OCS-A 0501

MASS USA

VINEYARD WIND

Draft
Construction and Operations Plan

Volume I

Vineyard Wind Project

June 3, 2020

Submitted by
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Submitted to
Bureau of Ocean Energy Management
45600 Woodland Road
Sterling, Virginia 20166

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June 3, 2020

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LIST OF ACRONYMS

AC	Alternating current
AR	Avangrid Renewables
BOEM	Bureau of Ocean Energy Management
Call	Call for Information and Nominations
CBP	County Business Patterns
CCC	Cape Cod Commission
CBA	Community Benefit Agreement
CFR	Code of Federal Regulations
CIP	Copenhagen Infrastructure Partners
CO_2	Carbon Dioxide
COP	Construction and Operations Plan
CSV	Construction support vessel
CTV	Crew Transfer Vessel
CVA	Certified Verification Agent
cy	Cubic yard
DP	Dynamically positioned
DPW	Department of Public Works
EA	Environmental Assessment
ECC	Export Cable Corridor
EEA	Executive Office of Energy and Environmental Affairs
eGRID	Environmental Protection Agency's Emissions & Generation Resource Integrated Database
ENF	Environmental Notification Form
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
ESP	Electrical service platform
FAA	Federal Aviation Administration
FDR	Facilities Design Report
FIR	Fabrication and Installation Report
FONSI	Finding of No Significant Impact
ft	feet
gal	gallons
G.L.	General Law
HDD	Horizontal directional drilling
HSE	Health, Safety and Environment
HVAC	Heating Ventilation and Air Condition
IEC	International Electrotechnical Commission
IHA	Incidental Harassment Authorization
IMCA	International Marine Contractors Association
IMO	International Maritime Organization

LIST OF ACRONYMS (CONTINUED)

kJ	kilojoules
km^2	Square kilometers
kV	kilovolt
L	liters
LOA	Letter of Authorization
m	meters
MA	Massachusetts
MA CZM	Massachusetts Coastal Zone Management
MA DEP	Massachusetts Department of Environmental Protection
MA DMF	Massachusetts Division of Marine Fisheries
MA EFSB	Massachusetts Energy Facility Siting Board
MA WEA	Massachusetts Wind Energy Area
MassCEC	Massachusetts Clean Energy Center
MEPA	Massachusetts Environmental Policy Act
MLLW	Mean Lower Low Water
mm^2	Square millimeters
MP	monopile
MSD	Marine sanitization device
MW	megawatt
nm	Nautical miles
NMFS	National Marine Fisheries Service
NO_x	Nitrogen Oxide
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance Facilities
OCS	outer continental shelf
OECC	Offshore Export Cable Corridor
OEM	Original Equipment Manufacturers
OSRP	Oil Spill Response Plan
RFI	Request for Interest
RI	Rhode Island
RNA	Rotor Nacelle Assembly
ROTV	Remotely operated towed vehicle
ROV	Remotely operated vehicle
ROW	Right-of-way
RSD	ripple scour depressions
SAP	Site Assessment Plan
SCADA	supervisory control and data acquisition
SMS	Safety Management System
SO_2	Sulfur dioxides

LIST OF ACRONYMS (CONTINUED)

SOV	Service Operations Vessel
TBD	To be determined
TBF	To be filed
THPO	Tribal Historic Preservation Officer
TP	Transition piece
tpy	Tons per year
TSHD	Trailing suction hopper dredge
US	United States
USCG	United States Coast Guard
USFWS	United States Fish & Wildlife Service
Utility ROW	Utility Right of Way
WDA	Wind Development Area
WEA	Wind Energy Area
WTG	wind turbine generator

Section 1.0

Project Overview

1.0 PROJECT OVERVIEW

1.1 Introduction

Vineyard Wind, LLC ("Vineyard Wind") is proposing an 800 megawatt ("MW") wind energy project within Bureau of Ocean Energy Management ("BOEM") Lease Area OCS-A 0501, consisting of offshore Wind Turbine Generators ("WTGs") (each placed on a foundation support structure), Electrical Service Platforms ("ESPs"), an onshore substation, offshore and onshore cabling, and onshore operations & maintenance facilities (these facilities will hereafter be referred to as the "Project"). The location of the Lease Area is depicted on Figure 1.1-1. As is described later in this document, the 800 MW Project will be located in the northern portion of the over 675 square kilometers ("km^2") (166,886 acre) Lease Area (referred to as the "Wind Development Area" or "WDA").

1.2 Massachusetts Offshore Wind Leasing Program

BOEM has evaluated areas along the Atlantic coast with respect to their potential suitability for offshore wind development via a public stakeholder and desktop screening[1] process, which began in 2009. The location of the Massachusetts offshore wind lease areas, including the Vineyard Wind Lease Area, was determined through a process that involved significant public input over a period of approximately six years. The process began with the formation of a Massachusetts-BOEM task force, composed of representatives from many federal, state, tribal, and local government agencies, as well as public stakeholder meetings. As a result of this initial planning and consultation, BOEM published a Request for Interest ("RFI") on December 29, 2010 for a preliminary Massachusetts ("MA") Wind Energy Area ("WEA") of approximately 7,628 km^2 (1,884,920 acres), referred to as the "RFI area." This RFI requested expressions of commercial interest from potential wind energy developers, as well as any information from the public relevant to determining the suitability of the RFI area for offshore wind development. After the initial round of responses to the RFI, BOEM announced a second public comment period, which closed on April 18, 2011. A total of 10 companies, including Vineyard Wind/Vineyard Power, responded to the RFI and 260 public comments were received.

After careful consideration of the public comments, as well as input from the Massachusetts-BOEM task force, BOEM extensively modified the RFI area to address stakeholder concerns. For example, BOEM decided to exclude certain areas identified as important habitats that could be adversely affected if ultimately used for offshore wind energy development. BOEM also excluded an area of high sea duck concentration, as well as an area of high fisheries value so as reduce potential conflict with commercial and recreational fishing activities. The

