, travel, and social activity during the day, and take deeper dives at night to search for vertically migrating prey (Baird et al. 2003). Another study also documented this behavior in long-finned pilot whales, which were observed to remain within the top 16 m of the water column during the day and take deeper, longer dives at night when vertically migrating prey became more accessible (Baird et al. 2002). These studies suggest that differences in diving behavior between short-finned and long-finned pilot whales may be motivated by differences in prey depth (Baird et al. 2003; Baird et al. 2002).

Within the U.S. Atlantic EEZ, both pilot whale species are categorized into Western North Atlantic stocks. The best available population estimates for short-finned and long-finned pilot whales in the Western North Atlantic are 28,924 and 39,215 individuals, respectively (Hayes et al. 2022). These estimates are from summer 2016 surveys covering waters from central Florida to the lower Bay of Fundy (short-finned), and summer 2016 surveys covering waters from central Virginia to Maine and in Canadian waters from the U.S. border to Labrador (long-finned) (Hayes et al. 2022). Total annual estimated average fishery-related mortality or serious injury from 2015 to 2019 was 136 short-finned pilot whales and nine long-finned pilot whales (Hayes et al. 2022). Based on abundance estimates from 2004, 2011, and 2016, there was no statistically significant population trend for the Western North Atlantic stock of short-finned pilot whales (Hayes et al. 2022). A population trend analysis has not been conducted for the long-finned pilot whale stock (Hayes et al. 2022). The Western North Atlantic stocks of short-finned and long-finned pilot whales are not considered strategic under the MMPA and neither species is listed as threatened or endangered under the ESA.

Short-finned pilot whales have a tropical and temperate distribution (Hayes et al. 2021), while long-finned pilot whales occur in subpolar and deep temperate waters (Hayes et al. 2022). The two species overlap spatially between the southern flank of Georges Bank and New Jersey, where they both occur along the mid-Atlantic shelf break (Payne and Heinemann 1993; Waring et al. 2015). Short-finned pilot whales have occasionally stranded as far north as Massachusetts, and long-finned pilot whales have stranded as far south as Florida (Pugliares et al. 2016b, 2016a). The latitudinal ranges of the two species therefore remain uncertain, although most pilot whale sightings south of Cape Hatteras are expected to be short-finned pilot whales, and most sightings north of ~42°N are expected to be long-finned pilot whales (Hayes et al. 2022). Sightings of pilot whales in the western North Atlantic occur primarily near the continental shelf break from Florida to the Nova Scotian Shelf (Mullin and Fulling 2003), and these species are often found in areas where steep slopes are present (Shearer et al. 2022). In U.S. Atlantic waters, pilot whales are distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring (CeTAP 1982; Payne and Heinemann 1993; Abend and Smith 1999). In late spring, long-finned pilot whales move into the Gulf of Maine and northern waters, and onto Georges Bank, and remain in these regions through late autumn (CeTAP 1982; Payne and Heinemann 1993). Specific pilot whale calving areas are not known, though a study of short-finned pilot whales off the coast of Portugal found that they may use the same area for resting, socializing, foraging, breeding, calving, and birthing (Alves and F.M.A. 2013). Critical habitat areas have not been designated for pilot whales as these species are not listed under the ESA.

Both long-finned and short-finned pilot whales are in the Mid Frequency Cetaceans hearing group (NOAA Fisheries 2018). Peak hearing sensitivity of a captive short-finned pilot whale was measured at approximately 40 kHz, and the upper limit of functional hearing was determined to fall between 80 and 100 kHz (Schlundt et al. 2011). Short-finned pilot whales produce sounds as low as 280 Hz and as high as 100 kHz, with dominant frequencies between 2 to 14 kHz and 30 to 60 kHz (Fish and Turl 1976b; Scheer, Hofmann, and Behr 1998; Caldwell and Caldwell 1969). The mean frequency of calls produced by short-finned pilot whales is 7,870 Hz, much higher than the mean frequency of calls produced by long-finned pilot whales (Rendell et al. 1999). As demonstrated by click production, pilot whales echolocate with a precision similar to bottlenose dolphins (W.E. Evans 1973), and source levels of clicks have been measured as high as 180 dB (Fish and Turl 1976b, 1976a).

Recent aerial transect surveys conducted by the SEFSC in June and July of 2021 as part of the AMAPPS program included 16 sightings (219 individuals) of pilot whales between Delaware Bay and the southernmost tip of Florida (NEFSC and SEFSC 2021). These sightings were concentrated between Delaware and North Carolina (NEFSC and SEFSC 2021). Shipboard surveys conducted by the SEFSC between June and September of 2021 similarly indicated 45 sightings of pilot whales in this region, also concentrated between Delaware and North Carolina, but with some sightings as far south as Florida (NEFSC and SEFSC 2021). Pilot whales tend to occur at or beyond the continental shelf break, and therefore are most likely to be found east of the Maryland Wind Energy Area (Williams et al. 2015d). Less recent multi-year visual and acoustic surveys specific to the Lease area and surrounding waters did not yield any confirmed pilot whale detections or sightings (Barco et al. 2015; Williams et al. 2015d; Williams et al. 2015c). Pilot whales tend to occur at or beyond the continental shelf break, and therefore are most likely to be found east of the Maryland Wind Energy Area (Williams et al. 2015d).

MGEL (2022) indicates that the average annual density of pilot whales in the buffered Lease area is estimated to be 0.00017 individuals per 1 km (0.54 NM) grid square for short-finned pilot whales and 0.00022 individuals per 1 km (0.54 NM) grid square for long-finned pilot whales.

According to the available data summarized above the likelihood of pilot whales occurring in the Project area is high.

4.2.5 Pantropical Spotted Dolphin (*Stenella attenuata*)

Two species of oceanic spotted dolphins can occur within the northwestern Atlantic: the pantropical spotted dolphin (*Stenella attenuata*), and the Atlantic spotted dolphin (*S. frontalis*, see Section 4.2.1). *Stenella* species in the Atlantic can be difficult to distinguish at sea, and hybrids have been documented (Kingston, Adams, and Rosel 2009). Pantropical spotted dolphins are relatively small, ranging in size from 1.8 to 2.1 m (6 to 7 ft) in length, and feed primarily on epipelagic fish, squid, cephalopods and crustaceans (W.F. Perrin and Hohn 2002). Pantropical spotted dolphins are quite social and are often observed in groups ranging in size from a few to 1,000 individuals and will often school with other dolphin species (W.F. Perrin and Hohn 2002). Pantropical spotted dolphins typically dive anywhere from 14 m (46 ft) to over 200 m (656 ft) (Scott and Chivers 2009). Data from a study conducted in the eastern tropical Pacific suggests that pantropical spotted dolphins are nocturnal feeders; dolphins were mainly found at depths between 10 and 20 m (33 to 66 ft) during daytime hours, but exhibited longer and deeper dives at night, tracking the vertical movement of prey organisms (Scott and Chivers 2009).

Pantropical spotted dolphins in U.S. Atlantic waters belong to the Western North Atlantic Stock. The best available abundance estimate for pantropical spotted dolphins in the western North Atlantic is 6,593, based on summer 2016 surveys covering waters from the lower Bay of Fundy to central Florida (S.A. Hayes et al. 2020b). Total annual estimated fishery-related mortality and serious injury to pantropical spotted dolphins between 2013 to 2017 was presumed to be zero (Hayes et al., 2020). Based on abundance estimates from 2004, 2011, and 2016, no statistically significant population trend was identified (S.A. Hayes et al. 2020b). This stock is not classified as strategic, and pantropical spotted dolphins are not listed as threatened or endangered under the ESA (S.A. Hayes et al. 2020b).

Pantropical spotted dolphins occur throughout tropical and sub-tropical waters of the world from roughly 40°N to 40°S (Jefferson, Webber, and Pitman 2015). Pantropical spotted dolphin sightings on the U.S. east coast are concentrated in the slope waters north of Cape Hatteras and in deeper waters offshore of the mid-Atlantic states, though sightings have been reported from as far north as George's Bank (S.A. Hayes et al. 2020b). The migration patterns and life history of this species is not well understood (Jefferson, Webber, and Pitman 2015). Similarly, calving behavior in the Western North Atlantic stock of Pantropical spotted dolphins is not well studied, but a study conducted on Hawai'i stocks found that peak calving occurred between July and October (Baird and R.W. 2016). Critical habitat areas have not been designated for the pantropical spotted dolphin as this species is not listed under the ESA.

Pantropical spotted dolphins are in the Mid Frequency Cetaceans hearing group (NOAA Fisheries 2018). Very limited data about the hearing sensitivities of pantropical spotted dolphins is available. However, this species produces whistles with a frequency range of 3.1 to 21.4 kHz (W.J. Richardson 1995) and clicks that are typically bimodal in frequency with peaks at 40 to 60 kHz and 120 to 140 kHz (Schotten et al. 2004). Clicks can reach source levels of up to 220 dB re 1 µPa at 1m (Schotten et al. 2004).

Recent aerial transect surveys conducted by the SEFSC in June and July 2021 as part of the AMAPPS project did not indicate any sightings of pantropical spotted dolphins between Delaware Bay and the southernmost point of Florida (NEFSC and SEFSC 2021). However, shipboard transect surveys conducted by the SEFCS between June and September of 2021 indicated 5 sightings of pantropical spotted dolphins in this range, concentrated off the coast of North and South Carolina (NEFSC and SEFSC 2021). These findings generally align with less recent but more location-specific visual and acoustic surveys conducted by Barco et al. (2015), Williams et al. (2015d; 2015c), and Bailey et al. (2018a). These studies indicate that *Stenella* spp. dolphins have a limited presence in the region of the Lease area and are most likely to be present in the summer months. Barco et al. (2015) observed one group of 45 spotted dolphins east of the Lease area in July 2014, and Williams et al. (2015d) sighted four individuals during a shipboard survey outside of Maryland waters in June 2013. No spotted dolphins were detected during a two-year acoustic survey of the Lease area and surrounding region (Bailey et al. 2018a).

MGEL (2022) indicates that the average annual density of pantropical spotted dolphins in the buffered Lease area is estimated to be 0.00004 individuals per 1 km (0.54 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of spotted dolphins occurring in the Project area is high.

4.2.6 Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are medium sized cetaceans that can grow up to 4 m (13 ft) in length (R.W. Baird 2009). This species generally feeds at night on a variety of fishes, cephalopods, and krill, though their diet predominantly consists of squid (R.W. Baird 2009). Risso's dolphins are usually found in groups of 10 to 50 animals, though solitary individuals, pairs, and groups as large as 4,000 individuals have been observed (R.W. Baird 2009). Risso's dolphins are active at the water surface, but can dive to at least 305 m (1,000 ft), and are generally found in deep offshore waters near the continental shelf edge and slope (Hartman 2018).

Risso's dolphins along the U.S. east coast belong to the Western North Atlantic stock, generally occurring from Florida to Eastern Newfoundland (Hayes et al. 2022). The best population estimate for the Western North Atlantic stock of Risso's dolphins is approximately 35,215 individuals (Hayes et al. 2022). This estimate was generated from the sum of surveys conducted by the NEFSC and Department of Fisheries and Ocean Canada from Newfoundland to Florida in 2016 (Hayes et al. 2022). Total annual estimated average fishery-related mortality or serious injury to this stock during the period of 2015 to 2019 was 35 individuals, the majority of which resulted from interactions with mid-Atlantic bottom trawling gear (Hayes et al. 2022). A population trend analysis has not been conducted for this stock due to a lack of precise abundance estimates (Hayes et al. 2022). The Western North Atlantic Stock of Risso's dolphins is not classified as depleted or strategic (Hayes et al. 2022), and Risso's dolphins are not listed as threatened or endangered under the ESA.

Risso's dolphins generally inhabit temperate and tropical zones of oceans worldwide, primarily in offshore waters near the continental shelf edge and slope between 30 and 45 degrees in latitude (Jefferson et al. 2013). This species has been observed in association with Gulf Stream features (including warm-core rings and the Gulf stream north wall) and strong bathymetric features in continental shelf and oceanic waters (Waring et al. 1992; Hamazaki 2002). Little is known about the migration patterns of Risso's dolphins, but seasonal migrations to higher latitudes have been suggested in the North Atlantic (R.W. Baird and Stacey 1991). Risso's dolphins occur from Cape Hatteras northeast to Georges Bank (35˚ to 42˚N) during the spring, summer, and fall, and are present in oceanic waters of the mid-Atlantic bight in winter (CeTAP 1982; Payne, Selzer, and Knowlton 1984). This species is known to inhabit waters of the Mid-Atlantic continental shelf edge year-round (Payne, Selzer, and Knowlton 1984). Limited information is available about mating and calving behaviors of Risso's dolphins, and no specific calving areas have been documented in the North Atlantic. However, calves may be born throughout all seasons in the northwest Atlantic, and geographical differences in calving may exist (R.W. Baird and Stacey 1991). Critical habitat areas have not been designated for Risso's dolphins as this species is not listed under the ESA.

Risso's dolphins are in the Mid Frequency Cetaceans hearing group (NOAA Fisheries 2018). Audiograms for Risso's dolphins indicate that their hearing sensitivity ranges in frequency from 1.6 to 110 kHz, with optimal hearing between 4 and 80 kHz (P. E. Nachtigall et al. 1995). A stranded infant male Risso's dolphin was studied in Portugal and that individual's hearing ranged from 4 to 150 kHz (P.E. Nachtigall et al. 2005). It is suspected that like other mammals, Risso's dolphins lose their higher frequency hearing as they age (P.E. Nachtigall et al. 2005). A stranded infant male Risso's dolphin was studied in Portugal and that individual's hearing ranged from 4 to 150 kHz (P.E. Nachtigall et al. 2005). A study conducted on Risso's dolphins off the coast of Australia found that vocalizations consisted of broadband clicks, barks, buzzes, grunts, chirps, whistles, and simultaneous whistle/burst-pulse sounds and ranged from 30 Hz to 22 kHz (Corkeron, P.J., and Van Parijs 2001).

Recent aerial transect surveys conducted by the SEFSC in June and July 2021 as part of the AMAPPS program indicated 10 sightings (233 individuals) of Risso's dolphins between Delaware Bay and the southernmost point of Florida, concentrated off the coast of Maryland and Virginia (NEFSC and SEFSC 2021). Similarly, shipboard transect surveys conducted by the SEFCS between June and September of 2021 indicated 33 sightings of Risso's dolphins in this range, also concentrated off the coast of Maryland and Virginia (NEFSC and SEFSC 2021). Less recent but more location-specific multi-year visual and acoustic surveys specific to the Lease area and surrounding waters indicate that Risso's dolphins are rare in the region. Though this species was not observed during the Barco et al. (2015) or Bailey et al. (2018a) study, one Risso's dolphin was sighted during aerial surveys in waters offshore of Maryland in October of 2013 (Barco et al. 2015; Williams et al. 2015d; Williams et al. 2015c).

MGEL (2022) indicates that the highest average density of Risso's dolphin in the buffered Lease area occurs in December and is estimated to be 0.00169 individuals per 1 km (0.54 NM) grid square.

According to the available data summarized above the likelihood of Risso's dolphins occurring in the Project area is high.

4.2.7 Short-Beaked Common Dolphin (*Delphinus delphis*)

The short-beaked common dolphin, herein referred to as the "common dolphin," occurs in temperate, tropical, and subtropical regions and is one of the most abundant and widely distributed cetacean species (Jefferson, Webber, and Pitman 2008). Common dolphins can reach 2.33 m (7.6 ft) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape" (W.F. Perrin 2009; Murphy, Collet, and Rogan 2005). This species primarily feeds on fish, cephalopods, crustaceans, and other mesopelagic species at night and dusk (IUCN 2010; Pusineri et al. 2007). Common dolphin group sizes generally range from 10 to 10,000 individuals (Jefferson, Webber, and Pitman 2015). Dives are typically less than 30 m (100 ft) but dives over 200 m (656 ft) have been recorded (Simonis et al. 2017).

Common dolphins along the U.S. east coast belong to the Western North Atlantic stock, generally occurring from Cape Hatteras, North Carolina to the Scotian Shelf (Hayes et al. 2022). The best population estimate for the Western North Atlantic stock of common dolphin is approximately 172,947 individuals (Hayes et al. 2022). Total annual estimated average fishery-related mortality or serious injury to this stock during 2015-2019 was 390.4 individuals (Hayes et al. 2022). The biggest threat to common dolphins is entanglement in fishing gear and bottom trawl bycatch (Hayes et al. 2022). A population trend analysis has not been conducted for this stock due to a lack of precise abundance estimates (Hayes et al. 2022). The Western North Atlantic stock of common dolphins is not classified as depleted, and the common dolphin is not listed as threatened or endangered under the ESA (Hayes et al. 2022). The biggest threat to common dolphins is entanglement in fishing gear and bottom trawl bycatch (Hayes et al. 2022)

Common dolphins are a highly seasonal, migratory species. In waters off the northeastern U.S. coast this species is distributed along the continental shelf between the 100 to 2000 m (328 to 6,562 ft) isobaths and is associated with Gulf Stream features (CeTAP 1982; Selzer and Payne 1988; Waring et al. 1992; Hamazaki 2002). Common dolphins occur from Cape Hatteras northeast to Georges Bank (35° to 42°N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to autumn (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 11°C (52°F) (Sergeant, Mansfield, and Beck 1970; Gowans and Whitehead 1995). Specific habitats used by common dolphins for mating and calving in the mid-Atlantic are not well documented. Critical habitat areas have not been designated for this species as common dolphins are not listed under the ESA.

Common dolphins are in the Mid-Frequency Cetaceans hearing group (NOAA Fisheries 2018). The hearing threshold of a common dolphin was measured to range from 10 to 150 kHz, with greatest sensitivity between 60 and 70 kHz (Popov and Klishin 1998). Common dolphins produce sounds as low as 0.2 kHz and as high as 150 kHz, with dominant frequencies at 0.5 to 18 kHz and 30 to 60 kHz (W.W.L. Au 1993; Moore and Ridgway 1995). Signal types consist of clicks, squeals, whistles, and creaks (W.E. Evans 1994). The whistles of common dolphin's range between 3.5 and 23.5 kHz (Ansmann et al. 2007). Most of the energy of common dolphin echolocation clicks is concentrated between 15 and 100 kHz (Croll et al. 1999). In the North Atlantic, the mean source level of common dolphin whistles was approximately 143 dB with a maximum of 154 (Croll et al. 1999).

Recent aerial transect surveys conducted by the SEFSC in June and July of 2021 as part of the AMAPPS program indicated 3 sightings (35 individuals) of common dolphins off the coast of Maryland (NEFSC and SEFSC 2021). Shipboard transect surveys conducted by the SEFSC between June and September of 2021 indicated 3 sightings of common dolphins between Delaware Bay and the southernmost point of Florida, concentrated off the coast of Virginia (NEFSC and SEFSC 2021). Less recent but more location-specific multi-year studies in the Lease area and surrounding waters suggest that common dolphins occur year-round in the region but exhibit strong seasonal changes in abundance. This species was the second most frequently observed delphinid in Maryland waters, after bottlenose dolphins (Williams et al. 2015c), and was observed in groups ranging in size from one to 75 individuals (Barco et al. 2015). Common dolphins are a cold tolerant species, and likely migrate into or through the region of the Lease area in the fall, remain in the area over the winter, and depart in the spring (Williams et al. 2015c). This pattern was observed during the Barco et al. (2015), Williams et al. (2015c), and Bailey at al. (2018a) studies; common dolphins were abundant in the region in the fall, winter, and spring months, and were not detected or observed in the summer. During these time periods, acoustic activity was greatest during the evening and early morning hours (Bailey et al. 2018a). Interestingly, though the number of sightings of this species peaked in winter, group size and the number of observed individuals was greatest in spring (Barco et al. 2015). Common dolphins were most often detected offshore of the Lease area on the outer continental shelf (Barco et al. 2015).

MGEL (2022) indicates that the highest average density of common dolphins in the buffered Lease area occurs in December and is estimated to be 0.07939 individuals per 1 km (5.4 NM) grid square.

According to the available data and site-specific information summarized above, the likelihood of common dolphins occurring in the Project area is high.

4.3 Pinnipeds

4.3.1 Harbor seal *(Phoca vitulina)*

The harbor seal, also known as the common seal, is found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30°N and is the most abundant pinniped on the east coast of the United States (Hayes et al. 2022). This species can reach approximately two meters (6 ft) in length and has a blue-gray back with light and dark speckling (R.W. Baird 2001). The harbor seal diet consists primarily of fish, such as American sandlance and Atlantic herring (Payne and Selzer 1989). Harbor seals complete both shallow and deep dives when hunting, dependent upon prey availability (Tollit, Greenstreet, and Thompson 1997). Pups can swim and dive at birth, and regularly engage in these behaviors throughout the lactation period (Burns et al. 1999). Harbor seals generally form groups as a means of avoiding predation (Silva and Terhune 1988).

Although the stock structure of the Western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population that is termed the Western North Atlantic stock (Tempte, Bigg, and Wiig 1991; Anderson and Olsen 2010). The best abundance estimate for harbor seals in the Western North Atlantic stock is 61,336 (Hayes et al. 2022). This estimate was derived from a survey along the Maine coast during May and June of 2012 and 2018 (Hayes et al. 2022). For the period of 2015 through 2019 the average human-caused mortality and serious injury to harbor seals was estimated to be 339 individuals per year (Hayes et al. 2022). Though estimated mean change in pup and non-pup harbor seal abundance was steady or declining from 2005 through 2018, these trends were not statistically significant (Hayes et al. 2022). The Western North Atlantic stock of harbor seals is not considered strategic under the MMPA and the harbor seal is not listed as threatened or endangered under the ESA (Hayes et al. 2022). An Unusual Mortality Event, believed to be the result of phocine distemper virus, was declared for pinnipeds on the northeastern coast of the U.S. from July 2018 through March 2020 (NOAA Fisheries 2022c). Though most mortalities were reported from Maine, New Hampshire, and Massachusetts, strandings have been reported as far south as North Carolina (NOAA Fisheries 2021b). In June 2022, a pinniped Unusual Mortality Event was declared for the southern and central Maine coast (NOAA Fisheries 2022d). Though the cause of this currently active UME is under investigation, some stranded harbor and gray seals have tested positive for highly pathogenic avian influenza (HPAI) H5N1 (NOAA Fisheries 2022d).