1 Conducted by the Department of Energy's National Renewable Energy Laboratory.

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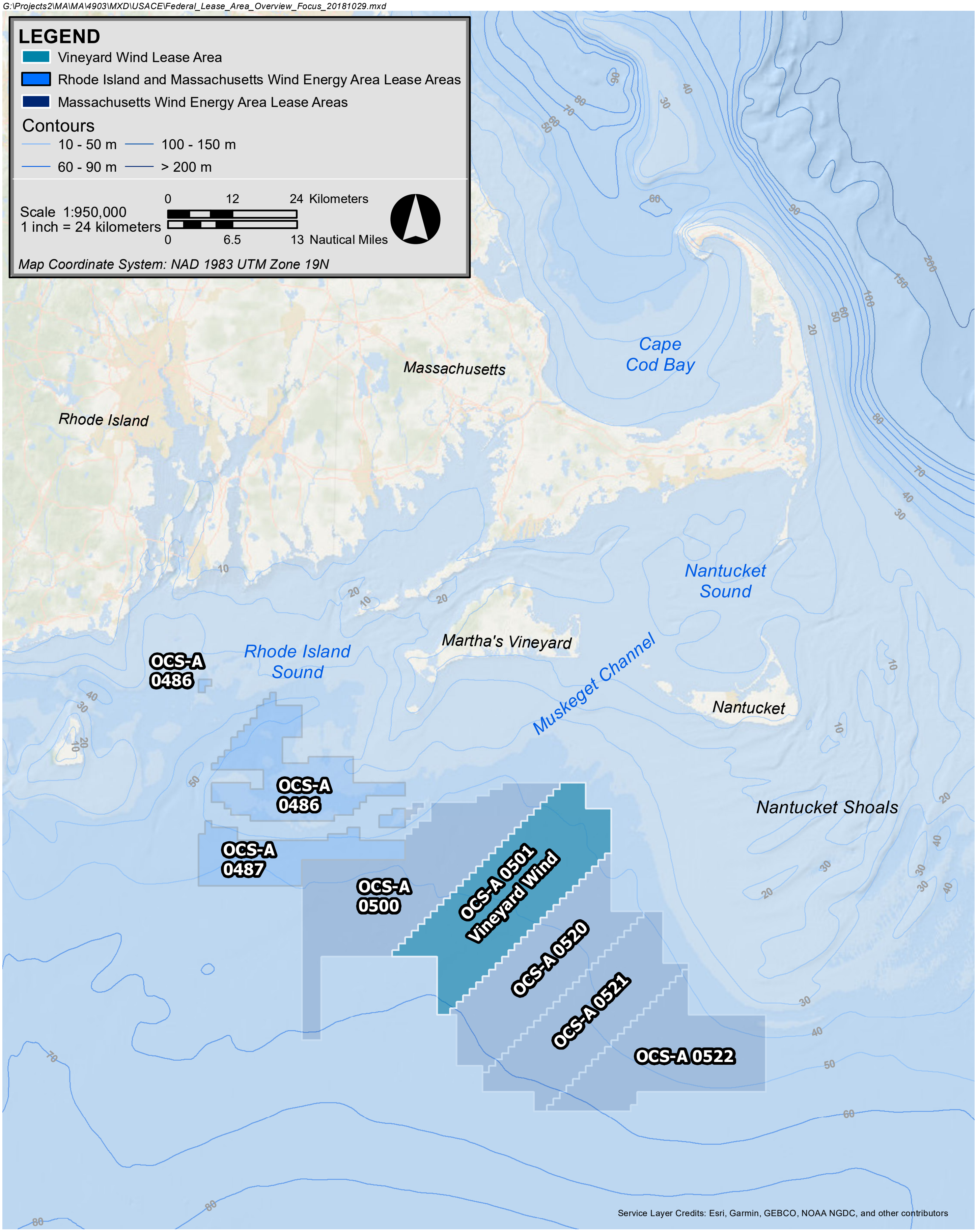

Vineyard Wind Project

VINEYARD WIND

Figure 1.1-1

RI and MA Lease Areas Overview

distance from the WEA to the nearest shore was also extended, in order to further reduce any possible viewshed impacts. These extensive revisions resulted in the revised MA WEA being reduced in size, as compared to the preliminary RFI area, by approximately 40%.

On February 6, 2012, BOEM published a "Call for Information and Nominations" ("Call") for areas within the revised MA WEA (the "Call Area"). The Call for Information and Nominations requested the submission of a nomination for a lease by those interested in potentially obtaining a commercial lease for the "Call Area" and also allowed interested and affected parties to provide comments about site conditions, resources, or uses within the "Call Area." That same month, BOEM also published a Notice of Intent to prepare an Environmental Assessment ("EA") for the "Call Area." The EA was made available for public review on November 12, 2012. Among other issues, the EA considered potential impacts to the endangered North Atlantic Right Whales (*Eubalaena glacialis*) and potential effects on viewsheds. Comments on the EA were considered and the revised EA for the WEA was issued on June 4, 2014. As a result of the analysis presented in the revised EA, BOEM issued a "Finding of No Significant Impact" (also known as a "FONSI"), which concluded that reasonably foreseeable environmental effects associated with the commercial wind lease issuance and related activities would not significantly impact the environment.

On June 17, 2014, BOEM and Massachusetts announced that 3,002 km^2 (742,000 acres) comprising the MA WEA would be made available for commercial wind energy leasing. On January 29, 2015, BOEM held a competitive lease sale, conducted as an auction, for the lease areas within BOEM's MA WEA. While the lease areas were to be awarded to the highest cash bid, prior to the auction, BOEM awarded Vineyard Wind[2] a discount to the bid amounts it would have to pay, in recognition of the Community Benefits Agreement ("CBA") Vineyard Wind had entered into with the local, community-based non-profit cooperative, Vineyard Power. Vineyard Wind won Lease Area OCS-A 0501 (see Figure 1.1-1) in the auction.

Lease Area OCS-A 0501 is as good as any offshore wind site in the world. The Lease Area has high wind speeds, excellent seafloor conditions, moderate water depths, and reasonable proximity to multiple grid connection locations in an area of high electrical load and a need for new generation capacity. Since winning the lease, Vineyard Wind has worked to optimize the project design and efficiency, while accounting for stakeholder input. These efforts also support the preparation of the major federal (i.e., BOEM) and Massachusetts (e.g. Energy Facility Siting Board and Massachusetts Environmental Protection Act) application submittals, as well as the Project's response to Massachusetts' recent Request for Proposals for long-term Power Purchase Agreements.

[2] At the time of the auction, Vineyard Wind, LLC was called Offshore MW, LLC.

1.3 Company Overview

Vineyard Wind is a New Bedford, MA based project company owned by Copenhagen Infrastructure Partners ("CIP") and Avangrid Renewables ("AR"). Together, these owners bring a considerable depth of offshore wind energy knowledge and experience as well as strong financial backing. CIP makes long-term clean energy infrastructure investments on behalf of 21 institutional investors, including several large Scandinavian pension funds, and currently has over five billion euros ($5.9 billion) under management.

Copenhagen Offshore Partners is a specialized team formed to develop and deliver offshore wind projects for institutional investors such as CIP[3]. The Copenhagen Offshore Partners team includes individuals who have had key roles on more than 15 offshore wind projects in Europe, dating back to 1995. Major projects undertaken to-date include Veja Mate, a 402 MW wind project in the German North Sea, and Beatrice, a 588 MW project under development in the Moray Firth portion of the North Sea. The 67 turbine Veja Mate project achieved its financial closing in 2015; commissioning was completed in May 2017, well ahead of schedule. The Beatrice project is currently under construction off the northeast coast of Scotland; commercial operation is scheduled for the second quarter of 2019.

Avangrid Renewables is a leader in the renewable energy industry in the United States ("US") and is amongst the nation's largest renewable energy operators. AR's mission is to lead the transformation to a competitive, clean energy future. The company is headquartered in Portland Oregon, and has regional offices in Philadelphia, Chicago, and Austin. AR controls over 6,000 MW of operating generation, including thermal, wind, solar, and biomass projects. AR is a subsidiary of Avangrid,[4] which is 81.5% owned by Iberdrola, SA. Iberdrola has an asset base which includes 14,000 MW of renewable energy projects in 12 countries.

Within the Avangrid/Iberdrola family, Scottish Power is where the considerable offshore wind energy expertise is positioned. Scottish Power has completed several major offshore projects, including the 389 MW West of Duddon Sands project in the UK. Scottish Power teams are currently completing construction of three new offshore wind projects: the 350 MW Wikinger project, located in the German Baltic Sea; the 714 MW East Anglia One project, located in the UK North Sea; and the 496 MW St Brieuc project, located in the Atlantic Ocean off the French coast of Brittany.

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[3] Copenhagen Offshore Partners has a long-term exclusivity arrangement to CIP in North America. However, there is no ownership or governance relationship between the two companies.

[4] Avangrid Renewables is a subsidiary of Avangrid, a New York Stock exchange listed company (AGR). Other subsidiaries of Avangrid include Central Maine Power, United Illuminating in Connecticut, New York State Electric & Gas, and Rochester Gas and Electric.

Vineyard Wind's New Bedford-based team includes scientists, engineers and managers with decades of local offshore wind energy expertise and a strong knowledge of the power grid, infrastructure, New England coastline, and ocean waters off Cape Cod and the Islands.

The Vineyard Wind team also includes Vineyard Power, a non-profit renewable energy cooperative based on Martha's Vineyard, with which Vineyard Wind has entered into a CBA. This partnership has enabled significant input into the Project design process from members of the local community, such that the Project's design addresses local concerns and enhances opportunities for local benefits. Vineyard Power staff and its board of directors have been working closely with the broader Vineyard Wind project team, and have lead responsibility for outreach to community stakeholders, including local towns, environmental interests, and commercial and recreational fisheries.

1.3.1 Contact Information

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1.3.2 Designation of Operator

The operator of the Project will be Vineyard Wind 1, LLC.

1.4 Standard Terminology

The following table defines standard terms that are used to describe elements of the Vineyard Wind Project throughout this Construction and Operations Plan.

Table 1.4-1 Standard Terminology Used to Describe Project Elements

Standard Term	Definition
Construction staging areas	Areas to be used for unloading and loading equipment, final equipment assembly, etc.
Duct bank	The underground structure that houses the onshore export cable, which consists of PVC pipes encased in concrete.
Electrical Service Platform ("ESP")	The offshore substations located in the WDA, which contain transformers and other electrical gear
Export cable	The entire physical transmission cable that transmits power generated by the WTGs to the onshore substation.
Export Cable Corridor ("ECC")	The area identified for routing the entire length of onshore and offshore export cable.

Table 1.4-1 Standard Terminology Used to Describe Project Elements (Continued)

Standard Term	Definition
Fisheries Communication Plan	A comprehensive communications plan with the various port authorities, federal, state and local authorities, and other key stakeholders.
Foundations	Steel structures that support both ESPs and Wind Turbine Generators ("WTGs") and are driven into the seabed.
Inter-array cables	Submarine transmission cables that connect groups of WTGs to the ESPs.
Inter-link cables	A submarine transmission cable that connects ESPs together.
Landfall Site	The shoreline landing site where the export cable transitions from offshore to onshore.
Lease Area	The entire area that Vineyard Wind purchased from BOEM, which includes more area than just the WDA.
MA or RI-MA Wind Energy Area	The areas designated in Massachusetts and Rhode Island ("RI") by BOEM for wind energy development.
New Bedford Marine Commerce Terminal ("New Bedford Terminal")	A 26-acre port facility in the Port of New Bedford, which Vineyard Wind intends to use as a construction staging area.
Offshore cable system	All offshore transmission cables (inter-array cable, inter-link cable, and offshore export cable).
Offshore export cable	The portion of the export cable that is located offshore below the seafloor.
Offshore Export Cable Corridor ("OECC")	The area identified for routing the offshore export cable.
Offshore facilities	All offshore infrastructure (WTGs, ESPs, etc.).
Offshore Project Area	The offshore area where Project components are physically located.
Onshore export cable	The portion of the export cable that is located onshore underground.
Onshore Export Cable Route	The area along onshore portion of the export cable.
Onshore facilities	All onshore infrastructure (onshore substation, onshore export cables, etc.).
Onshore Project Area	The onshore area where Project components are physically located.
Onshore substation	The landside substation located in Barnstable County that contains transformers and other electrical gear.
Operations and Maintenance Facilities ("O&M Facilities")	All buildings and infrastructure used to support operations and maintenance activities.
Project	All elements of the Vineyard Wind Project (both offshore and onshore).
Project Area	The combined onshore and offshore area where Project components are physically located.

Table 1.4-1 Standard Terminology Used to Describe Project Elements (Continued)

Standard Term	Definition
Project Region	The cities and towns surrounding the area where Project activities will occur.
Scour protection	Rock or other protection placed around the base of a foundation to prevent sediment erosion.
Splice vaults	Underground concrete "boxes" where segments of the onshore export cable are joined together.
Transition vault	A type of splice vault where the offshore cable is transitioned to the onshore cable.
Utility right-of-way ("utility ROW")	Previously disturbed corridors that contain existing electric transmission lines or other utilities.
Wind Development Area ("WDA")	The northeast portion of the Lease Area that will be developed initially for an 800 MW project.
Wind Turbine Generators ("WTGs")	Offshore wind turbines that will each generate approximately eight to 14 MW of electricity each.

1.5 Construction and Operation Concept

1.5.1 Objective

Vineyard Wind plans to design, permit, construct and operate an 800 MW offshore wind energy project in the northern half of BOEM Lease Area OCS-A 0501. The WTGs for this Project will be among the most efficient renewable energy generators currently demonstrated for offshore use. Based on detailed analysis of regional wind data, it is expected that the WTGs will be capable of operating with an annual capacity factor in excess of 45%; capacity factor refers to the ratio of the Project's annual power production to the nameplate production potential.

The Project will be new, privately financed, generation infrastructure that is ideally located to provide clean, renewable electric power to one of the densely populated areas along the Atlantic coast. Electricity generated by the WTGs is emission-free and will displace electricity generated by fossil fuel-powered plants, thereby significantly reducing emissions from the ISO New England ("NE") power grid over the lifespan of the Project. Based on air emissions data for New England power generation facilities, obtained from the Environmental Protection Agency's Emissions & Generation Resource Integrated Database (eGRID), the Project will reduce carbon dioxide ("CO_2") emissions from the ISO NE power grid by approximately 1,630,000 tons per year ("tpy"). In addition, the Project is expected to reduce nitrogen oxide ("NO_x") and sulfur dioxides ("SO_2") emissions by approximately 1,050 tpy and 860 tpy, respectively (see Section 5.1 of Volume III).

Beyond these very important environmental advantages, the Project will bring significant employment and other economic benefits to the south coast of Massachusetts and the region (see Section 7.0 of Volume III) as well as energy diversity, and on-peak power production (i.e., hot summer afternoons). Lastly, the Vineyard Wind Project could be the second offshore wind project in the US and would be an important foundational step in creating a thriving, utility-scale, domestic offshore wind industry.

Finally, the Project is being developed and permitted using an "Envelope" concept. The Envelope concept allows Vineyard Wind to properly define and bracket Project characteristics for purposes of environmental review and permitting while maintaining a reasonable degree of flexibility with respect to the selection and purchase of key Project components, such as the WTGs, foundations, submarine cables, offshore substations, etc.[5] As the Project is bidding into competitive power procurement processes, this flexible approach is particularly important to ensure projects can take advantage of rapidly advancing technology and produce the most cost-effective results for Massachusetts ratepayers.

The Project design may be further refined during the permitting process in an effort minimize potential impacts within the Envelope. The Project Envelope which is being used to develop this Construction and Operations Plan ("COP") is provided as Table 1.5-1, below.

5 The evolution of offshore wind technology toward less expensive, safer, and more efficient concepts often outpaces the speed of permitting processes. As BOEM recognized in its National Offshore Wind Strategy, the envelope concept allows for optimized projects once permitting is complete while ensuring a comprehensive review of the project by regulators and stakeholders.

Table 1.5-1 Vineyard Wind Project Envelope Parameters

Layout and Project Size

- 800 MW project
- Up to 106 WTG positions
- Up to 100 WTGs installed
- Continuous construction of 800 MW project

Foundation

- 100% monopiles for WTG foundations or up to 10 jacket foundations for WTGs, with the remainder monopiles
- Pile driving hammer
- Scour protection on all positions
- Installation with a jack-up vessel or vessel on dynamic positioning (DP) with feeder barges

WTGs

- 8 – ~14 MW WTG
- Rotor size of 164-222 m (538-729 ft)
- Hub height of 109-144 m (358-473 ft)
- Installation with a jack-up vessel or vessel on dynamic positioning (DP) with feeder barges

Inter-array Cables

- 66 kV cables beneath the seafloor
- Example layout identified, not finalized
- Maximum total cable lengths indicated
- Installation techniques include jet plow, mechanical plow & mechanical trenching
- Installation with a vessel on DP
- Pre-lay grapnel run

Offhore Export Cables

- Two 220 kV export cables beneath the seafloor
- One corridor identified with variants
- Max total cable lengths indicated
- Installation techniques include jet plow, mechanical plow & mechanical trenching, with dredging in some locations to achieve burial depth
- Installation with a vessel on DP and some use of an anchored vessel
- Use of rock protection, concrete mattresses, or half-shell, or similar on areas of minimal cable burial
- Pre-lay grapnel run

Electrical Service Platform (ESP)

- One 800 MW conventional ESP or two 400 MW conventional ESPs
- Each ESP installed on one monopile or a single jacket foundation
- Scour protection on all positions
- Installation using foundation and turbine installation vessels or specialized crane vessel

1.5.2 Proposed Activities

The key elements of the Project, as bounded by the Envelope (see Table 1.5-1), are as follows. A complete description of each component, including figures, is provided in Section 3.0:

- Wind Turbine Generators: The WTGs will range in size from eight to ~14 MW. Up to 106 turbine locations are being permitted to allow for spare positions (in the event of environmental or engineering challenges) and added power generation to account for electrical losses along the transmission line. If a larger turbine is selected, fewer positions will be occupied.