Harbor seals commonly occur in coastal waters and on coastal islands, ledges, and sandbars (Jefferson, Webber, and Pitman 2008). Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona, Rough, and Richardson 1993), and occur seasonally along the coastline from southern New England to New Jersey from September through late May (Schneider and Payne 1983; Barlas 1999; Schroeder 2000; deHart 2002). A general southward movement of harbor seals, from the Bay of Fundy to southern New England waters, occurs in autumn and early winter (Rosenfeld, George, and Terhune 1988; Whitman and Payne 1990; Barlas 1999). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine coast (D.T. Richardson 1976; Wilson 1978; Whitman and Payne 1990; M.K. Kenney 1994; deHart 2002). Though haul-out locations in New England and off the east coast of Canada are routinely used and well documented (Hayes et al. 2022), no harbor seal haulouts in the Project area, including the potential offshore export cable landing locations, are known. Critical habitat areas have not been designated for harbor seals as this species is not listed under the ESA.

Harbor seals are in the Phocid Pinnipeds (PW) Underwater hearing group (NOAA Fisheries 2018). Underwater, harbor seals hearing sensitivity ranges from 0.125 kHz to 100 kHz, with best hearing at frequencies from below one kHz and above 40 kHz (R.A. Kastelein et al. 2009). During the breeding season, male harbor seals defend their breeding territories by using acoustic displays (L. Matthews and Parks 2016). A low frequency vibration known as a roar is used to ward off any opposing males attempting to enter the resident male’s territory (L. Matthews and Parks 2016). Harbor seal vocalizations are uncommon outside of the breeding season.

Multi-year surveys specific to the Lease area and surrounding waters did not yield any confirmed harbor seal sightings (Williams et al. 2015a, 2015b; Barco et al. 2015). Though strandings have been reported in Delaware and Maryland between 2017 and 2019 (Hayes et al. 2017), harbor seals are not regular visitors to the Lease area.

MGEL (2022) indicates that the highest average density of harbor seals in the buffered Lease area occurs in January and is estimated to be 0.11759 individuals per 1 km (0.54 NM) grid square.

According to the available data the likelihood of harbor seals occurring in the Project area is low.

4.3.2 Gray seal *(Halichoerus grypus)*

Gray seals are the second most common pinniped along the Atlantic coast of the United States (Jefferson, Webber, and Pitman 2008). Gray seals are large, reaching 2 to 2.25 meters (6.6 to 7.4 ft) in length, and have a gray, tan, or brown coat with irregular dark blotches or spots

(Jefferson, Webber, and Pitman 2015). These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (Bonner 1971; Reeves, Stewart, and Leatherwood 1992; Jefferson, Webber, and Pitman 2008). Gray seals are generally gregarious and live in loose colonies during the breeding and pupping season (Jefferson, Webber, and Pitman 2008). Gray seals are found in smaller groups outside of the breeding season (Hayes et al. 2022). Though they spend most of their time in coastal waters, gray seals can dive to depths of 300 m (984 ft), and frequently forage in OCS regions (Jefferson, Webber, and Pitman 2008). Gray seal diving behavior varies between males and females (Beck et al. 2003). In the seven months before parturition, female gray seals generally undertook more frequent and longer but shallower (averaging 49 m [160 ft]) dives than males (57 m [187 ft]; (Beck et al. 2003). Additionally, male gray seals dive depth was consistent throughout the night and day, whereas female gray seal dives were deeper during the day, and shallower at night (Beck et al. 2003).

Gray seals found on the U.S. east coast are part of the Western North Atlantic stock. The size of the Northwest Atlantic gray seal population is estimated separately for the Canadian and U.S. populations, although the rate of exchange between these two populations is unknown. The best abundance estimate of gray seals in U.S. waters is 27,131 individuals, based on the number of pups born in U.S. breeding colonies and the pup-to-adult ratio of the Canadian population (Hayes et al. 2021). For the period of 2014 through 2018, the average estimated human caused mortality and serious injury to gray seals was 4,729 individuals per year for both the U.S. and Canadian populations (Hayes et al. 2021). The current trend for U.S. and Canadian gray seal populations is positive, though year-over-year pup production increase are slowing (Hayes et al. 2021). The Western North Atlantic stock is not considered strategic under the MMPA and gray seals are not listed as threatened or endangered under the ESA (Hayes et al. 2021). A prior Unusual Mortality Event, believed to be the result of phocine distemper virus, was declared for pinnipeds on the northeastern coast of the US from July 2018 through March 2020 (NOAA Fisheries 2022c). Though most mortalities were reported from Maine, New Hampshire, and Massachusetts, strandings have been reported as far south as North Carolina (NOAA Fisheries 2021b). In June 2022, a pinniped Unusual Mortality Event was declared for the southern and central Maine coast (NOAA Fisheries 2022d). Though the cause of this currently active UME is under investigation, some stranded harbor and gray seals have tested positive for highly pathogenic avian influenza (HPAI) H5N1 (NOAA Fisheries 2022d).

Gray seals inhabit temperate and sub-arctic waters and live on remote, exposed islands, shoals, and unstable sandbars (Jefferson, Webber, and Pitman 2008). The eastern Canada population ranges from New Jersey to Labrador and is centered at Sable Island, Nova Scotia (Davies 1957; Mansfield 1966; Katona, Rough, and Richardson 1993; Lessage and Hammill 2001). There are three breeding concentrations of gray seals in eastern Canada: Sable Island, the Gulf of St. Lawrence, and along the east coast of Nova Scotia (Laviguer and Hammill 1993b, 1993a). In U.S. waters, gray seals currently pup at four established colonies from late December to mid-February: Muskeget and Monomony Islands in Massachusetts, and Green and Seal Islands in Maine (Hayes et al. 2021), all of which are a significant distance from the Project area. Following the breeding season, gray seals may spend several weeks ashore in the late spring and early summer while undergoing a yearly molt (Bonner 1971). Critical habitat areas have not been designated for gray seals as this species is not listed under the ESA.

Gray seals are in the Phocid Pinnipeds (PW) Underwater hearing group (NOAA Fisheries 2018). Little information is available on the hearing sensitivity of this species. However, captive young gray seals, collected from the coast of Newfoundland, Nova Scotia, and the Gulf of St. Lawrence, were found to produce three to four different types of clicks when submerged (Schusterman, Balliet, and St John 1970). A buzz-like series of clicks (70 to 80 clicks per second) ranged in frequency from 0.5 kHz to 12 kHz (Schusterman, Balliet, and St John 1970). Additional clicking vocalizations produced high-pitched moaning or humming sounds, and mooing-type sounds (Schusterman, Balliet, and St John 1970). These vocalizations were observed mainly when the young gray seals were taking part in social interactions (Schusterman, Balliet, and St John 1970).

Multi-year surveys specific to the Lease area and surrounding waters did not yield any confirmed gray seal sightings (Williams et al. 2015a, 2015b; Barco et al. 2015). Though gray seal strandings have been reported from Delaware and Maryland (Hayes et al. 2021), this species is not a regular visitor to the Lease area.

MGEL (2022) indicates that the highest average densities of gray seals in the buffered Lease Area occurs in January and is estimated to be 0.05234 individuals per 1 km (0.54 NM) grid square.

According to the available data the likelihood of gray seals occurring in the Project area is high.

5.0 Type of Incidental Take Authorization Requested

Under the MMPA, NOAA Fisheries is allowed, upon request, to authorize the incidental, but not intentional, “taking” of small numbers of marine mammals by U.S. citizens or agencies who engage in a specified activity (other than commercial fishing) within a specified geographical region. The term “take,” as defined in Section 3.0 (16 U.S. Code [U.S.C.] section 1362 (13)) of the MMPA, means “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.” “Harassment” was further defined in the 1994 amendments to the MMPA, with two levels of harassment: Level A and Level B. Level A harassment is any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock, while Level B harassment is any act of pursuit, torment, or annoyance that 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.

Pursuant to Section 101 (a)(5)(A) of the MMPA of 1972, as amended (16 USC 1371), US Wind is applying for rulemaking and a LOA for the activities related to the construction and installation of the Maryland Offshore Wind Project on the Atlantic OCS. The MMPA directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing). The issuance occurs when the Secretary, after notice has been published in the *Federal Register* and opportunity for comment has been provided, finds that such takes would have a negligible impact on the species and stocks of marine mammals and would not have an unmitigable adverse impact on their availability for subsistence uses.

Marine mammals have the potential to be incidentally harassed by the underwater sound generated during the construction and installation of the Maryland Offshore Wind Project. As a result, US Wind is requesting rulemaking under the MMPA and a LOA for the taking of marine mammals by Level A and Level B harassment incidental to the installation of the WTG and OSS foundations, the installation of bracing piles for the Met Tower, and the use of HRG survey equipment on the Atlantic OCS.

6.0 Take Estimates for Marine Mammals

Anticipated impacts to marine mammals from the Project activities would be associated with noise generated by construction and survey activities, including impact pile driving activities and micro-siting HRG surveys. Although mitigation measures will be employed during impact pile driving and micro-siting HRG surveys, marine mammal takes are being requested should a marine mammal enter a zone of ensonification during the execution of these noise producing activities. Marine mammal take estimates associated with acoustic exposure have been calculated using the best available data for marine mammals in the Project area. For each of these proposed activities, takes are based on the maximum number of survey days or impact-driven piles, so the resulting take estimates represent the maximum number of takes estimated for each period (monthly, annual, or three-year takes).

Takes for each potentially affected marine mammal species have been computed for impact pile driving activities (monopile, skirt pile, and pin pile driving events) and micro-siting HRG surveys on a monthly and annual basis. As an overview of the iterative take estimation process, the annual schedule of pile driving and micro-siting HRG surveys is convolved with the maximum monthly takes for each annual activity to produce annual maximum takes per species for each of the three years of proposed activities. The total marine mammal take estimates for all years of construction and survey activities of the Project were determined from the acoustic exposure estimates, which were adjusted by group size in some cases based on the frequency and number of marine mammals expected to be seen in the Project area based on visual survey data. The MMPA Level A and Level B harassment estimates that are being requested by US Wind include application of mitigation measures for the North Atlantic right whale.

The following sections include background information necessary for the estimation of takes from acoustic exposure. Some of the information was excerpted from Appendix A, Underwater Acoustic Assessment of Pile Driving during Construction at the Maryland Offshore Wind Project.

6.1 Marine Mammal Density Derivation

Density estimates for marine mammals used in this Project's take estimation were extracted from the Marine Geospatial Ecology Laboratory (MGEL) (2022) marine mammal density dataset, which represents the best available marine mammal data for the Project area; the methodology for the density derivation is described in Roberts et al. (2016). These 2022 density estimates were applied to the assessments of marine mammal potential impacts for both the impact pile driving and HRG surveys. MGEL density estimates have been produced in 5-km square grid cells in U.S. Atlantic waters for all occurring marine mammal species or species groups, with discrete densities designated for each grid cell by month. However, for some marine mammal species or species groups like pantropical spotted, rough-toothed, and striped dolphins; killer whales; *Kogia* spp.; and pilot whales, only annual density estimates are available, as insufficient information (sighting data) for these individual species was available to derive densities by month. For these species, the annual mean density estimates were used as an input for each month of the year. Additionally, for some species like the harbor and gray seals and short-finned and long-finned pilot whales, MGEL densities are only available for the generalized groups of seals and pilot whales rather than for the individual species. To obtain density estimates for each of these individual species that were treated as a group in the MGEL 2022 database, the MGEL (2022) group density was scaled by the abundances of each of the individual species (Hayes et al. 2022), using the following equation with the harbor seal as an example:

$$d_{\text{harbor seal}} = d_{\text{MGEL(both)}} * (a_{\text{harbor seal}} / (a_{\text{harbor seal}} + a_{\text{gray seal}}))$$

where d represents density and a represents abundance.

Marine mammal densities were estimated for the buffered Lease area. The buffer distance applied to the Lease area boundary was the largest range to a marine mammal regulatory threshold for the pile driving hammer sources proposed for use in the Project, which was 5.25 km. This largest range of 5.25 km to a regulatory threshold for either impact pile driving or micro-siting HRG survey activities was buffered (or added) onto the outer Lease area boundary (Figure 6-1), and marine mammal densities were compiled for this buffered area for all pile driving and HRG activities. The mean density for each MGEL grid cell within the buffered Lease area was averaged by month (or annually) to provide a mean monthly density for each marine mammal species/species group for the buffered Lease area; only grid cells that are within the boundary of the buffered Lease area were included in the monthly density estimates for each species or species group (Table 6-1; Figure 6-1).

Two stocks of common bottlenose dolphins (Western North Atlantic Northern Migratory Coastal and Western North Atlantic Offshore) are present within the Project area, but density estimates are only available in the MGEL density dataset for the common bottlenose dolphin species in its entirety. The density of the bottlenose species from MGEL (2022) was used to represent the bottlenose dolphin.

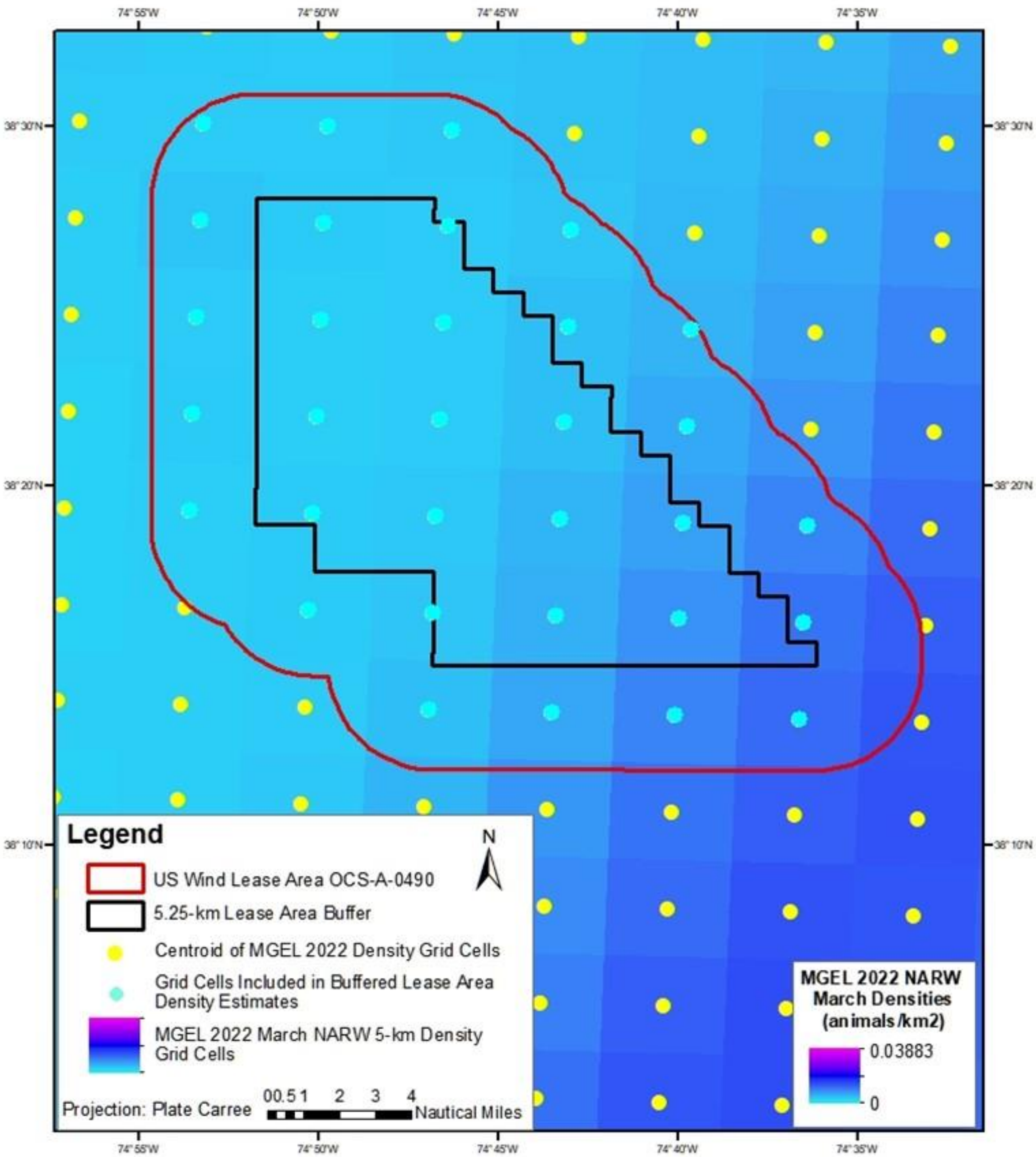

Figure 6-1. Lease Area with a 5.25-kilometer buffer and the March density surface and associated grid cells (MGEL 2022) for the North Atlantic right whale showing the grid cells within the buffered lease area averaged and used for the density estimation of this species; only the grid cells (shown as turquoise dots) that are located within the buffered lease area boundary were included in the density estimation.

Table 6-1. Mean Monthly (or in Some Cases, Annual) Densities of Potentially Affected Marine Mammals in the Buffered (5.25 km) Lease Area that were Used in the Marine Mammal Take Estimation of Noise Impacts Associated with Impact Pile Driving and micro-siting HRG Survey Sound Sources.

Marine Mammal Species	***Model Group[a]***	***Mean Monthly Densities (animals/km^2)[b]***											
		Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Atlantic spotted dolphin	*Stenella*	0.00003	0.00001	0.00002	0.00013	0.00046	0.00090	0.00396	0.01505	0.00475	0.00335	0.00243	0.00032
Blainville's beaked whale	Small BW	0.00001											
Common Bottlenose dolphin[c]		0.03855	0.01316	0.01659	0.05668	0.15225	0.1592	0.18323	0.20608	0.1647	0.14689	0.1713	0.11705
Common dolphin		0.04298	0.01869	0.01972	0.03268	0.03289	0.01471	0.01301	0.00501	0.00044	0.00765	0.05746	0.07939
Common minke whale		0.00069	0.00089	0.00114	0.00687	0.00750	0.00155	0.00050	0.00020	0.00010	0.00055	0.00025	0.00064
Cuvier's beaked whale	Small BW	0.00000											
Dwarf sperm whale	*Kogia* spp.	0.00000											
Fin whale		0.00214	0.00184	0.00154	0.00135	0.00094	0.00111	0.00041	0.00028	0.00040	0.00037	0.00045	0.00151
Gervais' beaked whale	Small BW	0.00001											
Gray seal[4]	Seals	0.05234	0.03722	0.02331	0.03659	0.03032	0.00335	0.00126	0.00073	0.00125	0.00665	0.00992	0.04848
Harbor porpoise		0.03653	0.03336	0.02586	0.03191	0.00615	0.00002	0.00001	0.00001	0.00000	0.00000	0.00002	0.02025
Harbor seal[d]	Seals	0.11759	0.08362	0.05238	0.08220	0.06811	0.00752	0.00282	0.00163	0.00280	0.01493	0.02230	0.10893
Humpback whale		0.00091	0.00062	0.00083	0.00187	0.00142	0.00102	0.00020	0.00011	0.00027	0.00112	0.00143	0.00088
Killer whale		0.00002											
Long-finned pilot whale[d]	Pilot Whales	0.00022											
North Atlantic right whale		0.00075	0.00076	0.00063	0.00045	0.00008	0.00003	0.00001	0.00001	0.00002	0.00004	0.00011	0.00036
Pantropical spotted dolphin	*Stenella*	0.00004											
Pygmy sperm whale	*Kogia* spp.	0.00000											
Risso's dolphin		0.00045	0.00006	0.00006	0.00056	0.00051	0.00018	0.00017	0.00018	0.00010	0.00023	0.00092	0.00169

Table 6-1. Mean Monthly (or in Some Cases, Annual) Densities of Potentially Affected Marine Mammals in the Buffered (5.25 km) Lease Area that were Used in the Marine Mammal Take Estimation of Noise Impacts Associated with Impact Pile Driving and micro-siting HRG Survey Sound Sources.

Marine Mammal Species	***Model Group[a]***	***Mean Monthly Densities (animals/km²)[b]***											
		Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Rough-toothed dolphin		0.00002											
Sei whale		0.00029	0.00021	0.00034	0.00061	0.00020	0.00005	0.00001	0.00000	0.00001	0.00006	0.00017	0.00046
Short-finned pilot whale[d]	Pilot Whales	0.00017											
Sperm whale		0.00004	0.00001	0.00001	0.00004	0.00006	0.00002	0.00002	0.00000	0.00000	0.00000	0.00001	0.00003
Striped dolphin	*Stenella*	0.00004											
True's beaked whale	Small BW	0.00001											

Source: Marine Geospatial Ecology Laboratory 2022

[a] Model group indicates those species that were modeled as a representative group rather than as individual species. BW= beaked whale

[b] Annual densities are shown for species with insufficient sightings to derive density estimates by month.

[c] Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented here.

[d] Densities are only available for the combined seal and pilot whale groups in the MGEL 2022 dataset; to derive species-specific densities for take calculations, the annual or monthly group densities were scaled by the relevant species' abundances

6.2 Marine Mammal Acoustics Thresholds

NOAA Fisheries (2018) has provided guidance for assessing the physiological impacts (Level A) of anthropogenic sound on marine mammals under their regulatory jurisdiction, which includes whales, dolphins, seals, and sea lions. The guidance specifically defines hearing groups, develops auditory weighting functions, and identifies the received levels or acoustic threshold levels above which individual marine mammals are predicted to experience changes in their hearing sensitivity (permanent threshold shift [PTS] or temporary threshold shift [TTS]) for acute, incidental exposure to underwater sound. The marine mammal hearing groups are:

- Low-frequency (LF) Cetaceans—this group consists of the mysticetes (baleen whales) with a collective generalized hearing range of 7 Hz to 35 kilohertz (kHz).
- Mid-frequency (MF) Cetaceans—includes most of the dolphins, all toothed whales except for *Kogia* spp., and all the beaked and bottlenose whales with a generalized hearing range of approximately 150 Hz to 160 kHz
- High-frequency (HF) Cetaceans—incorporates all the true porpoises, the river dolphins, plus *Kogia* spp., *Cephalorhynchus* spp. (genus in the dolphin family Delphinidae), and two species of *Lagenorhynchus* (Peale's and hourglass dolphins) with a generalized hearing range estimated from 275 Hz to 160 kHz
- Phocids Underwater (PW)—consists of true seals with a generalized underwater hearing range from 50 Hz to 86 kHz.
- Otariids Underwater (OW)—includes sea lions and fur seals with a generalized underwater hearing range from 60 Hz to 39 kHz and includes otariids, as well as walrus [Family Odobenidae], polar bear [*Ursus maritimus*], and sea and marine otters [Family Mustelidae]). It should be noted that no otariids, otters, polar bears, nor walruses occur in the Project area.

Within their generalized hearing ranges, the ability of a marine mammal to hear sounds varies with frequency, as demonstrated by examining audiograms of hearing sensitivity (NOAA Fisheries 2018). To reflect higher noise sensitivities at particular frequencies, auditory weighting functions were developed for each functional hearing group that reflected the best available data on hearing ability (composite audiograms), susceptibility to noise-induced hearing loss, impacts of noise on hearing, and data on equal latency (NOAA Fisheries 2018). These weighting functions are applied to individual sound received levels to reflect the susceptibility of each hearing group to noise-induced threshold shifts, which is not the same as the range of best hearing.

NOAA Fisheries (2018) defined acoustic threshold levels for marine mammals at which PTS is predicted to occur for each marine mammal hearing group for impulsive and non-impulsive signals. Non-impulsive signals do not have the high peak pressure with rapid rise time and decay characteristic of impulsive sounds; instead, the pressure (i.e., intensity) of non-impulsive signals is consistent throughout the signal. The acoustic threshold levels for non-impulsive sounds are defined as the cumulative sound exposure level over a 24-hr period ($L_{E,24h}$) with the appropriate frequency weighting for each hearing group, which is reflected in the subscript of each threshold (e.g., the LF cetacean threshold is identified as $L_{E,LF,24h}$) (Table 6-2). The cumulative sound exposure level (SEL) metric considers both received level and duration of exposure over the duration of the activity within a 24-hr period. Impulsive sounds are assessed against the SEL and peak thresholds, whereas non-impulsive sounds are assessed only against an SEL threshold. The TTS threshold is defined as 20 dB less than the PTS threshold for non-impulsive sources while the difference is 15 dB lower for impulsive sources (Table 6-2).

Table 6-2. Acoustic Threshold Levels for Marine Mammal Injurious Harassment (MMPA Level A) and Behavioral Harassment (70 FR 1871, (NOAA Fisheries 2018)).

Hearing Group	***Impulsive Sounds****		
	PTS Onset		***Behavior (dB re 1 µPa^2)***
	SEL (dB re 1 µPa^2-s)	***Peak (dB re 1 µPa^2)***	
Low-frequency cetaceans (LFC)	183 dB ($L_{E,LF,24h}$)	219 dB ($L_{pk,0\text{-}pk,flat}$)	160 dB (L_p)
Mid-frequency cetaceans (MFC)	185 dB ($L_{E,MF,24h}$)	230 dB ($L_{pk,0\text{-}pk,flat}$)	
High-frequency cetaceans (HFC)	155 dB ($L_{E,HF,24h}$)	202 dB ($L_{pk,0\text{-}pk,flat}$)	
Phocid pinnipeds underwater (PW)	185 dB ($L_{E,PW,24h}$)	218 dB ($L_{pk,0\text{-}pk,flat}$)	

*Dual metric thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds are recommended for consideration.

Behavior, along with TTS, is part of MMPA Level B harassment. NOAA Fisheries (70 FR 1871) defined 120 dB re 1 µPa^2 (L_P) at a reference pressure of 1 microPascal squared (re 1 µPa^2) as the behavioral threshold for continuous sources, such as noise generated by vibratory pile driving, and 160 dB re 1 µPa^2 as the behavioral threshold for intermittent sources, such as noise generated by impact pile driving (Table 6-2).

6.3 Weighting Used for Marine Mammal Acoustic Impact Analysis

To reflect higher noise sensitivities at particular frequencies, auditory weighting functions were developed for each of the functional marine mammal hearing groups to reflect the best available data on hearing ability (composite audiograms), susceptibility to noise-induced hearing loss, impacts of noise on hearing, and data on equal latency DON 2017a) (Figure 6-2). These weighting functions are applied to individual sound received levels to reflect the susceptibility of each hearing group to noise-induced threshold shifts, which is not the same as the range of best hearing. The cumulative SEL metric is assessed with the appropriate frequency weighting for marine mammals (by hearing group) for a 24-hour period ($L_{E,24h}$) (Figure 6-2).

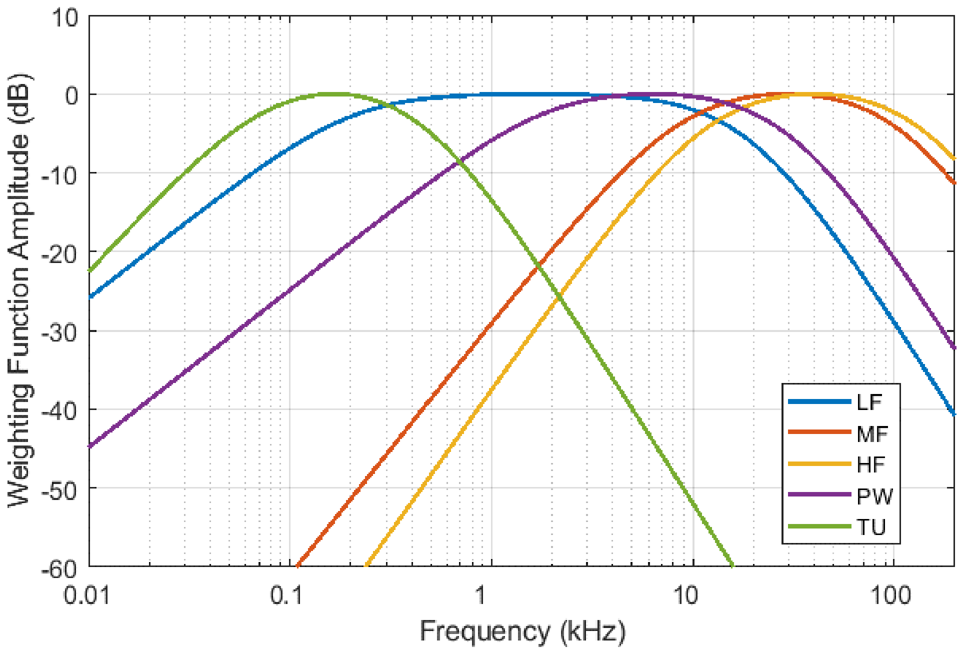

Figure 6-2. Auditory weighting functions for cetaceans (LF, MF, and HF species) and pinnipeds in water (PW) from NOAA Fisheries (2018d).

6.4 Acoustic Modeling to Determine Acoustic Exposure of Marine Mammals Associated with Pile Driving Construction Activities

A detailed description of the acoustic and animat modeling to determine acoustic exposures associated with pile driving activities is located in Appendix A, Underwater Acoustic Assessment of Pile Driving during Construction at the Maryland Offshore Wind Project. Included in the following sections, however, is descriptive information relevant to the acoustic modeling conducted on three impact pile driving sources to determine the acoustic exposures of marine mammals in the Project Area.

A single representative location (38.3°N, 74.7°W) was selected for the underwater acoustic modeling analysis (see Appendix A). The model site has a water depth of 27 m (86.5 ft), which is an intermediate water depth in the Project area, where water depths range from 13 to 42 m (42.7 to 137.8 ft). A sensitivity study conducted to assess the differences in acoustic propagation at the selected intermediate-depth model location (27 m), the deepest location (42 m), and shallowest location (13 m) within the Project area showed that the acoustic propagation was not significantly different between the sites but higher received levels were predicted for the intermediate site. Thus, the model site at the intermediate water depth of 27 m was selected as the most conservative of the possible sites.

Parameters of the physical environment at this model location, including the water column (e.g., bathymetry, surface roughness, and seasonal sound velocity profiles), atmosphere (wind speed), and seafloor (e.g., sediment type and sizes) properties were input into an acoustic propagation model. The predicted noise generated during three impact pile driving scenarios was assessed for an 11-m monopile, 3-m skirt pile (post-piled), and 1.8-m pin pile sources. A first step in the acoustic modeling of these sound sources is compiling the source spectra and the associated hammer energies for each model scenario, which are used to derive broadband source levels for each source. However, no source spectra were available for the combination of pile diameter and hammer strike energy planned for use in the Project. Surrogate spectra had to be developed for use in acoustic modeling from available literature and information (see Appendix A). These surrogate spectral values for each pile driving scenario were then scaled by the US Wind pile diameters and hammer energies to predict the associated broadband source levels for each pile driving scenario. Acoustic modeling of the predicted sound fields for each hammer sound source was then used to determine the ranges to regulatory isopleths (i.e., acoustic ranges) for marine mammals, sea turtles, and marine fishes.

For the acoustic propagation modeling, the impact piles were represented as a vertical line array. The pile beampattern was created from a vertical line array of elements with one meter spacing from the surface to the seafloor. This representative array was used to create a frequency-specific beampattern that was propagated using the range-dependent acoustic-parabolic equation model (Appendix A). This propagation process was followed for each third octave center frequency in the bands from 10 Hz to 25 kHz, with radials run at 10° intervals to a range of 50 km. Source levels for each pile driving source were derived (section 6.4.2.1). The third-octave band source levels were added to each transmission loss value to produce a received level value at each range, depth, and bearing point. Finally, the combined sound fields for each frequency were summed to generate a representative broadband sound field. This process was followed for each radial around each pile driving source to produce an N x 2-D grid of received sound levels in range, depth and bearing. The resulting predicted acoustic SEL field was weighted using the appropriate marine mammal or sea turtle weighting functions (NOAA Fisheries 2018).

Animat modeling, using the Acoustic Integration Model© (AIM), was conducted based on the sound fields for each pile driving source as well as marine mammal movement inputs (e.g., swim speeds, dive depths, dive durations, depth limitations) to simulate the four-dimensional movements of marine mammals through the model's temporal and spatial environment. Animats, or simulated animals, were programmed in AIM with relevant behavioral values extracted from scientific literature for each potentially occurring marine mammal species. Animats were randomly distributed over the model simulation area and were set to populate the simulation area with densities often higher than those estimated for the "real world" marine environment. This "over population" of the modeling environment ensures that the result of the simulation is not unduly influenced by the chance placement of a few simulated marine mammals and allows for greater statistical power without overestimating exposure. As the animats for each marine mammal species or modeled group move about the simulation area, they are exposed to the sound field generated by each of the pile driving sound sources and accumulate sound energy over a 24-hour period. To obtain acoustic exposure estimates, the animat sound exposure histories are normalized by the ratio of the modeled animat density to the real-world marine mammal density estimate for the buffered Lease area (MGEL 2022). The acoustic exposure history for each animat was analyzed to produce the metrics of maximum root-mean square sound pressure level, cumulative sound exposure level, and peak sound pressure level (i.e., behavior and PTS exposure estimates). Summing the number of exposures above the relevant threshold provides an estimate of the number of acoustic exposures. These daily exposures were multiplied by the planned number of piles driven each month and then year.

To derive the comprehensive take estimates, these annual modeled acoustic estimates for pile driving are combined with the annual micro-siting HRG survey takes. Those combined acoustic exposure estimates are scaled by the group size associated with each potentially occurring marine mammal species. Mitigation for the North Atlantic right whale is applied, which results in the final requested acoustic exposures or takes for the entire construction and survey period.

6.4.1 Installation of Project Foundations: Modeling Scenarios

Three foundation types were modeled for the installation of WTGs, OSS, and the Met Tower (Table 6-3) to represent the scope of pile driving construction activities planned for the Project. The most likely duration of pile driving for each pile type was used based on the known soil conditions, which may differ from the maximum duration described. The maximum duration is considered unlikely for all piles and therefore was not used in the modeling scenarios. Impact pile driving is planned for installation of the 11-m diameter WTG monopiles to be impact driven at a maximum strike energy of up to 4,400 kJ for a 2-hour duration, while the 3.0-m skirt piles would be impact driven as part of a jacket foundation for the OSSs at a maximum strike energy of 1,500 kJ and a duration of 2 hours per pile, and finally, 1.8-m diameter pin piles would be impact driven as part of the installation of the Met Tower at a maximum strike energy of 500 kJ for a duration of 2 hours per pile.

Table 6-3. Impact Pile Driving Scenarios Used for Acoustic Modeling for the US Wind Project.

Modeling Scenario	Description
Monopile	11-m Monopile Foundation Impact Pile Driving – 4,400 kJ* Hammer Modeled Energy – Two-hour duration
Skirt Pile (Post-piled)	3-m Skirt Pile Jacket Foundation Pin Pile Impact Pile Driving – 1,500 kJ Hammer Modeled Energy – Two-hour duration per pile
Pin Pile	1.8-m Pin Pile Met Tower Foundation Pin Pile Impact Pile Driving – 500 kJ Hammer Modeled Energy – Two-hour duration per pile

* This level was scaled to 1,100; 2,200; and 3,300 kJ in modelling.

The maximum hammer strike energy for each modeling scenario and pile type was used in the acoustic modeling; if adjustments were necessary based on the pile progression schedule proposed by US Wind (i.e., for the monopile installation), the received sound levels were adjusted to represent the lower strike energies expected. Specifically, for the monopile installation, 4,400 kJ was used in the modeling, with scaling adjustments made to account for the planned hammer energies of 1,100, 2,200, and 3,300 kJ that US Wind estimates for use during the installation of the monopiles (Table 6-4); this allows for maximum operational flexibility should a higher hammer energy be necessary than predicted.

The acoustic modeling for the monopile was performed at a hammer energy of 4,400 kJ, and the modeled sound fields were then adjusted by a broadband sound reduction to represent the lower strike energy levels planned for the monopile installation. To account for the differences in hammer energies between what US Wind expects to use in the installation of the 11-m monopiles (i.e., 1,100; 2,200; and 3,300 kJ) and the modeled maximum hammer energy of 4,400 kJ, the modeled spectra for the 4,400-kJ hammer was scaled using $10*\log10(E1/E2)$ (where E1 is the lower strike energy level and E2 is the modeled energy level) to represent each of the lower proposed hammer energies. This resulted in the application of scaling factors of 6, 3, and 1 dB to represent the 1,100; 2,200; and 3,300 kJ hammer energies, respectively (Table 6-4). This ramp up of hammer energy is accounted for when calculating the cumulative SEL over the installation of each monopile using the number of strikes at each energy level. The broadband dB scaling factor (Table 6-4) was subtracted from the modeled received levels for the indicated number of strikes before the cumulative SEL was calculated. The hammer strike energy progression for this scenario was considered in the calculation of the acoustic ranges and acoustic exposures, with the assumption that a single 11-m monopile was installed each day.

Table 6-4. US Wind's Planned Impact Hammer Strike Energy Progression and Installation Duration for the Impact Pile Driving Modeling Scenarios.

Pile Type/ Number Installed per Day	Hammer Energy (kJ)	Duration at Energy Level (minutes)	Blows per Minute	Number of Blows	Scaling Factor (dB)	Total Duration for Pile Install per Day (minutes)	Total Number of Blows for Pile(s) Installed per Day
11-m Monopile—1 pile per day	1100*	30	20	600	-6	120	4800
	2200*	60	40	2400	-3		
	3300*	30	60	1800	-1		
3-m Skirt Pile —4 piles per day	1500	480	40	19200	0	480	19200
1.8-m Pin Pile—3 piles per day	500	360	8.3+	2988	0	360	2988

*These hammer energies (1100 to 3300 kJ) are the hammer energies expected during the installation of the monopile but the maximum energy of 4400 kJ was used and then scaled in the monopile modeling.
+Although the fractional number of 8.3 hammer per minute is unlikely to be accomplished during installation, this number instead of the rounded, more realistic value of 8 blows per minute is included as it results in a higher number of total hammer blows than if the rounded blows per minute value were used.

The hammer energy for the 3-m skirt pile scenario was assumed to be 1,500 kJ for the duration of installation. Each 3-m pile is estimated to take 120 minutes and 4,800 hammer strikes at a rate of 40 strikes per minute, which results in 480 minutes and 19,200 hammer strikes to install the four piles for each jacket foundation. The acoustic ranges and acoustic exposure estimates were calculated assuming four 3-m skirt piles were installed each day. For the 1.8-m pin pile scenario, the hammer energy is 500 kJ for the duration of the installation, with an estimated time of 120 minutes to install each pile for a duration of 360 minutes and a total of 2,988 hammer blows for the 1.8-m pin pile installation of the Met Tower (Table 6-4). The acoustic ranges and exposures were calculated assuming three 1.8-m pin piles were installed in a day.

The installation of the WTGs, OSSs, and Met Tower will span a three-year period (Table 6-5). In year 1, US Wind estimates that a total of 21 11-m monopiles and 1 OSS jacket (four 3-m skirt piles) will be installed. In year 2, a total of 55 11-m monopiles, 2 OSS jackets (eight 3-m skirt piles), and 1 Met Tower (three 1.8-m pin piles) are estimated to be installed. In year 3, a total of 38 11-m monopiles and 1 OSS jacket (four 3-m skirt piles) are planned to be installed. Installation is anticipated to span the June to September timeframe in year 1, from May to August in year 2, and from June to August in year 3.

Table 6-5. Proposed Annual Piling Installation Schedule for the Three-year Construction Period.*

Annual Construction Period	Scenario 1: Monopile (11 m pile)	Scenario 2: OSS Foundation (4 3-m piles)	Scenario 3: Met Tower (3 1.8-m piles)
Year 1 (22 Total)			
May			
June	8		
July		1	
August			
September	13		
Year 2 (58 Total)			
May	16		
June	16		1
July	16	2	
August	7		
September			
Year 3 (39 Total)			
May			
June	15		
July	10	1	
August	13		

* This schedule is based on the availability of the foundation installation vessels.

6.4.2 Acoustic Ranges to Threshold Derivation for Pile Driving Activities

The source levels for the SEL and SPL (peak and RMS) for the mitigated (10 dB sound reduction level) driving of a 11-m monopile, a 3-m skirt pile, and a 1.8-m pin pile are needed in the acoustic modeling of these sources, particularly to compute the acoustic ranges to the regulatory thresholds for marine mammals. Source levels of the pile driving noise generated when piling the 11-m, 3-m, and 1.8-m piles planned for installation in the US Wind Project are not available in existing literature. Source level derivation for these types of acoustic sources is based on the acoustic spectra of each of the pile types.

6.4.2.1 11-m Monopile Predicted Source Spectrum and Source Level Derivation

The predicted acoustic spectrum for the 11-m diameter monopile uses the source signature developed for the South Fork Wind Farm (Denes, Zeddies, and Weirathmueller 2018) as a surrogate in the modeling of the 11-m monopile in the Project area (Figure 6-3). This surrogate spectrum was predicted for the impact pile driving of an 11-m monopile using an IHC S-4000 hammer at a strike energy of 4,000 kJ. This spectrum was used to represent the impact pile driving of the 11-m monopile in the Project area with a strike energy of 4,400 kJ. The expected difference in sound level between 4,000 and 4,400 kJ was determined to be minimal at 0.4 dB, which resulted in the Denes et al. (2018) spectrum being used as is (see Appendix A for additional details). The expected difference of 0.4 dB was estimated using the scaling relationship presented in von Pein et al. (2022), which states that, during impact pile driving, the measured sound exposure level of an impact hammer strike increases with increasing hammer strike energy according to $SEL_2 = SEL_1 + 10 \times \log_{10}(E_2/E_1)$.