- Monopile and Jacket Foundations: Foundations will be monopiles or jackets. A monopile is a long, steel tube that is driven into the seabed to support a WTG. The monopiles will typically be topped by a transition piece although in some cases an extended monopile may be used with no transition piece, subject to detailed design.

  Up to 12 jacket foundations may be used for the Project (up to ten jackets for WTG foundations and up to two jackets for ESP foundations). Jacket foundations, if used, would typically be located in the deeper water portions of the Lease Area. The jacket foundation is a large lattice-type steel structure that includes either three or four piles (i.e., legs) connected with welded steel tubular cross bracing. The jacket structures also include a transition piece to connect the WTG to the foundation.

- Scour Protection: All WTG and ESP foundations will have scour protection. The scour protection is expected to be a layer of stone or rock laid around the foundation.

- Inter-array Cables: 66 kilovolt ("kV") inter-array cables will connect radial "strings" of six to 10 WTGs to a shared offshore substation or ESP.

- Offshore Substations/Electrical Service Platforms: The ESPs will include step-up transformers (66 kV to 220 kV) and other electrical gear. The ESPs are expected to be located along the northwest edge of the WDA. Two options for ESPs are being considered and analyzed in this COP: one 800 MW conventional ESP or two 400 MW conventional ESPs.

- Offshore Cables: 220 kV offshore export cables will connect the offshore ESPs to the shore. Two cables will be needed for an 800 MW Project. If two 400 MW conventional ESPs are used, an inter-link cable will be used to connect them. The inter-link is a 220 kV cable, which connects the ESPs and provides additional reliability in the event of an export cable issue. A range of Offshore Export Cable Corridor variations and installation techniques are under consideration and are further described in Section 3.1.5. While the offshore export cables will follow a common corridor, a reasonable distance will be maintained between each cable to facilitate installation as well as any future repairs that may be needed (see Section 3.1.5.2).

- Onshore Cables: 220 kV underground onshore export cables will be used to connect the Landfall Site to a 220 kV to 115 kV step down onshore substation and the subsequent interconnection to the bulk power grid. As with the offshore export cables, a range of underground onshore export cable routes are under consideration. Section 3.2 describes the Onshore Export Cable Routes and onshore substation.

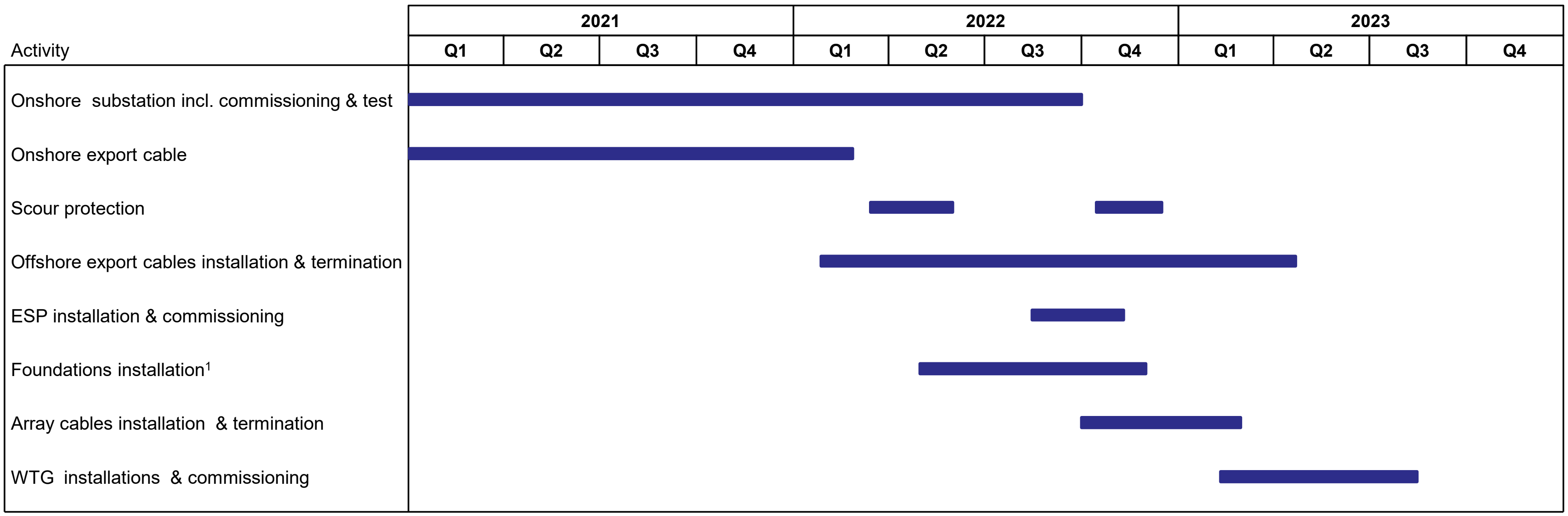
- Installation: The Project Envelope also describes potential foundation and equipment installation approaches. As a general matter, WTG installation will be performed using jack-up vessels or dynamically positioned ("DP") vessels, as well as necessary support vessels and barges. As described in Sections 4.2.3.3 and 4.2.3.6, cable laying will be accomplished primarily by jet plowing, mechanical plowing, or mechanical trenching. Vessel types under consideration for cable installation include DP, anchored, self-propelled, or barge. In accordance with standard industry practice, a pre-lay grapnel run will be made in all instances to locate and clear obstructions, such as abandoned fishing gear and other marine debris.

1.5.3 Tentative Schedule

Federal and Massachusetts environmental reviews, and subsequent federal, state, regional and local permitting are expected to be a principal focus of Project activities during 2018, 2019, and a portion of 2020. Assuming the necessary permits are issued and the planned financial close is completed, construction is estimated to begin in 2021 and will be continuous. A representation of an 800 MW project's construction schedule is provided as Figure 1.5-1.

The Proponent anticipates that onshore construction will commence with work at the Landfall Site, onshore substation, and onshore duct bank. On Cape Cod, there are general summer limitations on construction activities, which the Proponent has built into the Project schedule for construction at the Landfall Site and along the onshore transmission route where the route follows public roadway layouts. Activities at the Landfall Site where transmission will transition from offshore to onshore will not be performed during the months of June through September unless authorized by the host town. Likewise, Vineyard Wind will not conduct activities along the onshore transmission route within public roadway layouts from Memorial Day through Labor Day unless authorized by the host town; such work could extend through June 15 subject to consent from the local Department of Public Works (DPW). The Company will consult with the towns regarding the construction schedule. Typical construction hours will extend from 7:00 AM to 6:00 PM. Nighttime work will be performed only on an as-

Draft High-level Construction Plan



Note 1: Foundations installation activity includes monopile and transition piece installation.

Figure 1.5-1

Construction Schedule (Continuous 800 MW) needed basis, such as when crossing a busy road. When needed, nighttime work/extended construction hours, including possible work on weekends, will be coordinated through each Town.