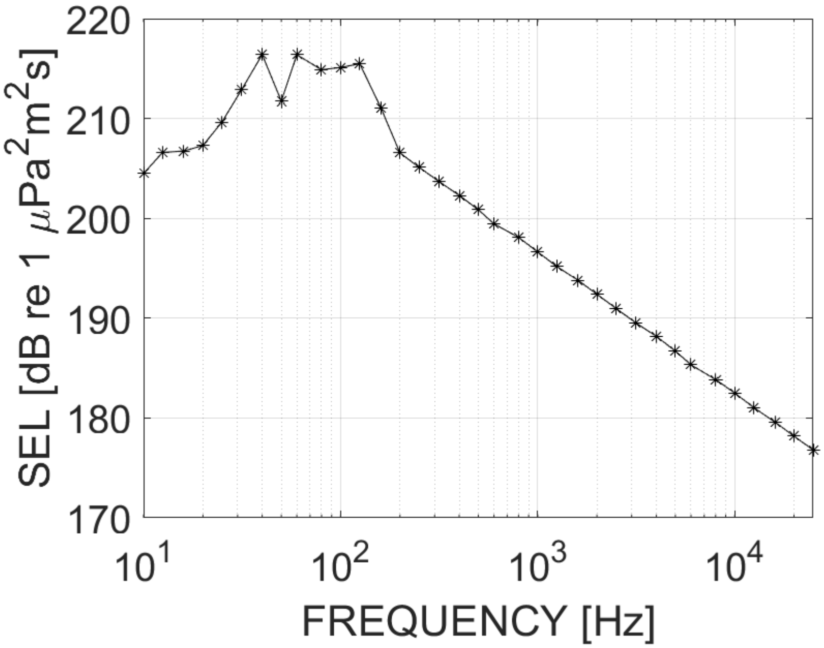

Figure 6-3. Acoustic Source Spectrum in Third Octave Bands Used to Model the Impact Piling of the 11-m Diameter Monopile for the US Wind Project Based on the 4000 kJ Hammer Spectra in Denes *et al.* 2018.

The spectral levels that were shown in Denes et al. (2018) did not include levels for frequencies above 16 kHz. The levels were linear in log-frequency for 200 Hz and greater, so a least-squares linear fit on the levels from 200 Hz to 16 kHz was used to extrapolate to the centers of the 20 kHz and 25 kHz frequency bands, resulting in the proposed source spectrum for the 11-m monopile (Figure 6-3).

This acoustic source spectrum for the hammering of the 11-m monopile was used to calculate the broadband source level. The source level was calculated by converting each frequency band level to intensity and converting their sum to a decibel value. The resulting broadband SEL source level at 4,400 kJ is 224 dB re 1µPa2-m2-s (Table 6-6). The broadband SEL source levels at hammer energies of 1100 kJ, 2200 kJ, and 3300 kJ are 218 dB re 1µPa2-m2-s, 221 dB re 1µPa2-m2-s, and 223 dB re 1µPa2-m2-s, respectively. The broadband SPL peak and SPLrms source levels at 4,400 kJ are 272 and 234 dB re 1 µPam, respectively (Table 6-6). For mitigated source levels, 10 dB is subtracted from the SEL, SPL_{peak}, or SPL_{rms} source levels.

Table 6-6. Unmitigated Source Levels (SL) Derived for the US Wind Impact Pile Driving Modeling Scenarios for Single Strikes at the Modeled Hammer Energies (i.e., Monopile hammer energy of 4400 kJ).

Model Scenario	SEL (dB re 1 μPa^2-m^2-s)	Peak SPL (dB re 1 μPam)	SPL$_{rms}$ (dB re 1 μPam)
11-m monopile	224	272	234
3-m skirt pile	208	259	218
1.8-m pin pile	199	247	209

6.4.2.2 3-m Skirt Pile Predicted Source Spectrum and Source Level Derivation

The source spectrum for the 3-m skirt pile used in the acoustic modeling was based on the measured spectra of a 6-m pile reported by (Bruns et al. 2014) and a 3.5-m FINO2 pile reported by (Matuschek and Betke 2009). Further details on the derivation of the source spectrum based on these publications may be found in Appendix A, Section 4.4.2. The 6-m pile reported by Bruns *et al.* (2014) was recorded at a distance of 15 m, and a hybrid spherical/cylindrical spreading model (i.e., 15 x $\log_{10}$ (range)) was used to adjust the received level to estimate the source level. The source levels were reduced by 5 dB (16.7 x $\log_{10}$(3m/6m)) to scale for the differences in pile diameters (von Pein *et al.* (2022)). The piling of a 3.5-m FINO2 pile was recorded at a distance of 500 m, and the same hybrid propagation loss model was used to adjust the received levels to source levels. For consistency, the FINO2 levels were also reduced by 1 dB to scale for diameter (16.7 x $\log_{10}$(3m/3.5m) = 1 dB). The mean of the two pile spectra from these sources was computed at frequencies at which source levels were provided in the Bruns et al. (2014) and Matuschek and Betke (2009) papers. The mean source levels were linear in log-frequency for frequencies 2500 Hz and greater. A linear fit on the mean source levels at 2500 Hz and greater was used to extrapolate to frequency band centers up to 25 kHz. This resulting mean spectrum was taken as the representative spectrum of the 3-m skirt pile for the Project (Figure 6-4). The broadband SEL source level derived using this spectrum is 208 dB re 1μPa^2-m^2-s, while the Peak SPL and SPLrms source levels are 259 and 218 dB re 1 μPam, respectively (Table 6-6).

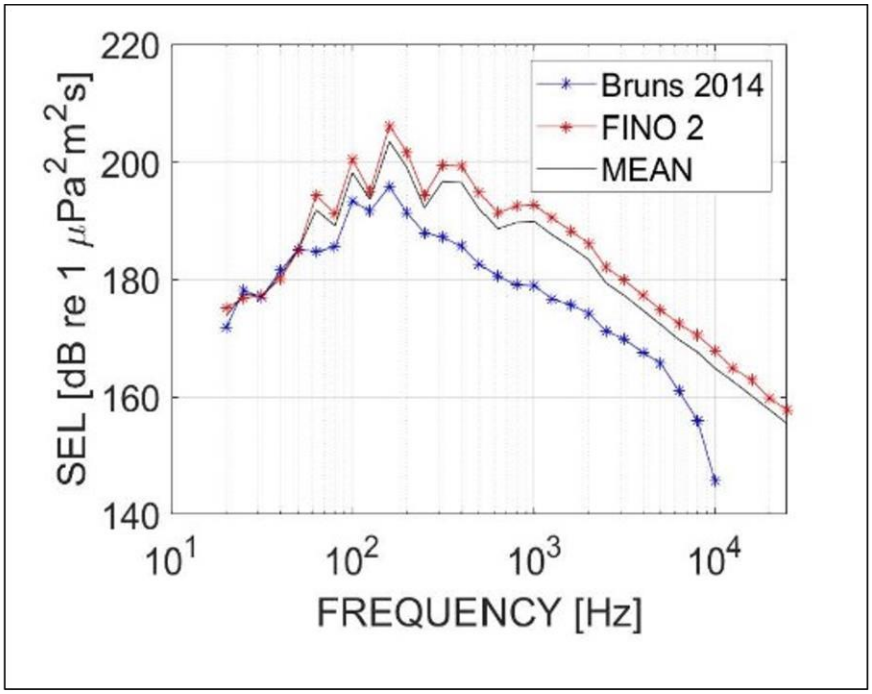

Figure 6-4. Measured and scaled spectra from Bruns et al. 2014 (measured at distance of 15 m) and Matuschek and Betke 2009 (measured at 500 m), along with the extrapolated mean source spectrum that was used as the representative spectrum for the 3-m skirt pile for the US Wind Maryland Offshore Wind Project. Both measured spectra have been scaled as described in the text.

6.4.2.3 1.8-m Pin Pile Predicted Source Spectrum and Source Level Derivation

The source spectrum for the 1.8-m skirt pile used in the acoustic modeling was based on the spectrum derived for the 3-m post piled skirt pile, which was then scaled to represent the 1.8-m pin pile planned for use in the installation of the Met Tower foundation. The 3-m pile spectrum was scaled based on maximum hammer energy and pile diameter using the relationships presented in von Pein et al. (2022). This resulted in the source levels being scaled down by 8.5 dB (10*log10(500 kJ/1500 kJ) + 16.7*log10(1.8m/3m) = 8.5 dB) (Figure 6-5). This resulting mean spectrum was taken as the representative spectrum of the 1.8-m pin pile for the Project (Figure 6-5). The resulting broadband SEL source level derived using this scaling method to derive the 1.8-m representative spectrum is 199 dB re 1μPa^2-m^2-s, while the Peak SPL and SPLrms source levels are 247 and 209 dB re 1 μPam, respectively (Table 6-6).

6.4.2.4 Range to Regulatory Threshold Calculations

The pile progression schedule (Table 6-4) was accounted for when calculating the acoustic ranges to SEL thresholds (see Appendix A). The modeled sound fields represented the single strike SELs at the modeled strike energies (Table 6-6). The single strike SEL fields were converted to cumulative SEL fields based on the different strike energy levels and the number of expected hammer blows at each energy. The difference between a single strike SEL and the cumulative SEL was calculated using 10 * log10(Number of strikes). For the 11-m monopile, ranges were calculated assuming one monopile is installed a day and 4,800 hammer blows per day (Table 6-4). For the 3-m skirt pile scenario, the acoustic ranges were calculated assuming four 3-m skirt piles were installed each day with 19,200 hammer blows per day. For the 1.8-m pile scenario, the acoustic ranges were calculated assuming three pin piles were impact driven in one day with an associated 2,998 hammer blows in that day (Table 6-4).

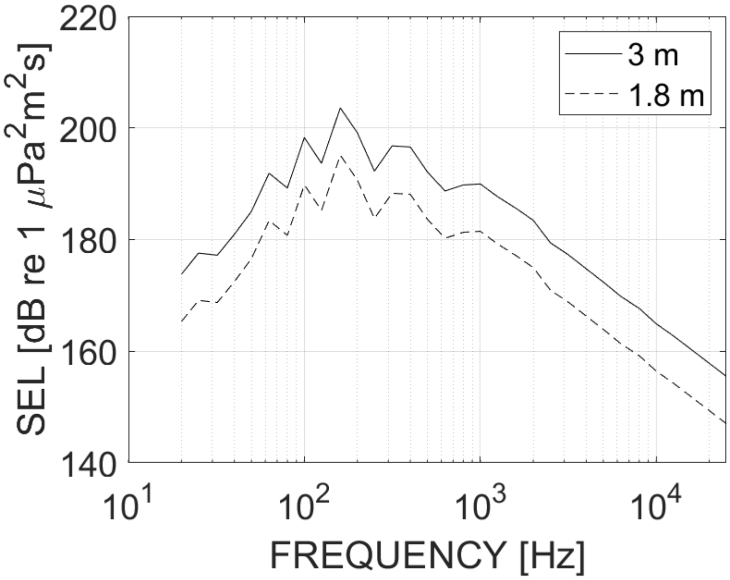

Figure 6-5. Derived Source Spectra Proposed for Acoustic Modeling of the 3-m Diameter and 1.8-m Diameter Piles for the US Wind Project; the 1.8-m Spectra are Based on Scaling of the 3-m Skirt Pile.

The maximum received level-over-depth was calculated at each range step and along each radial. The maximum and 95th percentile acoustic range to the marine mammal regulatory thresholds were then calculated for each of the modeling scenarios (Tables 6-7, 6-8, and 6-9). The maximum acoustic range value represents the greatest distance along any one single radial and is in general higher than the 95th percentile because of different bathymetry and transmission paths along each radial. The 95th percentile acoustic range is an improved representation of the range to the threshold as it eliminates major outliers and better represents all the modeled radials. All acoustic ranges presented to regulatory threshold are the 95th percentile range. Since these acoustic range values are taken from static sound fields, the SEL ranges reflect the ranges to stationary virtual receivers.

The mitigated acoustic range to the PTS injury thresholds for marine mammals for the piling of a monopile was greatest for the LF cetaceans, with a range of 2,900 m (95th percentile) as the range to the SEL threshold (Table 6-7). The range to injury thresholds for LF cetaceans does not vary from species to species because they are calculated from the sound fields directly and animat-based range determination was not employed. The range to the behavior thresholds for the mitigated (10 dB sound reduction) pile driving of an 11-m monopile for marine was 5,250 m for all marine mammal species (Table 6-7). This behavioral range was the largest range to threshold for any of the impact pile driving sources.

Table 6-7. Acoustic Ranges (95th Percentile) to PTS (SELcum and peak) and Behavioral Regulatory Threshold Levels for Marine Mammals Associated with the Installation of a Single 11-meter Monopile Per Day (2 Hours Pile Driving Per Day) Assuming a 10 dB Sound Reduction Level.[1]

Marine Mammal Hearing Group*	PTS Thresholds	PTS Range (m)	Behavior Threshold	Behavior Range (m)
LFC	SEL (183 dB ($L_{E,LF,24h}$))	2900	160 dB	5250
	Peak (219 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
MFC	SEL (185 dB ($L_{E,MF,24h}$))	0		
	Peak (230 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
HFC	SEL (155 dB ($L_{E,HF,24h}$))	250		
	Peak (202 dB ($L_{pk,0\text{-}pk,flat}$))	200		
PW	SEL (185 dB ($L_{E,PW,24h}$))	100		
	Peak (218 dB ($L_{pk,0\text{-}pk,flat}$))	<50		

*LFC=low frequency cetacean; MFC=mid-frequency cetacean; HFC=high frequency cetacean; PW=phocid pinniped underwater
[1] NOAA Fisheries 2018d.

Table 6-8. Acoustic Ranges (95th Percentile) to PTS (SELcum and Peak) and Behavioral Regulatory Threshold Levels for Marine Mammals Associated with Installation of Four 3-meter Skirt Piles Per Day (8 Hours of Pile Driving Per Day) Assuming a 10 dB Sound Reduction Level.

Marine Mammal Hearing Group*	PTS Thresholds	PTS Range (m)	Behavior Threshold	Behavior Range (m)
LFC	SEL (183 dB ($L_{E,LF,24h}$))	1400	160 dB	500
	Peak (219 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
MFC	SEL (185 dB ($L_{E,MF,24h}$))	0		
	Peak (230 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
HFC	SEL (155 dB ($L_{E,HF,24h}$))	100		
	Peak (202 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
PW	SEL (185 dB ($L_{E,PW,24h}$))	50		
	Peak (218 dB ($L_{pk,0\text{-}pk,flat}$))	<50		

*LFC=low frequency cetacean; MFC=mid-frequency cetacean; HFC=high frequency cetacean; PW=phocid pinniped underwater
[1] NOAA Fisheries 2018d..

Table 6-9. Acoustic Ranges (95th Percentile) to PTS (SELcum and Peak) and Behavioral Regulatory Threshold Levels for Marine Mammals Associated with Installation of Three 1.8-m Pin Piles Per Day (6 Hours Per Day) Assuming a 10 dB Sound Reduction Level.

Marine Mammal Hearing Group*	PTS Thresholds	PTS Range (m)	Behavior Threshold	Behavior Range (m)
LFC	SEL (183 dB ($L_{E,LF,24h}$))	50	160 dB	100
	Peak (219 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
MFC	SEL (185 dB ($L_{E,MF,24h}$))	0		
	Peak (230 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
HFC	SEL (155 dB ($L_{E,HF,24h}$))	0		
	Peak (202 dB ($L_{pk,0\text{-}pk,flat}$))	<50		
PW	SEL (185 dB ($L_{E,PW,24h}$))	0		
	Peak (218 dB ($L_{pk,0\text{-}pk,flat}$))	<50		

*LFC=low frequency cetacean; MFC=mid-frequency cetacean; HFC=high frequency cetacean; PW=phocid pinniped underwater

The range to the PTS injury thresholds for marine mammals assuming four 3-m skirt piles are installed in a day with 10 dB sound reduction mitigation was greatest for LF cetaceans, with a range to the SEL threshold of 1,400 m (95th percentile) (Table 6-8). Since the ranges to SEL thresholds assume that marine mammals remain in the area for the total duration of the driving of four piles, the ranges can be considered conservative estimates. The range to the behavior threshold for the mitigated (10 dB sound reduction) pile driving of four 3-m skirt piles in a day was 500 m.

The range to the PTS injury thresholds for marine mammals assuming three 1.8-m pin piles are installed in a day with 10 dB sound reduction mitigation was greatest for LF cetaceans, with a range to the SEL threshold of 50 m (95th percentile) (Table 6-9). Since the ranges to SEL thresholds assume that marine mammals remain in the area for the total duration of the driving of three piles, these ranges can be considered conservative estimates. The range to the behavior threshold for the mitigated (10 dB sound reduction) pile driving of three pin piles in a day was 100 m.

6.4.3 Basis for Take Estimation of Marine Mammals Associated with Impact Pile Driving Activities

Animat modeling of the potentially affected marine mammal species in the Project Area was conducted to determine their potential level of exposure to the underwater sounds generated during pile driving activities. The animat modeling integrated the predicted received level sound fields of the impact pile driving resulting from the acoustic modeling of the impact pile driving sources with the four-dimensional (4D) movements of marine mammals to estimate their potential acoustic exposure at which physiological effects, specifically, permanent threshold shift (PTS), and behavioral effects are experienced over time. The modeling was conducted using the Acoustic Integration Model© (AIM) (Frankel et al., 2002), which is a Monte Carlo based statistical model in which multiple iterations of realistic predictions of acoustic source use as well as animal distribution and movement patterns are conducted to provide statistical predictions of estimated effects from exposure to underwater sound.

In AIM, each acoustic source and sound receiver is modeled via the animat concept. Animats are computationally simulated marine animals, in this case marine mammals, with their movements defined by specified behavioral variables, including diving, swim speed, and course/direction changes. This results in a realistic representation of animal movements that mimic the real-world diving patterns and swimming abilities of marine mammals. Animat modeling was performed for all of the potentially affected marine mammal species present in the Project area (Table 6-1). Some of the marine mammal species were modeled as a group, such as the pantropical and Atlantic spotted dolphins and the beaked whales which were modeled using a representative animat (*Stenella* and Small Beaked Whales, respectively) (Table 6-1). Separate AIM simulations were created and run for each marine mammal species or species group, modeling scenario, and model site. During each of these modeling iterations or runs, animats were randomly distributed over the model simulation area, and the predicted sound received level was estimated every 30 seconds (sec) for each animat by species, which resulted in a sound exposure history over 24-hours of modeled construction activities. At each 30-second time step, every animat was moved according to the programmed rules describing each marine mammal species' behavior, and the received sound level for each animat is recorded (in the same units that were used to specify the source level, e.g., dB rms). Histograms of the water depths recorded for each animat during the 24-hour modeling runs were assessed to verify that the 30-second model time-step provides sufficient sampling over the range of water depths for the animats received levels. Further details regarding the time step metric used in AIM may be found in Appendix A. No behavioral aversions aside from water depth limitations were applied to the animats. Animat exposure histories for metrics of maximum sound pressure level, cumulative sound exposure level, and peak sound pressure level were generated.

Since AIM records the acoustic exposure history for each individual animat, the potential impact is determined on an individual animal basis. The modeled SEL and the peak SPL received by each individual animat over the duration of the model simulation (24 hours) were used to calculate the potential for that animat to have experienced PTS using the NOAA Fisheries (2018) criteria for marine mammals. If an animat was not predicted to experience PTS, then the sound levels received by each individual animat over the modeled period were used to assess the potential risk of biologically significant behavioral reactions. The modeled root-mean-square (rms) sound pressure levels were used to estimate the potential for marine mammal behavioral responses for animats that did not experience PTS based on the NOAA behavioral criteria (70 FR 1871).

These modeled results were subsampled to reflect the duty cycle of each construction activity's source to create multiple estimates of sound exposure for each source and marine mammal combination (e.g., if the monopile was estimated to take 2 hours to install, then 12 different two-hour exposure histories were extracted). These modeled acoustic exposure estimates were then normalized by the ratio of real-world density estimates (i.e., Table 6-1) to the modeled animat density for each modeled marine mammal species to obtain final acoustic exposure estimates. The density estimates extracted for the buffered Lease area were used to predict exposures assuming 10 dB of sound reduction due to the use of mitigation measures during impact pile driving. This results in the predicted number of acoustic exposures for each marine mammal species for each type of impact pile driving activity.

Maximum acoustic exposure estimates were calculated on an annual basis according to the annual installation schedule (Table 6-5) for the 11-m monopile, 3-m skirt pile, and 1.8-m pin pile driving scenarios for each year of the three years of planned impact pile driving activities with 10 dB sound level reduction applied (Tables 6-10, 6-11, and 6-12).

Table 6-10. Maximum Annual Injury (PTS; Cumulative and Peak Sound Exposure Levels [SEL]) and Behavior (Sound Pressure Level [SPL]) Acoustic Exposure Estimates of Potentially Affected Marine Mammals in the Buffered Lease Area Associated with the Sound Level Mitigated (10 dB Sound Reduction Level) Pile Driving of 11-m Monopiles During the Three Years of Construction Planned for the Project; Only Sound Level Attenuation (10 dB) Mitigation Applied.

Marine Mammal Hearing Group	Marine Mammal Species	PTS Cumulative Injury SEL Acoustic Exposures			PTS Peak Injury SEL Acoustic Exposures			Behavioral SPL Acoustic Exposures		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Low Frequency Cetaceans (LFC)	Fin whale	0.39	1.16	0.68	0.00	0.00	0.00	3.94	11.57	6.83
	Common Minke whale	0.49	5.55	1.11	0.00	0.00	0.00	2.96	33.31	6.66
	Humpback whale	0.42	1.55	0.67	0.00	0.00	0.00	2.52	9.29	4.05
	North Atlantic right whale	0.01	0.05	0.02	0.00	0.00	0.00	0.06	0.24	0.08
	Sei whale	0.01	0.12	0.02	0.00	0.00	0.00	0.11	0.83	0.17
Mid-frequency Cetaceans (MFC)	Atlantic spotted dolphin	0.00	0.00	0.00	0.00	0.00	0.00	14.07	38.86	50.75
	Blainville's beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Common bottlenose dolphin[1]	0.00	0.00	0.00	0.00	0.00	0.00	846.85	2320.67	1711.04
	Cuvier's beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gervais' beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Killer whale	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.22	0.15
	Long-finned pilot whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Pantropical spotted dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.45	0.31
	Risso's dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.79	4.33	1.94
	Rough toothed dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.11	0.08
Mid-frequency Cetaceans (MFC) (Cont'd)	Short-beaked common dolphin	0.00	0.00	0.00	0.00	0.00	0.00	28.63	233.12	96.48
	Short-finned pilot whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sperm Whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Striped dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.45	0.31
	True's beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High Frequency Cetaceans (HFC)	Harbor porpoise	0.00	0.00	0.00	0.00	1.19	0.01	0.03	15.83	0.08
	Dwarf sperm whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Pygmy sperm whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6-10. Maximum Annual Injury (PTS; Cumulative and Peak Sound Exposure Levels [SEL]) and Behavior (Sound Pressure Level [SPL]) Acoustic Exposure Estimates of Potentially Affected Marine Mammals in the Buffered Lease Area Associated with the Sound Level Mitigated (10 dB Sound Reduction Level) Pile Driving of 11-m Monopiles During the Three Years of Construction Planned for the Project; Only Sound Level Attenuation (10 dB) Mitigation Applied.

Marine Mammal Hearing Group	Marine Mammal Species	PTS Cumulative Injury SEL Acoustic Exposures			PTS Peak Injury SEL Acoustic Exposures			Behavioral SPL Acoustic Exposures		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Phocid Pinnipeds Underwater (PW)	Harbor seal	0.00	0.00	0.00	0.00	0.00	0.00	12.37	162.15	20.77
	Gray seal	0.00	0.00	0.00	0.00	0.00	0.00	5.50	72.17	9.25

[1]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

Table 6-11. Maximum Injury (PTS; Cumulative and Peak Sound Exposure Levels [SEL]) and Behavior (Sound Pressure Level [SPL]) Acoustic Exposure Estimates of Potentially Affected Marine Mammals in the Buffered Lease Area Associated with the Sound Level Mitigated (10 dB Sound Level Reduction) Pile Driving of 3-m Skirt Piles During the Three Years of Construction for the Project; Only Sound Level Attenuation (10 dB) Mitigation Applied.

Marine Mammal Hearing Group	Marine Mammal Species	Cumulative Injury SEL Acoustic Exposures			Peak Injury SEL Acoustic Exposures			Behavioral SPL Acoustic Exposures		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Low Frequency Cetaceans (LFC)	Fin whale	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.03
	Common minke whale	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.04
	Humpback whale	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	North Atlantic right whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sei whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MF Cetaceans (MFC)	Atlantic spotted dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.35	0.17
	Blainville's beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Common bottlenose dolphin[1]	0.00	0.00	0.00	0.00	0.00	0.00	9.53	19.06	9.53
	Cuvier's beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gervais' beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Killer whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Long-finned pilot whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Pantropical spotted dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Risso's dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01
	Rough toothed dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Short-beaked common dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.57	1.14	0.57
	Short-finned pilot whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sperm Whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Striped dolphin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	True's beaked whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC	Harbor porpoise	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High Frequency Cetaceans (HFC)	Dwarf sperm whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Pygmy sperm whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6-11. Maximum Injury (PTS; Cumulative and Peak Sound Exposure Levels [SEL]) and Behavior (Sound Pressure Level [SPL]) Acoustic Exposure Estimates of Potentially Affected Marine Mammals in the Buffered Lease Area Associated with the Sound Level Mitigated (10 dB Sound Level Reduction) Pile Driving of 3-m Skirt Piles During the Three Years of Construction for the Project; Only Sound Level Attenuation (10 dB) Mitigation Applied.

Marine Mammal Hearing Group	Marine Mammal Species	Cumulative Injury SEL Acoustic Exposures			Peak Injury SEL Acoustic Exposures			Behavioral SPL Acoustic Exposures		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Phocid Pinnipeds Underwater (PW)	Harbor seal	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.11	0.06
	Gray seal	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.03

[1]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

Table 6-12. Maximum Injury (PTS; Cumulative and Peak Sound Exposure Levels [SEL]) and Behavior (Sound Pressure Level [SPL]) Acoustic Exposure Estimates of Potentially Affected Marine Mammals in the Buffered Lease Area Associated with the Sound Level Mitigated (10 dB Sound Level Reduction) Pile Driving of 1.8-m Pin Piles During the Three Years of Construction for the Project. The 1.8-m Pin Piles for the Met Tower are only being installed in Year 2; no 1.8-m Pin Pile Installation will Occur in any Other Year; Only Sound Attenuation (10 dB) Level Mitigation Applied.

Marine Mammal Hearing Group	Marine Mammal Species	Cumulative Injury SEL Acoustic Exposures			Peak Injury SEL Acoustic Exposures			Behavioral SPL Acoustic Exposures		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Low Frequency Cetaceans (LFC)	Fin whale		0.00			0.00			0.01	
	Common Minke whale		0.00			0.00			0.01	
	Humpback whale		0.00			0.00			0.01	
	North Atlantic right whale		0.00			0.00			0.00	
	Sei whale		0.00			0.00			0.00	
Mid-frequency Cetaceans (MFC)	Atlantic spotted dolphin		0.00			0.00			0.00	
	Blainville's beaked whale		0.00			0.00			0.00	
	Common bottlenose dolphin[1]		0.00			0.00			1.91	
	Cuvier's beaked whale		0.00			0.00			0.00	
	Gervais' beaked whale		0.00			0.00			0.00	
	Killer whale		0.00			0.00			0.00	
	Long-finned pilot whale		0.00			0.00			0.00	
	Pantropical spotted dolphin		0.00			0.00			0.00	
	Risso's dolphin		0.00			0.00			0.00	
	Rough toothed dolphin		0.00			0.00			0.00	
	Short-beaked common dolphin		0.00			0.00			0.18	
	Short-finned pilot whale		0.00			0.00			0.00	
	Sperm Whale		0.00			0.00			0.00	
	Striped dolphin		0.00			0.00			0.00	
	True's beaked whale		0.00			0.00			0.00	
	Harbor porpoise		0.00			0.00			0.00	

Table 6-12. Maximum Injury (PTS; Cumulative and Peak Sound Exposure Levels [SEL]) and Behavior (Sound Pressure Level [SPL]) Acoustic Exposure Estimates of Potentially Affected Marine Mammals in the Buffered Lease Area Associated with the Sound Level Mitigated (10 dB Sound Level Reduction) Pile Driving of 1.8-m Pin Piles During the Three Years of Construction for the Project. The 1.8-m Pin Piles for the Met Tower are only being installed in Year 2; no 1.8-m Pin Pile Installation will Occur in any Other Year; Only Sound Attenuation (10 dB) Level Mitigation Applied.

Marine Mammal Hearing Group	Marine Mammal Species	Cumulative Injury SEL Acoustic Exposures			Peak Injury SEL Acoustic Exposures			Behavioral SPL Acoustic Exposures		
		Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
High Frequency Cetaceans (HFC)	Dwarf sperm whale		0.00			0.00			0.00	
	Pygmy sperm whale		0.00			0.00			0.00	
Phocid Pinnipeds Underwater (PW)	Harbor seal		0.00			0.00			0.06	
	Gray seal		0.00			0.00			0.03	

[1]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

6.5 Estimation of Acoustic Exposure for Marine Mammals Associated with Micro-Siting HRG Survey Activities

US Wind does not anticipate Level A harassment to occur during micro-siting HRG survey activities. NOAA Fisheries has previously determined that take from HRG survey equipment is not expected due to the small size of PTS threshold zones, even without mitigation measures (87 FR 61575; 87 FR 52913; 87 FR 51359; 87 FR 50293; 87 FR 44087). US Wind will implement the mitigation measures described in Appendix B, which will reduce the potential for Level B harassment of marine mammal species potentially affected (87 FR 51359; 87 FR 50293; 87 FR 44087).

6.5.1 Basis for Take Estimates

To estimate the number of potential Level B takes of marine mammals resulting from micro-siting HRG survey activities, US Wind utilized the following formula:

Take Estimation = n * ZOI * d

Where n = species density values, ZOI = area of the zone of influence (km^2) and d = total number of days during which the activity is expected to occur.

Take estimates were calculated by multiplying estimated species density within the buffered Lease area (see Section 6.1 and Figure 6-1) by the area ensonified to NOAA harassment thresholds for noise impacts (Zone of Influence, ZOI). As described in Section 1.5.1, micro-siting HRG surveys are most likely to occur between the months of April and June. However, as a conservative measure, the maximum monthly average density for each marine mammal species for an entire year (found in Table 6-13) was used for calculations of take for each construction campaign. This value was then multiplied by the total number of micro-siting survey days (rounded to the nearest whole number). All sound sources listed in Table 6-14 below are expected to be in operation during micro-siting HRG survey activities. Therefore, the sound source with the largest Level B distance (the Geo-Spark 2000; see Table 6-14 below) was used for the calculation of all take estimates.

The use of HRG survey equipment with the potential to cause harassment to marine mammals is not anticipated to occur during the MarWin phase of the Project. Micro-siting HRG survey activities utilizing equipment described in Table 6-14 below are anticipated to occur for a maximum of 14 days during the second construction campaign, and for a maximum of 14 days during the third construction campaign. Calculations below assume a daylight-only schedule for micro-siting HRG surveys. Information about ZOI calculations is presented in the following sections.

Table 6-13. Marine Mammal Species Densities Used for Micro-Siting HRG Survey Take Calculations*

		Mean Monthly Densities (animals/km^2)											
Hearing Group	**Common Name**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
LF Cetaceans	North Atlantic right whale	0.00075	**0.00076**	0.00063	0.00045	0.00008	0.00003	0.00001	0.00001	0.00002	0.00004	0.00011	0.00036
	Fin whale	**0.00214**	0.00184	0.00154	0.00135	0.00094	0.00111	0.00041	0.00028	0.0004	0.00037	0.00045	0.00151
	Humpback whale	0.00091	0.00062	0.00083	**0.00187**	0.00142	0.00102	0.0002	0.00011	0.00027	0.00112	0.00143	0.00088
	Common minke whale	0.00069	0.00089	0.00114	0.00687	**0.0075**	0.00155	0.0005	0.0002	0.0001	0.00055	0.00025	0.00064
	Sei whale	0.00029	0.00021	0.00034	**0.00061**	0.0002	0.00005	0.00001	0	0.00001	0.00006	0.00017	0.00046
MF Cetaceans	Atlantic spotted dolphin	0.00003	0.00001	0.00002	0.00013	0.00046	0.0009	0.00396	**0.01505**	0.00475	0.00335	0.00243	0.00032
	Bottlenose dolphin	0.03855	0.01316	0.01659	0.05668	0.15225	0.1592	0.18323	**0.20608**	0.1647	0.14689	0.1713	0.11705
	Long-finned pilot whale	**0.00039**											
	Short-finned pilot whale	**0.00039**											
	Pantropical spotted dolphin	**0.00004**											
	Risso's dolphin	0.00045	0.00006	0.00006	0.00056	0.00051	0.00018	0.00017	0.00018	0.0001	0.00023	0.00092	**0.00169**
	Short-beaked common dolphin	0.04298	0.01869	0.01972	0.03268	0.03289	0.01471	0.01301	0.00501	0.00044	0.00765	0.05746	**0.07939**
	Blainville's beaked whale	**0.00001**											
	Cuvier's beaked whale	**0**											
	Gervais' beaked whale	**0.00001**											
	True's beaked whale	**0.00001**											
HF Cetaceans	Harbor porpoise	**0.03653**	0.03336	0.02586	0.03191	0.00615	0.00002	0.00001	0.00001	0	0	0.00002	0.02025
	Kogia sp.	**0**											
Pinnepeds	Harbor seal	**0.11759**	0.08362	0.05238	0.08220	0.06811	0.00752	0.00282	0.00163	0.00280	0.01493	0.02230	0.10893
	Gray seal	**0.05234**	0.03722	0.02331	0.03659	0.03032	0.00335	0.00126	0.00073	0.00125	0.00665	0.00992	0.04848

*Month of maximum density is shown in bold and shaded grey, if applicable. These values were used for the micro-siting HRG calculations

6.5.1.1 Zone of Influence Calculations

The zone of influence for each sound source was calculated using the following formula:

$$ZOI = (\text{distance traveled/day} \times 2r) + \pi r^2$$

Where r is the distance from the sound source to the isopleth (effect distance) for Level B harassment thresholds. The distance traveled per day for mobile sound sources (HRG equipment), was calculated to be 111.1 km, based upon the average speed of the survey vessel (4 knots, 2.06 meters per second), and assuming a maximum of 15 survey hours per day. Micro-siting HRG survey activities would only occur during daylight hours.

Distance traveled = Speed of Vessel * Survey Hours per Day

6.5.1.2 Range to Threshold Calculations

For calculations of Level B take, the distance from each sound source to the harassment threshold (160 dBrms re 1 µPa) was identified (Table 6-14). Distances to the Level B threshold for all HRG sound sources were determined based upon the NOAA Fisheries Recommendation for Sound Source Level and Propagation Analysis for High Resolution Geophysical (HRG) Sources and the Associated Level B Harassment Isopleth Calculator (NOAA Fisheries 2020). Inputs for equipment specifications are summarized in Table 1-6. The micro-siting HRG surveys could occur anywhere within the Lease area and potentially only within a small portion during the permit term, therefore, a maximum depth of 42 meters (137.8 feet) was used to be conservative. HRG survey equipment will operate concurrently, so the greatest distance to the Level B harassment threshold (50.1 meters [164.4 feet] for the Geo-spark 2000 medium penetration SBP) was used for the take calculations.

Table 6-14. Distances to Level B Threshold (160 dB_{rms} re 1 µPa)

HRG System	Representative Survey Equipment[a]	Distance to Threshold (m)[b]
USBL	Sonardyne Mini Ranger 2 USBL	49.0
	SBL Wideband Mini Transponder	13.9
	USBL Wideband Nano Transponder	14.5
Shallow-penetration SBP	Innomar SES 2000 Std	0.7
Medium-penetration SBP	Applied Acoustics S Boomer	35.2
	Geo-spark 2000	**50.1**

[a] The equipment listed above was used during US Wind's previous HRG surveys within the Project area and the information has been verified by multiple contractors. Information obtained from manufacturer specifications, except for the Applied Acoustics S Boomer. Crocker and Fratantonio (2016) provide AA S Boomer measurements from Tables 6 and 7. Frequency and repetition rate of the AA S Boomer verified by the survey contractor.
[b] Calculated using the Associated Level B Harassment Isopleth Calculator (NOAA Fisheries 2020).

Bold indicates largest distance to threshold, used in subsequent take calculations.

The daily Level B harassment zone of influence for HRG survey activities (assuming daylight-only operations) was determined to be 11.1 km^2, based on the largest distance to the threshold (50.1 m, Geo-spark 2000 medium-penetration SBP) and assuming a vessel travel distance of 111.1 km per day.

6.5.2 Potential Takes due to Micro-Siting HRG Survey Activities

The estimated maximum number of marine mammals expected to experience Level B harassment as a result of micro-siting HRG survey activities during the Momentum and future development phases of the project, assuming a daylight-only operations schedule, are presented in Tables 6-15 and 6-16. These figures do not account for mitigation measures.

A limited number of Level B takes are expected due to micro-siting HRG activities. However, the maximum threshold for Level B harassment is approximately 50.1 meters (164.4 ft) from the sound source (Geo-spark 2000 medium-penetration SBP; see Section 6.5.1). As a 500-meter (1,640-foot) shutdown zone for NARW, and a 100-meter (328-foot) shutdown zone for all other marine mammals, will be established around the HRG vessel during sound source operation (Appendix B), Level B take of marine mammals will be minimized.

Table 6-15. Calculated Level B Takes of Marine Mammals by Acoustic Harassment due to Micro-Siting HRG Survey Activities, Second Construction Campaign, Daylight-only Operations.

Hearing Group	Common Name	Best Abundance Estimate of Stock	Month of Max Density	Calculated Level B Take	Max Percentage of Stock Impacted
LF Cetaceans	North Atlantic right whale	338	Feb	0.1	0.035
	Fin whale	6802	Jan	0.3	0.005
	Humpback whale	1393	Apr	0.3	0.021
	Minke whale	21968	May	1.2	0.005
	Sei whale	6292	Apr	0.1	0.002
MF Cetaceans	Atlantic spotted dolphin	39921	Aug	2.3	0.0059
	Bottlenose dolphin[a]	69490	Aug	32.1	0.046
	Killer whale	UNK	N/A	0.0	UNK
	Long-finned pilot whale	39215	N/A	0.1	0.000
	Short-finned pilot whale	28924	N/A	0.1	0.000
	Pantropical spotted dolphin	6593	N/A	0.0	0.000
	Risso's dolphin	35215	Dec	0.3	0.0007
	Rough toothed dolphin	136	N/A	0.0	0.002
	Short-beaked common dolphin	172974	Dec	12.4	0.007
	Striped dolphin	67036	N/A	0.0	0.000
	Sperm Whale	4349	May	0.0	0.000
	Blainville's beaked whale	10107	N/A	0.0	0.000
	Cuvier's beaked whale	5744	N/A	0.0	0.000
	Gervais' beaked whale	10107	N/A	0.0	0.000
	True's beaked whale	10107	N/A	0.0	0.000
HF Cetaceans	Harbor porpoise	95543	Jan	5.7	0.006
	Kogia sp.	UNK	N/A	0.0	UNK
Pinnepeds	Harbor seal	61336	Jan	18.3	0.030
	Gray seal	27300	Jan	8.2	0.030

UNK: no stock abundance estimate available
N/A: only annual density data available
[a]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

Table 6-16. Calculated Level B Takes of Marine Mammals by Acoustic Harassment due to Micro-Siting HRG Survey Activities, Third Construction Campaign, Daylight-only Operations.

Hearing Group	Common Name	Best Abundance Estimate of Stock	Month of Max Density	Calculated Level B Take	Max Percentage of Stock Impacted
LF Cetaceans	North Atlantic right whale	338	Feb	0.1	0.035
	Fin whale	6802	Jan	0.3	0.005
	Humpback whale	1393	Apr	0.3	0.021
	Minke whale	21968	May	1.2	0.005
	Sei whale	6292	Apr	0.1	0.002
MF Cetaceans	Atlantic spotted dolphin	39921	Aug	2.3	0.0059
	Bottlenose dolphin[a]	69490	Aug	32.1	0.046
	Killer whale	UNK	N/A	0.0	UNK
	Long-finned pilot whale	39215	N/A	0.1	0.000
	Short-finned pilot whale	28924	N/A	0.1	0.000
	Pantropical spotted dolphin	6593	N/A	0.0	0.000
	Risso's dolphin	35215	Dec	0.3	0.0007
	Rough toothed dolphin	136	N/A	0.0	0.002
	Short-beaked common dolphin	172974	Dec	12.4	0.007
	Striped dolphin	67036	N/A	0.0	0.000
	Sperm Whale	4349	May	0.0	0.000
	Blainville's beaked whale	10107	N/A	0.0	0.000
	Cuvier's beaked whale	5744	N/A	0.0	0.000
	Gervais' beaked whale	10107	N/A	0.0	0.000
	True's beaked whale	10107	N/A	0.0	0.000
HF Cetaceans	Harbor porpoise	95543	Jan	5.7	0.006
	Kogia sp.	UNK	N/A	0.0	UNK
Pinnepeds	Harbor seal	61336	Jan	18.3	0.030
	Gray seal	27300	Jan	8.2	0.030

UNK: no stock abundance estimate available
N/A: only annual density data available
[a]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

Take estimates presented in Tables 6-15 and 6-16 and discussed above are highly conservative, and were calculated based upon the following assumptions:

- Though micro-siting HRG surveys are most likely to occur between April and June, the maximum average marine mammal density estimated for any month of the year was used for calculations, resulting in a conservative estimate of takes.

- HRG sound sources were assumed to operate at the maximum source level (dB) for the entirety of the estimated activity period.

- The area of the zone of influence (ZOI) for HRG sources was calculated assuming that the entire area traveled by the vessel in a survey day (15 hours) remained ensonified throughout this time. A survey day was assumed to be 15 hours, representing the longest daylight period during the summer months. This is a conservative overestimate of the operation time during much of the survey period, as daylight hours will decrease from June to November.

Take estimations do not account for the implementation of comprehensive mitigation measures, including shutdown zones, monitoring, ramp-up and shut down procedures, and vessel strike avoidance, which US Wind intends to employ to ensure that marine mammals are not adversely affected by equipment noise or vessels (see Appendix B).

6.6 Total Requested Marine Mammal Takes

Maximum annual mitigated (10 dB sound level reduction) acoustic exposure estimates associated with each of the three years of impact pile driving (monopile, skirt pile, and pin pile) and HRG surveys in the buffered Lease area are presented in Table 6-18. To determine requested MMPA Level A and Level B takes (harassment) of each species, group size information was also considered. PSO survey data for the Lease area from 2021 through 2022 were assessed (RPS 2023; Smultea 2022) and group sizes of observed species were compiled. For species not observed during the PSO surveys, other available literature was reviewed to obtain group size information (DON 2017b). Few species had a group size larger than 10 individuals (Table 6-17). Requested Level A and Level B marine mammal takes (annual and Years 1, 2 and 3, Tables 6-19 and 6-20) were informed by consideration of group size and modeled acoustic exposures, as described below:

- For a given species, if the acoustic exposure was less than the mean group size, the mean group size was rounded to the nearest integer and used as the requested Level A and/or Level B take.

- Except for those species indicated below, if the acoustic exposure was greater than the mean group size, the acoustic exposure was rounded to the nearest integer and used as the requested Level A and/or Level B take.