Once an increment of the Project is completed and commissioned, it will have an operational life of up to 30 years. Throughout that time, the entire Project will be carefully monitored and maintained. Skilled technicians and engineers will be responsible for a rigorous preventive maintenance program and will be responsible for addressing any malfunctions that may occur, making repairs, and replacing components. A more detailed discussion of the Project's operations and maintenance is provided in Section 4.3. Decommissioning at the end of the Project's useful life is described in Section 4.4.

1.5.4 Plans for Phased Development

Vineyard Wind is not proposing to develop the WDA in phases at this time.

1.6 Guide to Location of Required Information for COP

The following table lists the BOEM regulations and where the corresponding information can be found in this COP.

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b)

Requirement	Location in COP
30 CFR §585.105(a)	
1) Design your projects and conduct all activities in a manner that ensures safety and will not cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components to the extent practicable; and take measures to prevent unauthorized discharge of pollutants including marine trash and debris into the offshore environment.	Section 3.1.1 of Volume I Section 4.2.2 of Volume I Section 4.3 of Volume I Appendix I-A Appendix I-B Appendix I-E Section 4 of Volume III Section 5 of Volume III Section 6 of Volume III Appendix III-A Appendix III-B Appendix III-C Appendix III-D Appendix III-F

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b) (Continued)

Requirement	Location in COP
30 CFR §585.621(a-g)	
a) The project will conform to all applicable laws, implementing regulations, lease provisions, and stipulations or conditions of the lease.	Section 1.6 (Table 1.6-1) of Volume I Section 1.7 (Table 1.7-1) of Volume I Section 1.10 of Volume I Section 3 of Volume I Section 4 of Volume I Section 5 (Table 5-1) of Volume I Appendix I-E
b) The project will be safe.	Section 3.1.1 of Volume I Section 4.2.2 of Volume I Section 4.3 of Volume I Appendix I-B
c) The project will not unreasonably interfere with other uses of the OCS, including those involved with National security or defense.	Section 7.5 of Volume III Section 7.6 of Volume III Section 7.9 of Volume III Appendix III-E Appendix III-I
d) The project will not cause undue harm or damage to natural resources; life (including human and wildlife); property; the marine, coastal, or human environment; or sites, structures, or objects of historical or archeological significance.	Section 4 of Volume III Section 5 of Volume III Section 6 of Volume III Section 7 of Volume III Appendix III-A Appendix III-B Appendix III-C Appendix III-D Appendix III-F Appendix III-G Appendix III-H.a Appendix III-H.b
30 CFR §585.621(a-g)	
e) The project will use the best available and safest technology.	Section 1.5.1 of Volume I Section 4.2.2 of Volume I Appendix I-B Appendix I-D Appendix I-E
f) The project will use best management practices.	Section 4 (Table 4.1-2) of Volume III
g) The project will use properly trained personnel.	Section 4.2.2 of Volume I Section 4.3.1 of Volume I Section 4.3.2 of Volume I
30 CFR §585.626(a)	
(1) Shallow Hazards	
(i) Shallow Faults;	Section 3.2 (Table 3.2-1) of Volume II-A
(ii) Gas Seeps or shallow gas;	Section 3.2 (Table 3.2-1) of Volume II-A
(iii) Slump blocks or slump sediments;	Section 3.2 (Table 3.2-1) of Volume II-A

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b) (Continued)

Requirement	Location in COP
30 CFR §585.626(a)	
(iv) Hydrates; or	Section 3.2 (Table 3.2-1) of Volume II-A
(v) Ice Scour of seabed sediments	Section 3.2 (Table 3.2-1) of Volume II-A
(2) Geological survey relevant to the design and siting of facility	
(i) Seismic activity at your proposed site;	Section 4.1 (Table 4.1-1) of Volume II-A
(ii) Fault zones;	Section 4.1 (Table 4.1-1) of Volume II-A
(iii)The possibility and effects of seabed subsidence; and	Section 4.1 (Table 4.1-1) of Volume II-A
(iv) The extent and geometry of faulting attenuation effects of geological conditions near your site.	Section 4.1 (Table 4.1-1) of Volume II-A
(3) Biological	
(i) A description of the results of biological surveys used to determine the presence of live bottoms, hard bottoms, and topographic features, and surveys of other marine resources such as fish populations (including migratory populations), marine mammals, sea turtles, and sea birds.	Section 5 of Volume II-A Section 6 of Volume III
(4) Geotechnical Survey	
(i) The results of a testing program used to investigate the stratigraphic and engineering properties of the sediment that may affect the foundations or anchoring systems for your facility.	Section 2.1.2.2 of Volume II-A (summary) Appendix F of Volume II-A Appendix N of Volume II-B
(ii) The results of adequate in situ testing, boring, and sampling at each foundation location, to examine all important sediment and rock strata to determine its strength classification, deformation properties, and dynamic characteristics.	Section 2.1.2.2 of Volume II-A (summary) Appendix F of Volume II-A Appendix N of Volume II-B
30 CFR §585.626(a)	
(iii) The results of a minimum of one deep boring (with soil sampling and testing) at each edge of the project area and within the project area as needed to determine the vertical and lateral variation in seabed conditions and to provide the relevant geotechnical data required for design.	Section 2.1.2.2 of Volume II-A (summary) Appendix F of Volume II-A Appendix N of Volume II-B
(5) Archeological Resources	
(i) A description of the historic and prehistoric archaeological resources, as required by the NHPA (16 U.S.C. 470 et. seq.), as amended.	Volume II-C (submarine) Section 7.3 of Volume III (terrestrial) Appendix III-G
(6) Overall Site Investigation	
(i) Scouring of the seabed;	Section 3.2 (Table 3.2-1 and Section 3.2.2) of Volume II-A Section 4.1 (Table 4.1-1) of Volume II-A
(ii) Hydraulic instability;	Section 4.1 (Table 4.1-1) of Volume II-A

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b) (Continued)

Requirement	Location in COP
(6) Overall Site Investigation	
(iii) The occurrence of sand waves;	Section 3.2 (Section 3.2-1) of Volume II-A Section 4.1 (Table 4.1-1) of Volume II-A
(iv) Instability of slopes at the facility location;	Section 3.2 (Table 3.2-1) of Volume II-A Section 4.1 (Table 4.1-1) of Volume II-A
(v) Liquefaction, or possible reduction of sediment strength due to increased pore pressures;	Section 4.1 (Table 4.1-1) of Volume II-A
(vi) Degradation of subsea permafrost layers;	Section 4.1 (Table 4.1-1) of Volume II-A
(vii) Cyclic loading;	Section 4.1 (Table 4.1-1 and Section 4.2.1) of Volume II-A
(viii) Lateral loading;	Section 4.1 (Table 4.1-1 and Section 4.1.2) of Volume II-A
(ix) Dynamic loading;	Section 4.1 (Table 4.1-1) of Volume II-A
(x) Settlements and displacements;	Section 4.1 (Table 4.1-1) of Volume II-A
(xi) Plastic deformation and formation collapse mechanisms; and	Section 4.1 (Table 4.1-1) of Volume II-A
(xii) Sediment reactions on the facility foundations or anchoring systems.	Section 4.1 (Table 4.1-1) of Volume II-A
30 CFR §585.626(b)	
(1) Contact information	Section 1.3.1 of Volume I
(2) Designation of operator, if applicable	Section 1.3.2 of Volume I
(3) The construction and operation concept	Section 1.5 of Volume I
(4) Commercial lease stipulations and compliance	Section 1.7 of Volume I
(5) A location plat	Section 2.1 (Figure 2.1-1) of Volume I Section 2.2 (Figure 2.2-1) of Volume I
(6) General structural and project design, fabrication, and installation	Section 1.9 of Volume I Section 3 of Volume I Appendix I-C Appendix I-D Section 2 of Volume III
30 CFR §585.626(b)	
(7) All cables and pipelines, including cables on project easements	Section 2.1 (Figure 2.1-1) of Volume I Section 2.2 (Figure 2.2-1) of Volume I Section 3.1.5 of Volume I Section 3.1.6 of Volume I Section 3.2.1 of Volume I Section 3.2.2 of Volume I Section 3.2.3 of Volume I Section 3.3 of Volume I Section 4.2.3.3 of Volume I Section 4.2.3.5 of Volume I Section 4.2.3.6 of Volume I