- For Atlantic spotted dolphins, it is anticipated that 5 groups would be observed in Year 1 and 10 groups would be observed in Years 2 and 3. These anticipated observations were used to determine requested Level B take based on the mean group size of this species.

- For both pilot whale species, although no acoustic exposures were calculated in Year 1, requested take was based upon the assumption that one group would be observed during Year 1. Therefore, requested Year 1 take was based on the mean group size of these species.

- For harbor porpoises, it is anticipated that 3 groups would be observed in Year 3, which was used to determine requested Level B take based on the mean group size of this species.

In recognition that only whole marine mammals can be authorized for takes, the number of requested Level A and Level B takes of marine mammals have been rounded upwards to the nearest integer. The number of total requested Level A and Level B marine mammal rounded takes (Table 6-20) is a summation of the annual (per year) requested take estimates (Table 6-19).

As stated in Section 1.3, construction, and therefore pile driving, will progress from the southeastern corner of the Lease area in Year 1 and extend in a western direction during Year 2 and then Year 3. The take of common bottlenose dolphin is anticipated to be attributed to each stock (Western North Atlantic Offshore Stock and Western North Atlantic Northern Migratory Coastal Stock) in the following manner:

- Year 1: 100% offshore stock
- Year 2: 70% offshore stock and 30% coastal stock
- Year 3: 15% offshore stock and 85% coastal stock

In addition to group size and modeled acoustic exposure, consideration was also given to the planned comprehensive mitigation plan that is specifically tailored to add protective measures for the highly endangered North Atlantic right whale. Given the efficacy of the planned mitigation, no takes by MMPA Level A are requested for the North Atlantic right whale. However, Level B harassment takes of NARW are requested as a conservative measure (Table 6-20). Additionally, no takes are being requested for either of the *Kogia* species (dwarf and pygmy sperm whales) nor the sperm whale (Tables 6-19 and 6-20) as no Level A nor Level B takes have been estimated for these species. Additionally, no takes are being requested for killer whales, rough-toothed dolphins, striped dolphins, and beaked whales due to their limited occurrence within the Project areas (see Section 4.0). Conservatively, small numbers of Level A takes for the remaining Mysticete species (LF cetacean hearing group) have been requested, although it is highly likely that the comprehensive mitigation plan will be effective in precluding any PTS takes of the potentially occurring fin, common minke, humpback, or sei whales (Tables 6-19 and 6-20). With group size applied, the common bottlenose dolphins represents the species for which the highest Level B takes are estimated (Table 6-20).

Table 6-17. Marine Mammal Group Sizes

Marine Mammal Hearing Group	Marine Mammal Species	Mean Group Size	Group Size References**
Low Frequency Cetaceans (LFC)	Fin whale	1.64	RPS, 2023
	Common Minke whale	1.00	RPS, 2023
	Humpback whale	1.95	RPS, 2023
	North Atlantic right whale	2.00	RPS, 2023
	Sei whale	1.00	RPS, 2023
MF Cetaceans (MFC)	Atlantic spotted dolphin	5.89	RPS, 2023
	Common Bottlenose dolphin	11.53	RPS, 2023
	Pantropical spotted dolphin	4.33	RPS, 2023
	Risso's dolphin	8.47	DoN, 2017
	Short-beaked common dolphin	7.00	RPS, 2023
	Pilot whales (both spp. combined)	26.00	DoN, 2017
High frequency cetaceans (HFC)	Harbor porpoise	3.00	RPS, 2023
Pinnipeds Under Water (PW)	Gray seal	1.00	RPS, 2023
	Harbor seal*	1.00	RPS, 2023

*Neither DoN (2017b) nor RPS (2023) included group sizes for the harbor seal, so the RPS gray seal group size of 1.00 was used as a proxy for the harbor seal.

**No PSO data from the Smultea Associates PSO interim report were used to determine group sizes because activity in the report occurred during a time period in which no pile driving or HRG micro-siting surveys are planned.

Table 6-18. Maximum Annual MMPA Level A and Level B Acoustic Exposure Estimates of Potentially Affected Marine Mammals in the Buffered Lease Area Resulting from Acoustic Exposure During Mitigated (10 dB Sound Reduction Level) Impact Pile Driving (Monopile, Skirt Pile, and Pin Pile) and Micro-Siting HRG Survey Activities During Each Year of the Planned Construction and Survey Activities for the Project.

Marine Mammal Hearing Group	Marine Mammal Species	Level A Harassment					Level B Harassment				
		Year 1	Year 2		Year 3		Year 1	Year 2		Year 3	
		Pile Driving	Pile Driving	HRG Surveys	Pile Driving	HRG Surveys	Pile Driving	Pile Driving	HRG Surveys	Pile Driving	HRG Surveys
Low Frequency Cetaceans	Fin whale	0.39	1.16	0	0.68	0	3.97	11.65	0.3	6.86	0.3
	Common Minke whale	0.49	5.55	0	1.11	0	3.00	33.39	1.2	6.70	1.2
	Humpback whale	0.42	1.55	0	0.67	0	2.54	9.33	0.3	4.06	0.3
	North Atlantic right whale	0.01	0.05	0	0.02	0	0.06	0.24	0.1	0.08	0.1
	Sei whale	0.01	0.12	0	0.02	0	0.11	0.83	0.1	0.17	0.1
Mid-Frequency Cetaceans	Atlantic spotted dolphin	0.00	0.00	0	0.00	0	14.24	39.21	2.3	50.92	2.3
	Blainville's beaked whale	0.00	0.00	0	0.00	0	0.00	0.00	0	0.00	0
	Common Bottlenose dolphin[1]						856.38	2341.64	32.10	1720.57	32.10
	Cuvier's beaked whale	0.00	0.00	0	0.00	0	0.00	0.00	0	0.00	0
	Gervais' beaked whale	0.00	0.00	0	0.00	0	0.00	0.00	0	0.00	0
	Killer whale	0.00	0.00	0	0.00	0	0.08	0.22	0	0.15	0
	Long-finned pilot whale	0.00	0.00	0	0.00	0	0.00	0.00	0.1	0.00	0.1
	Pantropical spotted dolphin	0.00	0.00	0	0.00	0	0.17	0.45	0	0.31	0
	Risso's dolphin	0.00	0.00	0	0.00	0	0.27	1.50	0.3	0.67	0.3
	Rough toothed dolphin	0.00	0.00	0	0.00	0	0.04	0.11	0	0.08	0
	Short-beaked common dolphin	0.00	0.00	0	0.00	0	29.20	234.44	12.4	97.06	12.4
	Short-finned pilot whale	0.00	0.00	0	0.00	0	0.00	0.00	0.1	0.00	0.1
	Sperm whale	0.00	0.00	0	0.00	0	0.00	0.00	0	0.00	0
	Striped dolphin	0.00	0.00	0	0.00	0	0.17	0.45	0	0.31	0
	True's beaked whale	0.00	0.00	0	0.00	0	0.00	0.00	0	0.00	0
High Frequency Cetaceans	Harbor porpoise	0.00	1.19	0	0.01	0	0.03	15.83	5.7	0.09	5.7
	Dwarf sperm whale	0.00	0.00	0	0.00	0	0.00	0.00	0	0.00	0
	Pygmy sperm whale	0.00	0.00	0	0.00	0	0.00	0.00	0	0.00	0
Pinnipeds in Water	Harbor seal	0.00	0.00	0	0.00	0	12.42	162.32	18.3	20.83	18.3
	Gray seal	0.00	0.00	0	0.00	0	5.53	72.25	8.2	9.27	8.2

[1]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

Table 6-19. Annual MMPA Level A and Level B Takes Requested of Potentially Affected Marine Mammals in the Buffered Lease Area Resulting from Acoustic Exposure During Mitigated (10 dB Sound Reduction Level) Impact Pile Driving (Monopile, Skirt Pile, and Pin Pile) and Micro-Siting HRG Survey Activities During Each of the Three Years of the Planned Construction and Survey Activities for the Project (Takes Rounded Up to Nearest Integer).

Marine Mammal Hearing Group	Marine Mammal Species	Abun-dance	Year 1			Year 2			Year 3		
			Level A Takes	Level B Takes	Percent of Stock Affected	Level A Takes	Level B Takes	Percent of Stock Affected	Level A Takes	Level B Takes	Percent of Stock Affected
Low Frequency Cetaceans	Fin whale [a]	6,802	2	4	0.088	2	12	0.206	2	8	0.147
	Common minke whale [b]	21,968	1	3	0.018	6	35	0.187	2	8	0.046
	Humpback whale [c]	1,396	2	3	0.358	2	10	0.860	2	5	0.501
	North Atlantic right whale [d]	338	0	2	0.592	0	2	0.592	0	2	0.592
	Sei whale [e]	6,292	1	1	0.032	1	1	0.032	1	1	0.032
Mid-Frequency Cetaceans	Atlantic spotted dolphin [f]	39,921	0	30	0.075	0	60	0.150	0	60	0.150
	Common Bottlenose dolphin[1] (Offshore/Coastal)	62,851/ 6,639	0	857	1.364 (offshore)	0	2374	2.644 (offshore) 10.74 (coastal)	0	1753	0.42 (offshore) 22.46 (coastal)
	Pantropical spotted dolphin [d]	6,593	0	5	0.076	0	5	0.076	0	5	0.076
	Risso's dolphin [d]	35,215	0	9	0.026	0	9	0.026	0	9	0.026
	Short-beaked common dolphin	172,974	0	30	0.017	0	247	0.143	0	110	0.064
	Pilot whale [g] (Long-finned/ Short-finned)	39,215/ 28,924	0	26	0.066 (long-finned) 0.09 (short-finned	0	26	0.066 (long-finned) 0.09 (short-finned)	0	26	0.066 (long-finned) 0.09 (short-finned
High Frequency Cetaceans	Harbor porpoise [h]	95,543	0	3	0.003	3	22	0.026	3	9	0.013
Pinnipeds in Water	Gray seal	27,300	0	6	0.022	0	81	0.297	0	18	0.066
	Harbor seal	61,336	0	13	0.021	0	181	0.295	0	40	0.065

UNK = Unknown
[1]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

[a] Level A take was adjusted by mean group size in Years 1, 2 and 3.
[b] Level A take was adjusted by mean group size in Year 1.
[c] Level A take was adjusted by mean group size in Years 1, 2 and 3.
[d] Level B take was adjusted by mean group size in Years 1, 2 and 3.
[e] Level A and Level B take were adjusted by mean group size in Years 1, 2, and 3.
[f] Level B take adjusted based on expected groups in Year 1. Level B take adjusted based on expected groups in Years 2 and 3.
[g] Level B take was adjusted by mean group size in Years 1, 2 and 3.
[h] No Level A take is requested for Year 1. Level A take was adjusted by mean group size in Years 2 and 3. Level B take was adjusted by mean group size in Year 1. Level B take adjusted based on expected groups in Year 3.

Table 6-20. Total Requested MMPA Level A (PTS Cumulative and Peak) and Level B (Behavior) Harassment Takes Associated with Acoustic Exposure During Mitigated (10 dB Sound Reduction Level) Impact Pile Driving (Monopile, Skirt Pile, and Pin Pile) and Micro-Siting HRG Survey Activities for the Full Duration of the Construction and Survey Periods for the Project; Harassment Takes Rounded Upwards to Nearest Whole Integer.

Marine Mammal Hearing Group	Marine Mammal Species	Abundance[1]	MMPA Level A Harassment Requested	Percent of Stock Affected	MMPA Level B (Behavior) Harassment Requested	Percent of Stock Affected
Low Frequency Cetaceans	Fin whale	6,802	6	0.088	24	0.353
	Common minke whale	21,968	9	0.041	46	0.209
	Humpback whale	1,396	6	0.430	18	1.289
	North Atlantic right whale	338	0	0.000	6	1.775
	Sei whale	6,292	3	0.048	3	0.048
Mid-Frequency Cetaceans (MFC)	Atlantic spotted dolphin	39,921	0	0.000	150	0.376
	Common Bottlenose dolphin[2]	69,490	0	0.000	4984	7.17
	Pantropical spotted dolphin	6,593	0	0.000	15	0.228
	Risso's dolphin	35,215	0	0.000	27	0.077
	Short-beaked common dolphin	172,974	0	0.000	387	0.224
	Pilot whales (both species combined)	68,139	0	0.000	78	0.114
High Frequency Cetaceans	Harbor porpoise	95,543	6	0.006	34	0.036
Pinnipeds in Water	Gray seal	27,300	0	0.000	105	0.385
	Harbor seal	61,336	0	0.000	234	0.382

[1]Hayes et al. 2022, 2021, 2020, 2019; Waring et al. 2015; UNK=unknown
[2]Two stocks of common bottlenose dolphin (the Western North Atlantic migratory coastal stock and the Western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

7.0 Anticipated Impact of the Activity

7.1 Determination of Impacts

Under the requirements of 50 CFR § 216.103, NOAA Fisheries has defined negligible impact as an impact that is not reasonably expected to adversely affect a species or stock through effects on annual rates of recruitment or survival, i.e., population-level effects.

An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ‘‘taken’’ through harassment, NOAA Fisheries considers other factors, such as the likely nature of any impacts or responses (e.g., intensity, duration), the context of any impacts or responses (e.g., critical reproductive time or location, foraging impacts affecting energetics), as well as effects on habitat, and the likely effectiveness of mitigation measures. US Wind identified the following potential impacts to marine mammals from Project activities:

- acoustic impacts from pile driving, micro-siting HRG surveys, and vessel sound, and
- physical impacts from deployment of equipment and vessel strikes.

US Wind designed Project elements and activities in a manner that minimizes and mitigates acoustic and physical impacts to marine mammal that may cause mortality, injury and disturbance. Sections 11.0,13.0, and Appendix B further detail the procedures US Wind plans to implement during construction and operations activities.

7.2 Acoustic Impacts

Marine mammals rely heavily on sound for navigation, communication, reproduction, prey location, and predator avoidance. Marine mammal responses to anthropogenic sound exposure can range from apparent indifference to behavioral changes to physical injury, depending upon the sound source and species.

The NOAA acoustic guidance bases the criteria for impacts of sound on marine mammals on the potential of a sound source to cause a permanent loss of hearing (permanent threshold shift, PTS). Exposure to sound levels above PTS thresholds results in Level A harassment under the MMPA.

Actions that have the potential to disturb a marine mammal stock in the wild by altering behavioral patterns are classified as Level B harassment under the MMPA. Behavioral impacts caused by exposure to anthropogenic sound can include masking of communication, exclusion of animals from the area of activity, and stress responses.

7.2.1 Impact Pile Driving

Impact pile driving generates low frequency impulsive sound. The activity could potentially affect marine mammals from all four hearing groups detailed in Section 6.2, primarily by causing marine mammals to avoid an area or by masking communication.

Low frequency cetaceans (baleen whales) potentially occurring in the Lease area are more likely to experience impacts due to the alignment of these species’ hearing ranges with the sound frequencies typically generated by pile driving. Of particular concern is the NARW, one of the rarest and most endangered whale species in the world, which is known to occur in the Lease area year-round (Hayes et al. 2022; Bailey et al. 2018b; Williams et al. 2015c; Barco et al. 2015). NARW are more vulnerable to communication masking by anthropogenic sounds than other baleen whales due to the lower sound source levels of NARW communication calls compared to the songs of other species (e.g., fin and humpback) (C.W. Clark et al. 2009). NARW are under stress throughout its range, and research has identified a dramatic decrease in potential NARW "upcall" communication space since the 1950's due to increasing vessel traffic and offshore activities (63% loss of communication opportunities on Stellwagen bank; (Hatch et al. 2012)). A second type of NARW vocalization, called "gunshots", was less impacted due to increasing ambient noise levels, with these calls only experiencing an estimated 5% decrease in communication space (Cholewiak et al. 2018). However, it is possible that individual NARW could shift their vocalizations to a higher frequency and vocalize for a longer duration to account for high background noise levels and prevent acoustic masking (Parks, Clark, and Tyack 2008; Parks, Clark, and Tyack 2007).

A study by Sivle et al. (2015) examined the behavioral responses of minke whale, humpback whale, and northern bottlenose whale (*Hyperoodon ampullatus*) to sonar signals ranging from 1 to 2 kHz. All three species exhibited avoidance of the area during exposure to the sound source, by increasing speed and changing the diving pattern in ways that would increase the distance between the individual whale and the sound source (Lise D. Sivle et al. 2015). Dunlop et al. (2018) also measured avoidance responses in humpback whales, which were more likely to avoid the sound source (an air gun) when the received sound level exposure was greater than 130 dB re 1 $\mu Pa^2 \cdot s$ and whales were less than 4 km away.

Though mid-frequency cetaceans are not as susceptible to communication masking from pile driving noise as low frequency cetaceans, mid-frequency cetaceans could also be impacted by Project construction activities. Certain species, such as bottlenose dolphins, are unlikely to experience permanent hearing damage from pile driving, although behavioral effects are likely. Field measurements of unmitigated pile driving noise off Northeastern Scotland indicated that sound levels sufficient to cause behavioral disturbance, due to masking of bottlenose dolphin communication whistles, were present up to 50 km (27 NM) from the sound source (Bailey et al. 2010). However, sound levels sufficient to cause permanent injury to bottlenose dolphin were only present within 100 m (328 ft) of the pile driving activity (Bailey et al. 2010). Temporary displacement of bottlenose dolphins from the area is the most likely response to pile driving, and dolphins have shown some ability to modify their behavior when exposed to communication-masking sound levels (David 2006). Bottlenose dolphins are common within the Project area and are expected to experience temporary displacement during project activities, but no permanent injury or population-level impacts are expected.

Pile driving noise may impact harbor porpoises, which are present but uncommon in the region of the Lease area. Pile driving noise has been documented to cause displacement of porpoises up to 25 km (13.5 NM) away from the sound source (Tougaard et al. 2009; Tougaard et al. 2012), and vocalizations of this species have been documented to remain below pre-activity levels until 24 to 72 hours after cessation of pile driving (Brandt et al. 2011). Because breaks between pile driving events are expected to be less than 72 hours, porpoises could be functionally excluded from the Project area for the duration of pile driving operations (Brandt et al. 2011). However, local porpoise distributions are expected to return to pre-event levels within a few days of the completion of pile driving. Impacts to harbor porpoises due to construction within the Lease area are expected to be temporary, and a limited number of individuals are expected to be exposed to pile driving noise due to the scarcity of this species.

Responses to noise can also include stress responses, which may include short-term increases in heart rate, higher blood pressure, and gas exchange, and long-term effects if an individual is in a constant state of stress (Erbe, Dunlop, and Dolerman 2018). A study by Romano et al. (2004) tested the nervous system response to sound on a captive bottlenose dolphin (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*). Several physiological parameters (dopamine, epinephrine, and norepinephrine) increased compared to baseline levels following exposure to impulsive sounds (Romano et al. 2004). If marine mammals are constantly under stress from increased noise levels, their ability to carry out necessary behaviors (i.e., feeding, migrating, mating, and avoiding predation) may be diminished (Erbe, Dunlop, and Dolerman 2018). Therefore, exposure to sound below PTS levels has the potential to cause population level impacts due to reduced fecundity or non-direct mortality due to reduced foraging efficiency or decreased access to food, decreased mating opportunities, and reduced time spent nursing or caring of young (Erbe, Dunlop, and Dolerman 2018).

Mitigation measures to reduce acoustic impacts from pile driving are described in more detail in Section 11.0 and Appendix B and are summarized here. US Wind will monitor clearance zones to the Level B threshold for the monopile, skirt pile, or pin pile, and ensure the zones are clear of marine mammals prior to starting pile driving. Pile driving will begin with a “soft start” at a low energy level and shutdown zones to the Level A threshold will be established such that when a marine mammal enters the shutdown zone pile driving will be ceased unless the health and safety of personnel or technical feasibility of shutdown are deemed to be at risk. Sound attenuation measures will be implemented for driving each pile, with a 10 dB minimum reduction when driving monopiles. A 10 dB sound reduction level will reduce the modeled range to the regulatory behavioral threshold for marine mammals from 14.1 km (8.8 mi) to 5.4 km (3.3 mi), and US Wind intends to target a 20 dB reduction reducing the threshold further. The acoustic impacts to marine mammals from pile driving will be negligible due to the monitoring and mitigation measures US Wind will implement during pile driving and the small numbers of individuals exposed in relation to the species stock.

7.2.2 Micro-Siting HRG Surveys

Micro-siting HRG surveys would employ low frequency sound survey equipment described in Section 1.5.1. Exposure of marine mammals to sound in excess of Level B thresholds, which can cause temporary changes in hearing sensitivity, and can elicit behavioral responses, is estimated to occur during micro-siting HRG survey activities. The main behavioral response of marine mammals to sound levels over the Level B threshold is avoidance of the area (in this case, avoidance of the area being surveyed). Some species, such as dolphins and porpoises, may voluntarily approach survey vessels and could potentially enter the maximum Level B threshold zone (32.2 meters [105.4 feet] from the sound source).

Unmitigated Level B exposure estimates for all micro-siting HRG survey activities were less than two individuals for all but six species. Estimated Level B takes represented less than 0.03 % of the current stock abundance for all ESA-listed species, and less than 0.75 % of the stock for all other species. The western north Atlantic migratory coastal stock of bottlenose dolphins had the highest calculated total take, at 98.7 individuals, representing an impact to 1.5% of the stock (see Tables 6-12 and 6-13). Though a total of 0.2 takes of NARW by Level B harassment were calculated to occur during HRG survey activities, the mitigation measures described in Appendix B would prevent any impacts to this highly endangered species.

Mitigation measures for micro-siting HRG surveys are described in Section 11 and Appendix B and are summarized here. US Wind would mitigate acoustic impacts from survey activities by monitoring a clearance zone prior to powering on the equipment that must be free of marine mammals. Equipment would be "ramped up", starting with a low level of energy prior to reaching full strength. Shutdown zones would be established of 500 m (1,640 ft) for NARW is and 100 m (328 ft) for all other marine mammals such that equipment would be powered down if animals enter the shutdown zone.

US Wind does not anticipate Level A harassment to occur during micro-siting HRG survey activities. NOAA Fisheries has previously determined that take from HRG survey equipment is not expected due to the small size of PTS threshold zones, even without mitigation measures (87 FR 61575; 87 FR 52913; 87 FR 51359; 87 FR 50293; 87 FR 44087). By implementing mitigation measures to reduce acoustic impacts the effects on marine mammals are anticipated to be negligible.

7.2.3 Vessel Noise

Increased vessel traffic during construction and operations of the Project could increase vessel sound underwater and marine mammal behavioral responses could result in the Project area. Marine mammals have been known to alter their foraging methods due to vessel noise while actively foraging (Blair et al. 2016). Blair et al. (2016) documented slower decent rates and fewer side-roll feeding events per dive in foraging humpback whales exposed to increased vessel noise. Vessel noise can also result in a reduction of the communication space available to marine mammals (Putland et al. 2017). Using AIS data, Putland et al. (2017) concluded that routine vessel traffic reduced communication space for Bryde's whale (*Balaenoptera edeni*) by up to 87.4%. For a large commercial vessel passing less than 10 km (6.2 miles) from the listening station, communication space for this species was reduced up to 99% as compared to ambient conditions (Putland et al. 2017).

Marine mammals may also experience increased stress as the result of vessel noise. Rolland et al. (2012) examined the effect of reduced noise on NARW due to reduced shipping traffic in the Bay of Fundy, Canada, following the events of September 11, 2001. Measurements indicated a 6 dB decrease in background noise, with noise below 150 Hz greatly reduced (Rolland et al. 2012). The decreased level of underwater noise caused a significant decrease in NARW stress-related fecal hormone metabolites (glucocorticoids), demonstrating that shipping traffic and the noise it generates causes stress to marine mammals like NARW (Rolland et al. 2012; Southall et al. 2007).

The Lease area is adjacent to commercial shipping lanes into and out of Delaware Bay immediately to the east of the Lease area. Bailey et. Al. (2018) identified the elevated ambient sound levels in the low frequency range with median values in the eastern part of the Lease area, closest to the shipping lanes, of 115.3-116.1 dB and approximately 18-20% of the hours recorded during the 3-year study greater than 120 dB. The Project will result in increased vessel traffic and presumably increased sound, the difference is not expected to be significant.

7.3 Physical Impacts

US Wind does not anticipate the direct physical harm of any marine mammals from deployment of equipment related to the Project due to the monitoring and mitigation efforts US Wind will implement throughout all Project activities. These efforts are described in detail in Sections 11.0 and 13.0, as well as Appendix B.

7.3.1 Equipment and Project Component Deployment

During Project construction activities, multiple Project components and installation equipment will be lowered from vessels into the water, including WTG foundations, OSS foundations, the Met Tower foundation, cable installation equipment, and gravity cells. Objects lowered into the water column have the potential to strike marine mammals passing underneath, resulting in minor to severe injuries to the individual. US Wind will avoid placing equipment and/or lowering Project components into the water column if a marine mammal is within 10 m (33 ft) of the equipment.

PSOs would be deployed in foundation installation vessels to visually watch for marine mammals within 10 m (33ft). All other installation vessel operators and crew will be briefed about the 10-m zone such that equipment will not be placed in the water if marine mammals are within 10 m of the placement location.

7.3.2 Vessel Strikes

Increased in vessel traffic during Project construction, operations, and maintenance has the potential to seriously injure or kill marine mammals from vessel strikes. Vessel strikes, in addition to entanglement with commercial fishing gear, are a leading cause of marine mammal mortality, particularly NARW.

The Project area is not considered critical habitat to any Endangered Species Act (ESA) listed whale species, although the Project area is within a Biologically Important Area (BIA) for NARW (LaBrecque et al. 2015). This BIA is used for migration, with NARW moving north from March-April and south from November-December (LaBrecque et al. 2015).

NOAA implements measures in the Project area to reduce vessel strikes, specifically to protect the NARW. The NARW Seasonal Management Area (SMA) extends in a 20-NM radius from the entrance to Delaware Bay (Figure 7-1). The entirety of the Project area also falls within the proposed Right Whale Seasonal Speed Zone (87 FR 46921).

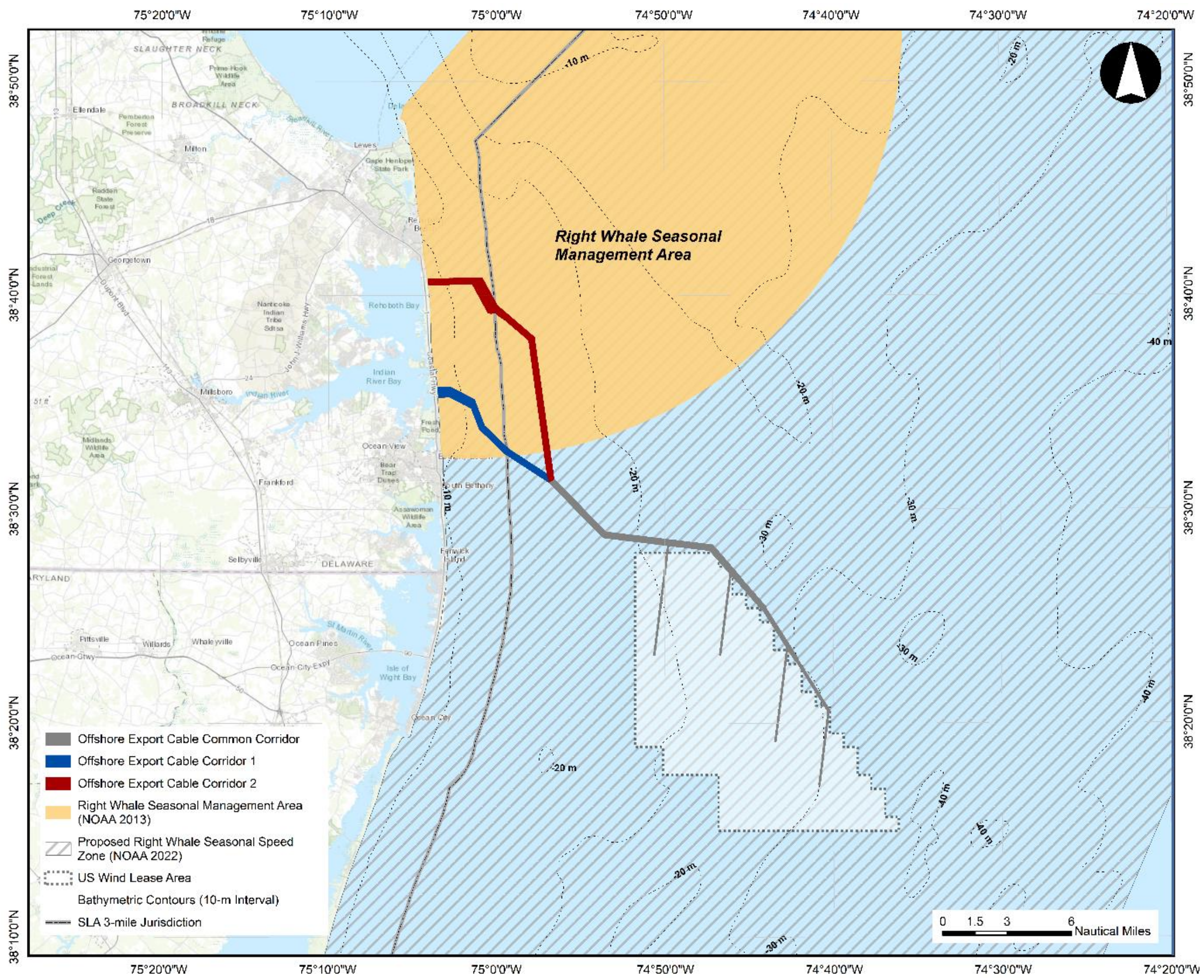

Figure 7-1. Right Whale Seasonal Management Area (with proposed NARW seasonal speed zone).

US Wind's proposes mitigation measures summarized in Section 11.0 and detailed in Appendix B, to minimize the likelihood of vessel strikes such that impacts related to vessel traffic is not anticipated and therefore the effect would be negligible.

US Wind measures in Section 11.0 and Appendix B include:

- observance of speed restrictions in the current SMA and adherence to limits imposed by the proposed rule if adopted as proposed, or as modified[16];
- observance of Right Whale Slow Zones and Dynamic Management Areas; and

[16] On August 1, 2022, NMFS published proposed amendments to the North Atlantic right whale vessel strike reduction rule (87 FR 46921). As of this writing the proposed amendments have not been finalized.

- minimum separation distances of 500 m from NARW, 100 m from other large cetaceans, and 50 m from delphinid cetaceans or pinnipeds, as well as strike avoidance measures for vessels underway.

7.4 Summary of Negligible Impacts

The mitigation measures discussed in detail in Appendix B (i.e., pre-start clearance, deployment of far- and near-field sound attenuation technologies, shutdown measures, and maintenance of shutdown zones) are anticipated to prevent Level A take of marine mammal species. However, as a conservative measure, US Wind is requesting Level A takes for the following marine mammal species: fin whale, common minke whale, humpback whale, sei whale, and harbor porpoise.

US Wind expects that potential Level B takes due to behavioral harassment will be in the form of temporary avoidance of the area (see Sections 7.2.1 and 10.1), communication masking (see Section 7.2.1), stress (i.e., changes in hormone levels [see Section 7.2.3]), shifts in foraging grounds (see Sections 9.0 and 10.0), and other behavioral disturbances (i.e., changes in migration [see Section 10.1]). In most cases, marine mammal behavioral responses to sound results in avoidance of the ensonified area and therefore reduced exposure to the sound. Project activities may cause migrating marine mammals to shift their migration corridors, but as discussed in Section 10.1, migration activities will not cease altogether. As stated above, no important habitat areas (i.e., breeding, calving, pupping, nursery, or haul-out areas) are known to occur within the Project area (Hayes et al. 2022). Therefore, US Wind does not anticipate population level impacts to occur as a result of Project activities.

Impact driving of piles for foundations the use of HRG survey equipment during micro-siting activities, and vessel activity in the Project area, are not expected to result in population-level effects to marine mammals. Potential exposure to Level A harassment is expected to be limited to one individual fin whale, humpback whale, minke whale, and sei whale, and would have a negligible impact on the populations of these species. The requested Level A and Level B takes for fin whale, humpback whale, minke whale, sei whale, and harbor porpoise are all much lower than each species' respective PBR (11, 22, 170, 6.2 and 851 respectively; see Table 3-1). Project activities are not expected to contribute to ongoing UMEs for the NARW, humpback whale, or minke whale. Additionally, due to the localized area impacted by Project activities, these activities would not prevent the movement of marine mammals through the region and are not anticipated to impact marine mammal feeding. No long-term or population level effects to marine mammal stocks are expected to result from Project activities.

8.0 Anticipated Impacts on Subsistence Uses

There are no traditional Arctic subsistence hunting areas in the Lease Area, and the proposed activities will have no impact on the availability of marine mammal species or stocks for subsistence uses.

9.0 Anticipated Impacts on Habitat

Project activities, including construction, installation, and operations, could impact habitats within the Project area due to exposure to noise, and changes in water quality and benthic habitat due to bottom-disturbing actions and the addition of hard substrate.

As detailed above, construction and installation activities are expected to result in the exposure of limited numbers of marine mammals to levels of noise with the potential to cause behavioral (Level B) or physiological (Level A) impacts.

9.1 Short-Term Impacts

Exposure to noise from pile driving and site characterization activities could cause behavioral or physiological responses in fish and other marine mammal prey species. Potential physiological effects to fish exposed to high levels of noise include stress, injury, and death, though responses are likely to be species-specific. The most likely behavioral response in fish is avoiding the sound source, though some species may be attracted to noise (Normandeau Associates 2012). Though these organisms may temporarily vacate the ensonified area, this response will be temporary, and fish distribution in the Project area should return to pre-activity conditions following the cessation of noise-producing activities.

Vessel noise can also result in a reduction of the communication space available to fish (Putland et al. 2017). Using AIS data, Putland et al. (2017) discovered that routine vessel traffic reduced communication space for bigeye (*Pempheris adspersa*) by up to 61.5%. For a large commercial vessel passing less than 10 km (6.2 miles) from the listening station, the communication space was reduced up to 99%, as compared to ambient conditions (Putland et al. 2017).

The installation of WTGs, OSSs, the Met Tower, and offshore export cables would also result in the disturbance of a small amount of seafloor habitat, potentially causing changes in water quality that have the potential to impact marine mammal prey species. Increased suspended sediments can negatively impact fish and invertebrates by clogging their filtering or respiratory organs, necessitating increased respiratory rates to maintain sufficient oxygen intake (fish; (Newcombe and Jensen 1996)), or leading to decreased feeding efficiency (benthic invertebrates; (Thrush et al. 2004)). However, any increases in suspended sediments resulting from installation activities are expected to be highly localized and temporary. As sand is the dominant grain size within the Lease area and export cable corridors (ESS Group 2022; Wood Thilsted 2022), disturbed sediments are expected to rapidly settle out of the water column.

Small releases of lubricants, solvents, or other chemicals could occur during the installation of nacelles, turbines, and blades on the WTGs. In the event of a collision, allision, or other accident, oils and hydraulic fluids contained within components of the WTGs and OSSs could be spilled; however, this is highly unlikely to occur and spill prevention plans will mitigate any impacts. US Wind has an Oil Spill Response Plan and an Oil Spill Response Organization under contract (US Wind 2022, Appendix I-A) to immediately respond to and clean up spills in the event a spill could occur. Bejarano et al. (2013) found that the accidental release of up to a few thousand gallons of oils would have a localized and temporary impact on the environment. Any larger spills would have increased impacts on a spatial and environmental scale, but these spills are unlikely (1 occurrence in ≥1,000 years; (Bejarano et al. 2013)). Water quality impacts due to routine and accidental releases are anticipated to have negligible impacts on marine mammal habitat.

9.2 Long-Term Impacts

The addition of foundations for the WTGs, OSSs, and Met Tower would result in very localized alterations in bottom habitat within the Lease area. These structures would also provide new habitat, of a type previously rare within the Lease area, for the duration of Project operation (Wilhelmsson and Malm 2008; Glasby 1999; Connell 2000). Project structures may act as “artificial reefs”, attracting invertebrate and fish species previously absent from the sandy soft bottom habitats in the Project area (described in Section 2.2, (Wilhelmsson and Malm 2008; Glasby 1999; Connell 2000)).

To examine the impact of an operational wind farm on fish species, a demersal trawl survey was performed monthly from October 2012 to September 2019 at Block Island Wind Farm in Rhode Island (Wilber et al. 2022). The study determined that while there was no significant impact on catch due to the wind farm's operation, the catch of structure-oriented fish (like black sea bass) was higher near the wind farm than in a reference area (Wilber et al. 2022). The relative abundance of schooling species (like Atlantic herring, butterfish, and scup) was not affected by wind farm operations and any observed changes corresponded to regional trends (Wilber et al. 2022). Similarly, another recent study determined that the installation of an operational wind farm in Sweden did not cause large-scale changes in fish diversity and abundance (Bergström, Sundqvist, and Bergström 2013). Though Bergström et al. (2013) did document changes in pre-installation and post-installation species occurrence and community composition; these changes were consistent with trends observed at a control site, indicating that regional environmental factors were the main drivers of these changes. Based on the Block Island study, the installation of structures in the Project area is expected to result in increased localized abundance of species (such as black sea bass, an important commercial and recreational fishery in the region). However, community-scale changes are not anticipated. The benthic habitat within the Lease area and the offshore export cable corridors is dominated by soft bottom habitat and large grained complex habitat is exceptionally rare (TRC Companies 2022). Therefore, the Project will increase the habitat complexity in an otherwise mostly sandy bottom area, which may also benefit species.

New structures may impact ocean circulation, although more study is needed on the Atlantic OCS. Previous studies have shown that the presence of turbines influences the prevailing wind pattern, which can cause upwelling and impact stratification of the water column (Broström and G. 2008; Paskyabi and Fer 2012).

Tougaard et al. (2020) examined the impacts of wind farm noise in Europe and Block Island, Rhode Island. The study indicated that the source levels of the turbines were 10-20 dB lower than ship noise that occurs in the same frequency range (Tougaard, Hermannsen, and Madsen 2020). Sound pressure levels were primarily determined by distance to the turbines (Tougaard, Hermannsen, and Madsen 2020). In areas where ambient noise was low, operational wind turbine noise levels could be detected up to a few kilometers away (Tougaard, Hermannsen, and Madsen 2020). However, when ambient noise was high due to vessel traffic or high winds, cumulative wind farm operational noise was below ambient levels, except for in close proximity to turbines (Tougaard, Hermannsen, and Madsen 2020). US Wind intends to install direct drive WTGs which have been found to have lower operational sound than older, gear box drive WTGs (Tougaard, Hermannsen, and Madsen 2020; Stöber and Thomsen 2021). The Project is located in an area where ambient noise levels are high due to the adjacent Traffic Separation Scheme and high volume to commercial shipping traffic (Bailey et al. 2018a). Cumulative operational noise levels from the Project are expected to be below ambient levels.

10.0 Anticipated Effects of Habitat Impacts on Marine Mammals

10.1 Short-Term Impacts

Noise from construction and installation activities (discussed in Section 1.5) and increased vessel presence within the Project area, may cause marine mammals to temporarily avoid the Project area. Marine mammals have been known to shift their migratory corridors to avoid acoustically noisy areas (Erbe, Dunlop, and Dolerman 2018). A study by Clark et al. (1983) found that grey whales shifted their migratory corridor in response to low frequency sonar, with larger shifts documented in response to louder source levels. However, grey whales did not abandon their migratory behavior as a result of increased noise levels (C. Clark et al. 1983). Based on information in Section 4.0, marine mammals that may shift their migration corridors to avoid noise from Project activities include NARW, humpback whales, minke whales, common bottlenose dolphins, and potentially other species whose migratory patterns are not well understood. Due to the small area impacted by Project activities, these activities would not prevent the movement of marine mammals through the region and are not anticipated to have long-term or population level effects to marine mammal stocks.

There are no known foraging areas within the Project area, although it is possible that some species, including but not limited to bottlenose dolphins, harbor porpoises, and seals, may feed in the area. As stated in Section 9.1, marine mammal prey species may also avoid the Project area during construction (Normandeau Associates 2012) or be negatively impacted due to increased sediment suspension from installation activities (Newcombe and Jensen 1996; Thrush et al. 2004), potentially reducing prey availability for marine mammals. Project installation activities would be short-term and have temporary and localized impacts, so prey distribution is expected to rapidly return to pre-activity conditions and, therefore, short-term habitat impacts to marine mammals are expected to be negligible.

10.2 Long-Term Impacts

Operation of the Project would result in the addition of new structures (i.e., WTGs, OSSs, and Met Tower) within the water column in the Project area. Marine mammals traveling within or through the Project area (like the North Atlantic right whale) would need to divert their course to avoid striking these structures. The presence of WTGs, OSSs, and the Met Tower would not prevent the movement of marine mammals through the region (i.e., migration) due to the spacing between structures and are not anticipated to have population level effects on marine mammal stocks (Erbe, Dunlop, and Dolerman 2018; C. Clark et al. 1983).

New habitat created from the installation of foundations for the WTGs, OSSs, and Met Tower may also influence prey availability for marine mammals. These structures may act as artificial reefs and attract prey species to areas where they were previously absent, due to the difference in substrate type between the foundations and the surrounding soft bottom habitat (Wilhelmsson and Malm 2008; Glasby 1999; Connell 2000). Foundations may become hotspots of fish diversity and act as “fish aggregating devices,” because of the availability of different food sources, increasing the availability of prey for marine mammals (Reubens et al. 2013). Seals have been documented to forage on underwater man-made structures (Russell et al. 2014; Arnould et al. 2015), and increased catch of striped bass, a structure-oriented species, was documented on the wind farm in comparison to a reference area (Wilber et al. 2022). Impacts on the abundance of shoaling species were not observed (Wilber et al. 2022), and another recent study determined that the installation of wind farms did not cause large-scale changes in fish diversity and abundance (Bergström, Sundqvist, and Bergström 2013). Therefore, though the installation of Project structures may result in localized changes in the abundance of certain species (e.g., black sea bass, fouling organisms), community-scale changes in marine mammal prey abundance are not expected to occur.

If the presence of Project structures causes a change in ocean circulation, it may cause marine mammals to shift their foraging grounds to account for shifting distributions of prey species. US

Wind would follow existing regulations that work to reduce impacts to NARW and other marine species during Project operations.

10.3 Summary

Habitat alteration due to the presence of the submarine cables, WTGs, OSSs and the Met Tower foundations are not expected to impact marine mammal populations. The addition of man-made structures to the marine habitat within the Project area would not physically restrict marine mammal movement and would not present a barrier for marine mammal migration. The Ocean Wind Draft Environmental Impact Statement (DEIS) assessed the presence of structures and their potential impact on marine mammals. This analysis concluded that the largest individuals of the four largest whale species (NARW, fin whale, sei whale, and sperm whale) would fit lengthwise between two foundations spaced 1 NM (1.9 km) apart 100 times over (BOEM 2022), and, therefore, WTG and OSS foundations would not act as a physical barrier to the movement of marine mammals. Secondary effects of physical habitat alteration and Project operation may facilitate increased abundance of some marine mammal species due to increased prey densities due to artificial reef effects (see Section 9.0).