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b) (Continued)

Requirement	Location in COP
30 CFR §585.626(b)	
	Section 4.2.3.8 of Volume I Section 4.2.3.9 of Volume I Section 4.3.2.1 of Volume I Section 4.4 of Volume I
(8) A description of the deployment activities	Section 4.2 of Volume I
(9) A list of solid and liquid wastes generated	Section 4.2.5 of Volume I
(10) A listing of chemical products used (if stored volume exceeds Environmental Protection Agency (EPA) Reportable Quantities)	Section 4.2.6 of Volume I
(11) A description of any vessels, vehicles, and aircraft you will use to support your activities	Section 3.2.6 of Volume I Section 4.2.3 of Volume I Section 4.2.4 of Volume I Section 4.4 of Volume I Section 5.1 of Volume III Section 7.9 of Volume III Appendix III-I Appendix III-J
(12i) A general description of the operating procedures and systems under normal conditions	Section 4.3.1 of Volume I Section 4.3.2 of Volume I Appendix I-B
(12ii) A general description of the operating procedures and systems in the case of accidents or emergencies, including those that are natural or manmade.	Section 4.3.3 of Volume I Appendix I-A Appendix I-B Section 8 of Volume III
(13) Decommissioning and site clearance procedures	Section 4.4 of Volume I
(14i) A listing of all Federal, State, and local authorizations, approvals, or permits that are required to conduct the proposed activities, including commercial operations	Section 5 (Table 5-1) of Volume I
30 CFR §585.626(b)	
The U.S. Coast Guard, U.S. Army Corps of Engineers, and any other applicable authorizations, approvals, or permits, including any Federal, State or local authorizations pertaining to energy gathering, transmission or distribution (e.g., interconnection authorizations).	

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b) (Continued)

Requirement	Location in COP
30 CFR §585.626(b)	
(14ii) A listing of all Federal, State, and local authorizations, approvals, or permits that are required to conduct the proposed activities, including commercial operations A statement indicating whether you have applied for or obtained such authorization, approval, or permit.	Section 5 (Table 5-1) of Volume I
(15) Your proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts	Section 4 (Table 4-1) of Volume III Section 5 of Volume III Section 6 of Volume III Section 7 of Volume III Appendix III-A Appendix III-C Appendix III-D Appendix III-F
(16) Information you incorporate by reference	Section 7 of Volume I
(17) A list of agencies and persons with whom you have communicated, or with whom you will communicate, regarding potential impacts associated with your proposed activities	Section 6 (Table 6-1 and Table 6-2) of Volume I
(18) Reference	Section 7 of Volume I Section 9 of Volume III
(19) Financial assurance	Section 1.8 of Volume I
(20) CVA nominations for reports required in subpart G of this part	Section 1.9 of Volume I Appendix I-C Appendix I-D
(21) Construction schedule	Section 1.5.3 (Figure 1.5-1) of Volume I Section 4.1 (Figures 4.1-1) of Volume I
(22) Air quality information	Section 5.1 of Volume III Appendix III-B
(23) Other information	Section 1.1 of Volume 1 Section 1.2 of Volume 1 Section 1.4 of Volume 1 Section 1.6 of Volume 1 Section 3 of Volume III Appendix III-G
30 CFR §585.627(a)	
(1) Hazard information	Section 3 of Volume II-A Section 4 of Volume II-A Appendix III-A

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b) (Continued)

Requirement	Location in COP
30 CFR §585.627(a)	
(2) Water quality	Section 5.2 of Volume III Appendix III-A
(3)(i) Benthic Communities	Section 5 of Volume II-A Section 6.5 of Volume III Appendix III-D
(3)(ii) Marine Mammals	Section 6.7 of Volume III
(3)(iii) Sea turtles	Section 6.8 of Volume III
(3)(iv) Coastal and marine birds	Section 6.2 of Volume III Section 6.4 of Volume III Appendix III-C
(3)(v) Fish and shellfish	Section 6.5 of Volume III Section 6.6 of Volume III Appendix III-D Appendix III-F
(3)(vi) Plankton	Appendix III-F
(3)(vii) Seagrasses	Section 5.2.2 of Volume II-A Section 6.4 of Volume III Appendix III-F
(3)(viii) Plant life	Section 6.1 of Volume III Section 6.4 of Volume III
(4) Threatened or endangered species	Section 6 of Volume III
(5) Sensitive biological resources or habitats	Section 5.2 of Volume II-A (marine-benthic) Section 6 of Volume III Appendix III-D Appendix III-F
(6) Archaeological resources	Volume II-C (submarine) Section 7.3 of Volume III (terrestrial) Appendix III-G
(7) Social and economic resources	Section 7 of Volume III, Appendix III-E Appendix III-H.a Appendix III-H.b
(8) Coastal and marine uses	Section 7.6 of Volume III Section 7.8 of Volume III Section 7.9 of Volume III Appendix III-E Appendix III-I
(9) Consistency Certification	Appendix III-P

Table 1.6-1 Construction and Operations Plan Requirements for Commercial Leases Pursuant to 30 CFR §585.105(a), 621 (a-g), 626(a) and (b), 627(a) and (b) (Continued)

Requirement	Location in COP
30 CFR §585.627(a)	
(10) Other resources, conditions, and activities	Section 5.1 of Volume III Section 5.3 of Volume III Section 6.3 of Volume III Section 7.9 of Volume III Appendix III-B Appendix III-J
30 CFR §585.627(b)	
Consistency certification	Appendix III-P
30 CFR §585.627(c)	
Oil spill response plan	Appendix I-A
30 CFR §585.627(d)	
Safety management system	Appendix I-B

1.7 Commercial Lease Stipulations and Compliance

Table 1.7-1 demonstrates compliance with the stipulations in the Project's lease.

Table 1.7-1 Commercial Lease Stipulations and Compliance

Stipulation	Compliance
Section 4(a): The lessee must make all rent payments to the Lessor in accordance with applicable regulations in 30 CFR Part 585, unless otherwise specified in Addendum "B".	The Proponent has made and will continue to make all rent payments in accordance with applicable regulations, unless otherwise specified in Addendum "B".
Section 4(b): The Lessee must make all operating fee payments to the Lessor in accordance with applicable regulations in 30 CFR Part 585, as specified in Addendum "B".	The Proponent will make all operating fee payments in accordance with applicable regulations.
Section 5: The Lessee may conduct those activities described in Addendum "A" only in accordance with a SAP or COP approved by the Lessor. The Lessee may not deviate from an approved SAP or COP except as provided in applicable regulations in 30 CFR Part 585.	The Proponent will conduct activities as described in the COP.
Section 7: The Lessee must conduct, and agrees to conduct, all activities in the leased area in accordance with an approved SAP or COP, and with all applicable laws and regulations.	The Proponent will conduct all activities in the leased area in accordance with the COP and all applicable laws and regulations.
Section 10: The Lessee must provide and maintain at all times a surety bond(s) or other form(s) of financial assurance approved by the Lessor in the amount specified in Addendum "B".	The Project will provide the necessary financial assurances as described in Section 1.8 of Volume I.

Table 1.7-1 Commercial Lease Stipulations and Compliance (Continued)

Stipulation	Compliance
Section 13: Unless otherwise authorized by the Lessor, pursuant to the applicable regulations in 30 CFR Part 585, the Lessee must remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by activities on the leased area, including any project easements within two years following lease termination, whether by expiration, cancellation, contraction, or relinquishment, in accordance with any approved SAP, COP, or approved Decommissioning Application, and applicable regulations in 30 CFR Part 585.	Preliminary decommissioning plans are described in Section 4.4 of Volume I. The decommissioning will be in accordance with the applicable regulations.
Section 14: The Lessee must (a) Maintain all places of employment for activities authorized under this lease in compliance with occupational safety and health standards and, in addition, free from recognized hazards to employees of the Lessee or of any contractor or subcontractor operating under this lease; (b) Maintain all operations within the leased areas in compliance with regulations in 30 CFR Part 585 and orders from the Lessor and other Federal agencies with jurisdiction, intended to protect persons, property and the environment on the OCS; and (c) Provide any requested documents and records, which are pertinent to occupational or public health, safety, or environmental protection, and allow prompt access, at the site of any operation or activity conducted under this lease, to any inspector authorized by the Lessor or other Federal agency with jurisdiction.	(a) The Proponent will maintain all places of employment in compliance with applicable standards. (b) The Proponent will maintain all operations in the leased area in compliance with applicable regulations. (c) The Proponent will provide any requested documents and records.
Section 15: The Lessee must comply with the Department of the Interior's non-procurement debarment and suspension regulations set forth in 2 CFR Parts 180 and 1400 and must communicate the requirement to comply with these regulations to persons with whom it does business related to this lease by including this requirement in all relevant contracts and transactions.	The Project will comply with the applicable Department and suspension regulations.

Table 1.7-1 Commercial Lease Stipulations and Compliance (Continued)

Stipulation	Compliance
Section 16: During the performance of this lease, the Lessee must fully comply with paragraphs (1) through (7) of section 202 of Executive Order 11246, as amended (reprinted in 41 CFR 60-1.4(a)), and the implementing regulations, which are for the purpose of preventing employment discrimination against persons on the basis of race, color, religion, sex, or national origin.	The Project will fully comply with paragraphs (1) through (7) of section 202 of Executive Order 11246, as amended.
Addendum "B", Section III (Payments): Unless otherwise authorized by the Lessor in accordance with the applicable regulations in 30 CFR Part 585, the Lessee must make payments as described below.	The Proponent will make payments as stipulated in Addendum "B", Section III.

As described in Section 4.3.2 and Table 4.3-1, offshore and nearshore geophysical surveys will be conducted post-construction during the operations and maintenance phase of the Project to conduct activities such as, inspect cable depth of burial and conduct as-built cable surveys. In addition, it is anticipated that short ad-hoc geophysical or geotechnical surveys may be required during construction to verify site conditions. Geotechnical work would only be conducted in areas already cleared for archaeological/historical resources. Any unanticipated discoveries of cultural resources will be reported and avoided during further onsite work, with review and recommendations by the qualified marine archaeologist.

All surveys will use Best Management Practices and industry standard equipment that has been approved for use previously for offshore renewable energy work on the OCS. Most of the surveys will entail use of geophysical systems 200 kHz or higher in frequency that do not require any special mitigation (multi-beam echosounder, side scan sonar, and magnetometer). Standard operating conditions (i.e., vessel strike avoidance, separation distances from protected species, necessary notifications, marine trash and debris prevention, etc.) for work on the OCS will be observed.

For surveys using sonar equipment less than 200 kHz in frequency (sub-bottom profilers) and any bottom disturbing investigations that have been previously cleared, in addition to the standard operating procedures identified above, the following mitigation measures will be employed to maintain a level of consistency with pre-COP offshore project activities.

- Notifications when appropriate: national security and military organizations, USCG communication, tribal correspondence.
- Vessel strike avoidance measures, including speed restrictions in Dynamic Management Areas and from November 1 through July 31.

- Protected Species Observer ("PSO") monitoring: PSOs will accompany survey vessels and follow standard monitoring protocols, actively observing an established exclusion zone around each vessel.

- Shut down and soft start procedures.

1.8 Financial Assurance

The activities and facilities proposed in the COP will be covered by financial assurance in amounts and within time frames approved by BOEM.

1.9 Certified Verification Agent Nomination

BOEM regulations at 30 C.F.R. § 585.705 et seq. define the requirements for use of a Certified Verification Agent ("CVA") for offshore wind projects subject to BOEM jurisdiction. The CVA role is a key component in maintaining safety and reducing environmental risk in offshore wind projects.

Nomination Statement

Vineyard Wind nominates DNV GL as CVA for the Facility Design Report ("FDR") and Fabrication and Installation Report ("FIR") as required by 30 C.F.R. § 585.706(a). DNV GL is world-recognized as a leading certification and classification society and has significant experience in the US offshore wind sector.

Qualification Statement

The Statement of Qualifications for CVA Services is provided in Appendix I-C. The Statement addresses:

- Previous experience of the nominated CVA in third-party verification and BOEM procedures

- Technical capabilities of the CVA and staff members

- Size and type of organization

- Availability of technology

- Ability to perform

- Conflict of interest

- Professional Engineer supervision

Scope of Work and Verification Plan

The CVA Scope of Work and Verification Plan is provided in Appendix I-D. This document defines the alignment of 30 C.F.R. § 585 with the International Electrotechnical Commission ("IEC") Standard 61400-22, including issuance of IEC-compliant conformity statements and evaluation reports. IEC 61400-22 will be supplemented by DNVGL-SE-0073, Service Specification for Project Certification of Wind Farms. The scope specifies the level of work to be performed by the CVA at all phases of the verification, and identifies the high-level list of documents and subject matter that the CVA will review.

1.10 Design Standards

BOEM's COP Guidelines recognize that "[t]he BOEM's renewable energy regulations are not prescriptive regarding the design standards that must be used for an offshore wind energy installation" (COP Guidelines Appendix C, Section I). Further, the Guidelines state that" [f]or offshore wind turbines, BOEM will accept a 'design-basis' approach whereby the applicant proposes which criteria and standards to apply, and then justifies why each particular criterion and standard is appropriate" (COP Guidelines Appendix C, Section I). Towards that end, Vineyard Wind has created a Hierarchy of Standards, provided in Appendix I-E, to inform the Project design and development process.

[redacted]

Section 2.0

Project Location – Location Plat

2.0 PROJECT LOCATION – LOCATION PLAT

2.1 Vineyard Wind Lease Area (OCS-A 0501)

The over 675 square kilometers ("km^2") (166,886 acres) Lease Area is approximately 16 kilometers ("km") (8.7 nautical miles ["nm"]) wide and 50 km (26 nm) long.[6] As shown on Figures 2.1-1 and 2.1-2, the long axis of the Vineyard Wind Lease Area is oriented northeast to southwest. At its nearest point, the Lease Area is just over 23 km (14 miles ["mi"]) from the southeast corner of Martha's Vineyard and a similar distance to Nantucket.

Water depths in the Lease Area range from about 35-60 meters ("m") (115-197 feet ["ft"]). As shown on Figure 2.1-1, water depths gradually increase as distance from land increases. Water depths in the northern half of the Lease Area generally range from approximately 37-49.5 m (121-162 ft). As noted above and discussed in subsequent sections, the Project would be located within the northern portion of the Lease Area, referred to as the Wind Development Area ("WDA"). The WDA is 306 km^2 (75,614 acres).

Coordinates for the Wind Turbine Generators ("WTGs") and Electrical Service Platforms ("ESPs") are provided in Table 2.1-1, below.