11.0 Mitigation Measures to Protect Marine Mammals and Their Habitat

The mitigation measures that US Wind plans to implement would reduce the potential for negative impacts to marine mammals during construction and operations. In addition to compliance with the regulations US Wind is applying advanced mitigation measures to decrease the potential impacts to marine mammals.

Vessel strike avoidance measures

All Project vessels used during surveys, construction, and operations will abide by the vessel strike avoidance measures.

- Vessels 19.8 meters (65 feet) in length or greater would operate at speeds of 10 knots or less in NARW Special Management Areas (SMAs). Additionally, all vessels would operate at speed of 10 knots or less in Right Whale Slow Zones, identical to Dynamic Management Areas (DMAs), to protect visually or acoustically detected NARW. US Wind would incorporate the proposed revision to the NARW vessel speed rule[17] for vessels 10.6-19.8 meters (35-65 feet) in length upon implementation.
- All vessels would maintain a minimum separation distance of 500 meters (1,640 feet) or greater from any sighted NARW. If a NARW is sighted within this shutdown zone while underway, the vessel would steer a course away from the whale at 10 knots (18.5 kilometers/hour) or less until the 500 meters (1,640 feet) minimum separation distance has been established. If a NARW is sighted within 100 meters (328 feet) of an underway vessel, the vessel operator would immediately reduce speed and promptly shift the engine to neutral. If the vessel is stationary, the operator would not engage engines until the North Atlantic right whale has moved beyond 100 meters (328 feet).
- All vessels would maintain a separation distance of 100 meters (328 feet) or greater from any sighted non-delphinid cetacean other than the NARW. If a non-delphinid cetacean is

[17] On August 1, 2022, NMFS published proposed amendments to the North Atlantic right whale vessel strike reduction rule (87 FR 46921). As of this writing the proposed amendments have not been finalized.

sighted within 100 meters (328 feet) of an underway vessel, the vessel operator would immediately reduce speed and promptly shift the engine to neutral. The vessel operator would not engage the engines until the non-delphinid cetacean has moved beyond 100 meters (328 feet). If a vessel is stationary, the operator would not engage engines until the non-delphinid cetacean has moved beyond 100 meters (328 feet).

- All vessels would maintain a separation distance of 50 meters (164 feet) or greater from any sighted delphinid cetacean or pinniped, except if the mammal approaches the vessel. If a delphinid cetacean or pinniped approaches an underway vessel, the vessel would avoid excessive speed or abrupt changes in direction to avoid injury to these organisms. Additionally, vessels underway may not divert to approach any delphinid cetacean or pinniped.
- All vessels would reduce speed to less than or equal to 10 knots when mother/calf pairs, pods, or large assemblages of ESA-listed marine mammals are observed.
- All vessels would monitor for marine mammal species both visually and acoustically during all Project activities. Zone size would depend on the species. This is discussed further in the following section.

Visual and Acoustic Monitoring

Visual monitoring methods have been effectively employed by US Wind and others to detect the presence of marine mammals and identify species. Visual monitoring would be employed during specified project activities. The intent is for visual monitoring to be coupled with acoustic monitoring to trigger mitigation measures for the protection of marine mammals and other protected species.

US Wind anticipates using Passive Acoustic Monitoring (PAM) during Project construction and installation activities which would be conducted by PAM Operators using equipment that can detect all known species in the region using one or a combination of the technologies.

- PSOs would visually monitor 360° as far as the eye can see, including the clearance and/or shutdown zone around the vessel at all times for the presence of marine mammals and all other protected species. Visual observers will use binoculars with a minimum of 8x or 10x magnification, reticule binoculars that allow for range estimations to be made, and an SLR camera with a zoom lens. PSOs would also have access to big eye binoculars (25/40x) mounted on the deck in a location that provides for optimal observation, PSO safety, and safe vessel operation.

- A sufficient number of PSOs will operate in shifts to effectively monitor and visually clear the clearance and shutdown zones as required.

    - A team of four to six Protected Species Observers (PSOs) supplied by a third-party PSO Provider will be on board each vessel that will be conducting daylight only survey operations to undertake visual watches, implement mitigation, and conduct data collection and reporting.

    - A team of two to three PSOs supplied by a third-party PSO Provider will be on board each vessel that will be conducting daylight only survey operations to undertake visual watches, implement mitigation and conduct data collection and reporting.

- A team of six to eight dual role PAM Operators / PSO supplied by a third-party PSO Provider will be on board the construction vessel and the secondary support vessel that will be conducting daylight only construction operations (impact piling of foundations) to undertake visual and acoustic watches, implement mitigation and conduct data collection and reporting. Each PSO would only perform one duty (visual observing or PAM) at a given time.
- During pile driving at least two PSOs would be on duty on the foundation installation vessel.

- It will be the responsibility of the PSO team to report any visual or acoustic detections via the appropriate communication channels, outlined in the following communication diagram (Figure 11-1).

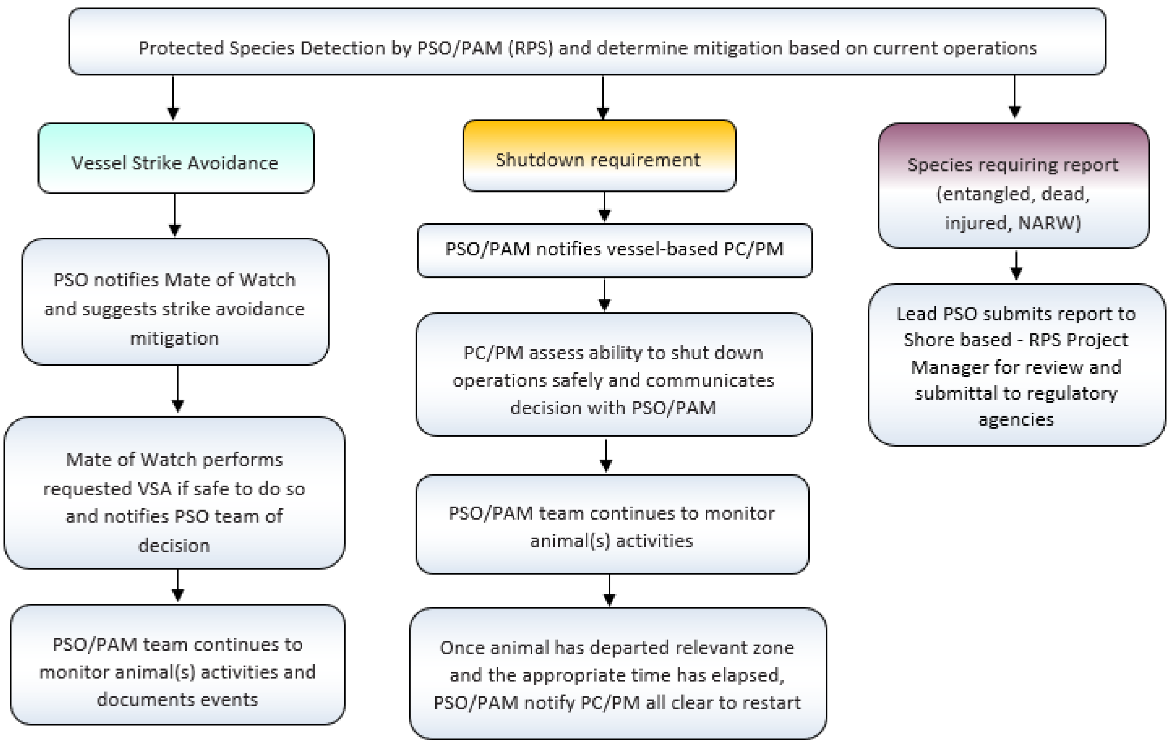

Figure 11-1. Situational communication plan for PSO/PAM Operators deployed on project vessels

Micro-siting HRG Survey Mitigation Measures

US Wind would implement the following mitigation measures during micro-siting HRG surveys:

- Employ a 500-meter (1,640-foot) clearance zone for all ESA-listed species and a 200-meter (656-foot) clearance zone for non-ESA-listed marine mammals and sea turtles.

- Employ a 500-meter (1,640-foot) shutdown zone for NARW and unidentified whales and a 100-meter (328-foot) shutdown zone for all other marine mammals.

- PSOs will monitor the shutdown zones for marine mammals during all micro-siting HRG surveys.

- Employ ramp-up procedures at the start or re-start of survey activities to allow for marine mammals to vacate the area. Equipment startup will begin with the power of the smallest acoustic equipment at its lowest power output. Power output would then gradually increase when technically feasible. If a marine mammal enters the shutdown zone during ramp-up, this procedure will be delayed until the animal exits the shutdown zone or no further sightings are reported for 15 minutes for small odontocetes and pinniped and 30 minutes for all other species.

- Shutdown of micro-siting HRG equipment if a non-delphinoid cetacean is sighted at or within the shutdown zone. Power up would occur after the shutdown zone is clear of marine mammals or it is determined that the marine mammal, based on its speed and vector, voluntarily approached the vessel.

  - For Delphinus, Stenella, Lagenorhynchus, and Turiops (small delphinid genera that are known to bow-ride), the shutdown requirement would be waived. If there is uncertainty regarding the identification of the marine mammal species as one of these exempt species, the PSOs on duty would use their best professional judgement in calling for a shutdown. Shutdown would still be implemented for other delphinids that enter the shutdown zone that are not part of the exempt genera.

- If the shutdown occurred for reasons other than the presence of marine mammals within the shutdown zone and lasted for longer than 20 minutes, the ramp-up procedures would be followed after clearance of the shutdown zone. If the shutdown is less than 20 minutes, then the equipment may be restarted as long as visual surveys continued through the down time and no marine mammals entered the shutdown zone; otherwise, the equipment will follow ramp-up procedures following the clearance of the shutdown zone.

Sound Mitigation Measures for Impact Pile Driving

US Wind would implement the following pile driving sound mitigation measures:

- Prepare a pile driving monitoring plan, to include details about the measures listed below, prior to construction activities. Mitigation measures may be modified to reflect conditions set by NOAA Fisheries following the submission of this LOA.

- Pile driving would occur only between May and November of any construction year.

- Noise attenuation through deployment of near- and far-field sound attenuation technologies. Near-field sound abatement technologies would be deployed during monopile installation and could include technologies such as AdBm Technologies Noise Mitigation System or using a damper between the hammer and sleeve to prolong the impact pulse. Far-field technologies employed during all impact pile driving would include a large double bubble curtain, deployed by a separate vessel mobilized to the installation location. Implement sound attenuation technologies such as double bubble curtains and nearfield attenuation devices to reduce underwater pile driving noise by 10 dB, with a target of 20 dB for monopile installation, at the source.

- Establish a clearance zone prior to pile driving using a combination of visual and acoustic monitoring for large whales. The clearance zone is to be monitored for as far as the eye can see, for a minimum of 60 minutes and the zone must be clear for 30 minutes before beginning soft-start procedure. The clearance and shutdown zones for each pile driving activity are included in Tables 11-1 to 11-3.

Table 11-1. Distances from Monopile Installation for Clearance and Shutdown

Marine Mammal Hearing Group	Clearance Zone	Shutdown Zone
Low Frequency Cetaceans	5,250 m	2,900 m
Mid-frequency Cetaceans		0 m
High Frequency Cetaceans		250 m
Pinnipeds in Water		100 m

Table 11-2. Distances from Skirt Pile Installation for Clearance and Shutdown

Marine Mammal Hearing Group	Clearance Zone	Shutdown Zone
Low Frequency Cetaceans	1,400 m	1,400 m
Mid-frequency Cetaceans		0 m
High Frequency Cetaceans		100 m
Pinnipeds in Water		50 m

Table 11-3. Distances from Pin Pile Installation for Clearance and Shutdown

Marine Mammal Hearing Group	Clearance Zone	Shutdown Zone
Low Frequency Cetaceans	100 m	50 m
Mid-frequency Cetaceans		0 m
High Frequency Cetaceans		0 m
Pinnipeds in Water		0 m

- Once clearance zone is confirmed clear of marine mammals through visual and acoustic methods, a soft-start procedure would be implemented during installation activities. This process would consist of pile driving starting with minimum hammering at low energy for no less than 30 minutes.

- If a marine mammal is detected within the clearance zone, prior or during the soft-start procedure, pile driving would be delayed until the marine mammal leaves or is no longer observed after 30 minutes.

- If a marine mammal is detected after pile driving has commenced, an immediate shutdown of pile driving would be implemented unless it is determined not feasible due to an imminent risk of injury or loss of life.

- Pile driving would halt if the shutdown zones cannot be effectively monitored visually, or in the case of the minimum visibility of 2,900 m, cannot be visually and acoustically monitored.
- Additional restrictions on pile driving would include: no simultaneous pile driving; no more than one monopile driven per day; daylight pile driving only unless health and safety issues require completion of a pile; and initiation would not begin within 1.5 hours of civil sunset or in times of low visibility when the visual clearance zone and shutdown zone cannot be visually monitored, as determined by the lead Protected Species Observer (PSO) on duty.

US Wind's Marine Mammal Monitoring and Mitigation Plan is included in the LOA Application as Appendix B.

12.0 Mitigation Measures to Protect Subsistence Uses

There are no traditional Arctic subsistence hunting areas within the Project area. As such, it can be expected that the proposed activities would have no impact on the availability of marine mammal species or stocks for subsistence hunting uses.

13.0 Monitoring and Reporting

13.1 Mitigation Monitoring

US Wind will apply the monitoring procedures to decrease the potential impact to marine mammals. These are detailed in Appendix B.

- Visual clearance and shutdown zones would be monitored by NOAA Fisheries-approved Protected Species Observers (PSOs) from vantage point on vessels with an unobstructed view of the water when feasible. PSOs would follow the required protocols for observing and reporting marine mammals.

    - PSOs would inform the captain, or designated personnel, if a protected species is heading toward or enters the clearance and/or shutdown zone around the sound-producing activity so as to minimize or reduce the chance of injuring a protected species.

    - PSOs would summarize daily monitoring effort and submitting data forms to the appropriate staff or database.

    - The designated Lead PSO would communicate with the vessel team, the PSO onshore support team (contractor support team for on duty PSOs) and US Wind compliance personnel. The Lead PSO will communicate with the vessel, survey and/or installation equipment operators in the event that mitigation measures must be implemented. The Lead PSO would also be responsible for monitoring the NOAA Fisheries North Atlantic Right Whale Reporting Systems for the presence of right whales. This includes checking the Early Warning System, Sighting Advisory System, and the Mandatory Ship Reporting System.

- Passive Acoustic Monitoring (PAM) would be implemented during construction activities. The monitoring will be performed by qualified PSOs. The PAM Leads will be responsible for monitoring for acoustic detections of marine mammals. The PAM system will be located away from the installation vessel to avoid interference. The system would be in operation in accordance with the pre-piling clearance timing. Deployment of the PAM system will be outside the perimeter of the shutdown zone for WTG and OSS foundation installation.

- US Wind will ensure that vessel operators monitor NOAA Fisheries NARW reporting systems (e.g., Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System) for the presence of NARWs during all Project activities.

- US Wind would ensure that vessel operators and crews maintain a vigilant watch for marine mammals, and slow down or stop their vessel to avoid striking these protected species. All vessel operators would be briefed to ensure they are familiar with the guidance specified in the Vessel Strike Avoidance Policy described in Appendix B.

13.2 General Monitoring

US Wind has partnered with the University of Maryland Center for Environmental Science (UMCES) to perform a passive acoustic monitoring study to detect large whales, such as NARW, and dolphins. Utilizing a before-during-after-gradient design, deployed devices will be used to characterize the ambient noise levels and evaluate how marine mammals and other tagged species using receivers on the PAM array (i.e., fishes, sharks, rays, and turtles) respond to the construction and installation of the Project. This study will help distinguish changes in marine mammal behavior due to Project activities versus natural inter-annual variation in the region. More information on this study is provided in Section 1.4.3.2.

13.3 Reporting

US Wind will comply with all applicable marine mammal reporting requirements for Project construction and installation activities and surveys, including the following:

Prior to start of construction activities

- US Wind will confirm in a report to NOAA Fisheries that personnel involved in offshore activities, including but not limited to vessel crews, vessel captains, PSOs, and PAM operators, have completed training regarding protected species awareness and vessel strike avoidance measures.

- PSO resumes with training detail, prior experience, prior NOAA Fisheries' approvals, and other relevant information will be submitted to NOAA Fisheries for approval prior to the start of activities for which take is requested.

- US Wind will establish a reporting schedule to provide weekly, monthly, and annual information to NOAA Fisheries.
    - PSO and PAM reports would be compiled daily and provided to NMFS on a weekly basis. Details of data to be collected by PSOs and PAM operators are described below.

- All data contained in the weekly reports will be compiled into a monthly report. Monthly reports would also include vessel transit information, number of piles installed or survey line kilometers during the reporting period, observations of marine mammals, and summary of mitigation actions taken.

- US Wind will provide NOAA Fisheries with an annual report every calendar year following the commencement of Project construction and installation activities. A final report will be provided at the conclusion of Project activities. The reports will include a summary of the raw data pertaining to Project activities, all PSO, PAM, and incident reports, and an estimate of the number of listed marine mammals observed and/or taken during the Project activities for the preceding year. The report will also contain a detailed analysis and interpretation of sound source verification data collected by US Wind.

During Project activities

- PSO data collection will occur daily. Standardized forms provided to and approved by NOAA Fisheries will include, at a minimum, the following information:

  - Vessel name;

  - Observers' names and affiliations;

  - Date, location, duration and a description of the type and duration of Project activities;

  - Time and latitude/longitude when daily observations began;

  - Time and latitude/longitude when daily observations ended;

  - Environmental conditions during visual surveys, including wind speed and direction; sea state (glassy, slight, choppy, rough, or Beaufort scale, tidal state); swell (low, medium, high, or swell height in meters); weather conditions (i.e., percent cloud cover, visibility, percent glare); and overall visibility (poor, moderate, good) and distance;

  - Species (or identification to lowest possible taxonomic level, sex, age, classification [if known], numbers);

  - Certainty of identification (sure, most likely, best guess);

  - Total number of animals;

  - Number of juveniles;

  - Time and location (i.e., distance from sound source) of observation;

  - Description (as many distinguishing features as possible of each individual seen, including length, shape, color and pattern, scars or marks, shape and size of dorsal fin, shape of head, and blow characteristics);

- Direction of animal's travel – related to the vessel (drawing preferably);
- Reaction of the animal(s) to relevant sound source (if any) and behavior - as explicit and detailed as possible; note any observed changes in behavior (e.g., avoidance, approach) including bearing and direction of travel; and
- Activity of vessel or Project activity when sighting occurred.

- Real-time PAM observational reports will include the following information:
  - Location of hydrophone and site descriptor;
  - Bottom depth and depth of recording unit;
  - Make and model of recorder and manufacturer, along with platform type;
  - Deployment and retrieval times;
  - Duration of recording;
  - Recording schedule;
  - Details of the hydrophone and recorder including sensitivity, calibration, sampling rate, and detection range;
  - Acoustic detections would be logged and include species identification, call type and number of calls, timing of detection(s), detection confidence level, and relation to visual sightings, if any;
  - Details of sampling protocols for determining detections such as software, frequencies monitored; and,
  - Name of PAM operator(s) and monitor(s).

Situational reporting

- Any sighting or confirmed acoustic detection of a NARW will be reported to NOAA Fisheries within 24 hours of the observation and reported on the WhaleAlert application.
- US Wind will notify BOEM and NOAA Fisheries at least 24 hours prior to the commencement of pile driving for each of the construction campaigns and micro-siting HRG survey activities, and again within 24 hours of the conclusion of pile driving activities for each construction campaign and the completion of micro-siting HRG survey activities.
- US Wind will ensure that any sightings of injured or dead marine mammals are reported to BOEM, NOAA Office of Protected Resources (OPR), and the NOAA Fisheries Greater Atlantic (Northeast) Regional Fisheries Office's (GARFO) Stranding Hotline (866-755-6622 or current).
  - Sightings will be reported within 24 hours to OPR, GARFO, and BOEM, including whether the injury or death was caused by a vessel under contract to US Wind.

   - US Wind will use the form provided in Appendix A to the Addendum "C" of the Lease to report the sighting or incident. If Project activities are responsible for the injury or death, US Wind will supply a vessel to assist in any salvage effort as requested by NOAA Fisheries.

- US Wind will ensure that the PSOs report any observations concerning impacts on Endangered Species Act listed marine mammals to BOEM and NOAA Fisheries within 48 hours. US Wind will report any injuries or mortalities using the Incident Report provided in the Lease. Any observed takes of listed marine mammals resulting in injury or mortality will be reported within 24 hours to BOEM and NOAA Fisheries.

14.0 Suggested Means of Coordination

US Wind will compile a comprehensive online wildlife information database to include surveys, PSO data, and other wildlife monitoring efforts such as digital aerial avian surveys. US Wind retained Normandeau Associates, Inc. and the Remote Marine and Onshore Technology (ReMOTe) platform to compile wildlife information that can be accessible to interested agency staff, UMCES, and the research community. All data collected during Project surveys and during Project construction on marine mammals in the Project area will be provided to NOAA Fisheries, BOEM, and other interested government agencies. The database will also be made available upon request to research and environmental groups. The data collected could be used to make informed management decisions that help reduce incidental harassment.

US Wind is a member of the Regional Wildlife Science Collaborative providing information regarding survey efforts to other industry members, government agencies, environmental non-governmental organizations, and the academic community members.

15.0 List of Preparers

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