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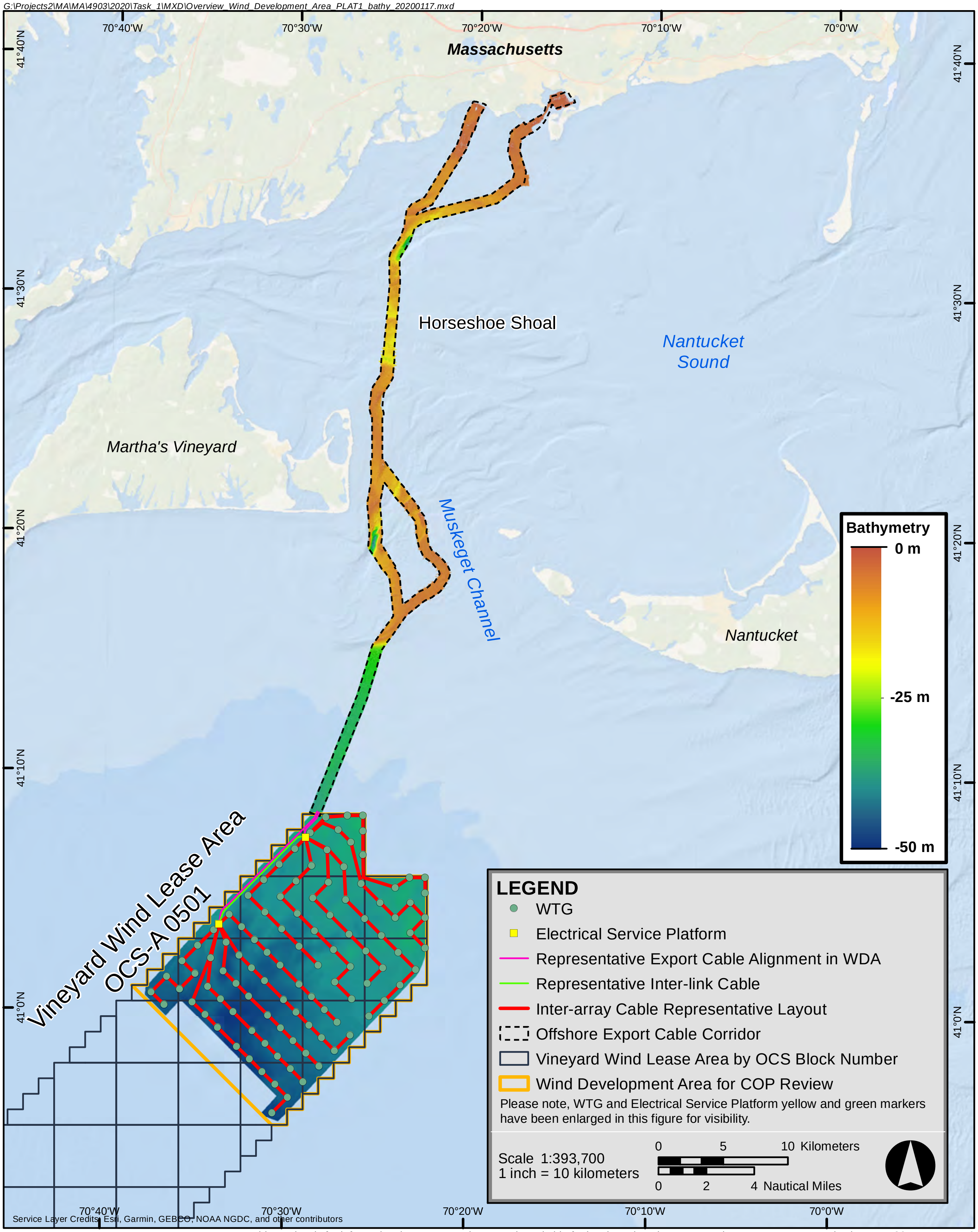
6 As shown on Figure 1.1-1, the perimeter of the Lease Area is irregular or "sawtoothed," hence the overall area is less than that of a true 10 x 30 mi rectangle.



This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes. Map Projection: NAD83 UTM Zone 19

Figure 2.1-1
Offshore Location Plat

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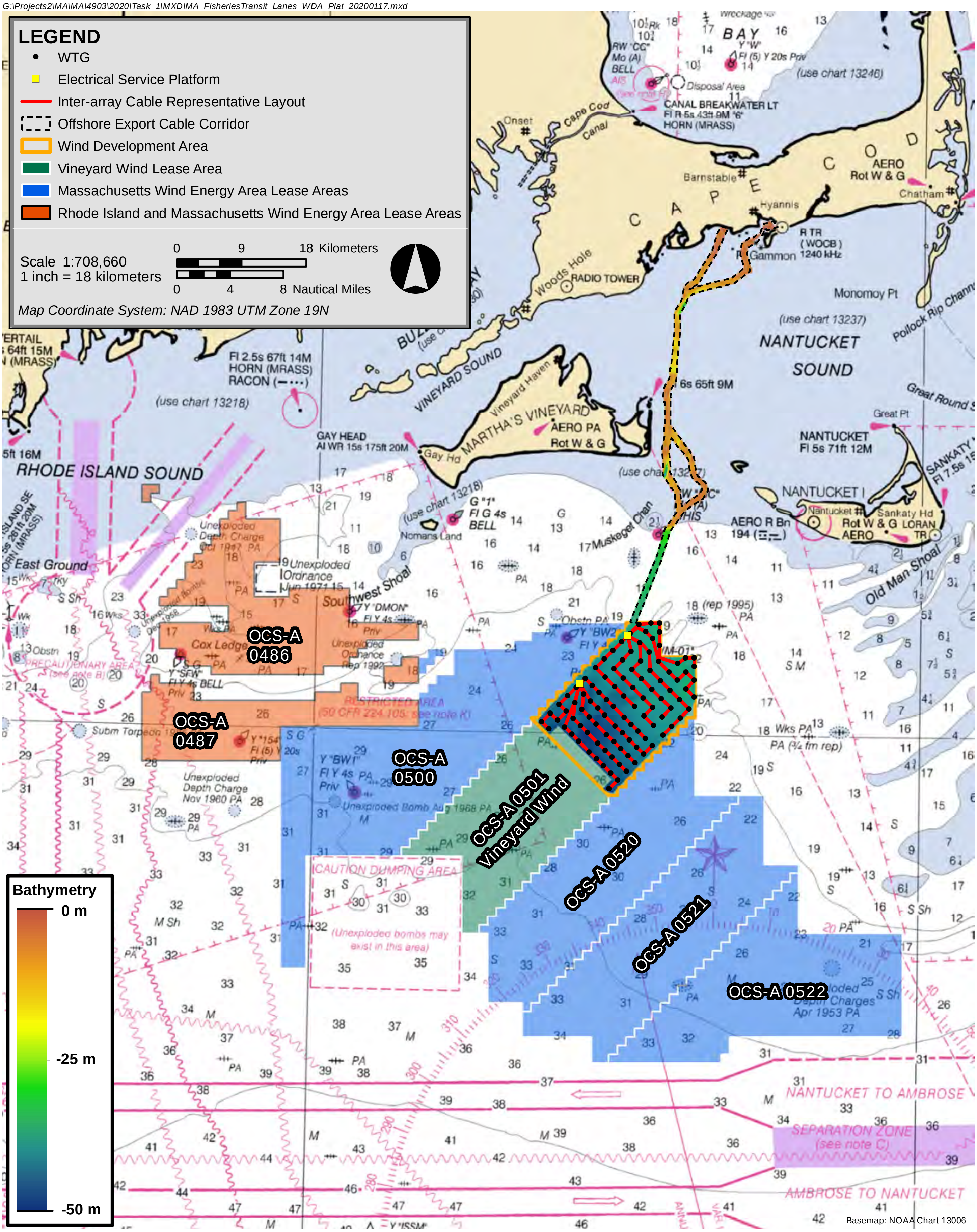

Vineyard Wind Project

VINEYARD WIND

Figure 2.1-2

Offshore Location Plat (Regional View)

Table 2.1-1 Coordinates for the WTGs and ESPs

Name	Easting (m)	Northing (m)	Latitude	Longitude	Water Depth (m)
WTGs					
VYW01_R00_P01	379890	4555090	41° 08' 17.6589" N	70° 25' 52.0635" W	37.1
VYW01_R00_P02	384690	4550290	41° 05' 44.5510" N	70° 22' 22.9830" W	39.7
VYW01_R01_P01	378690	4555090	41° 08' 17.0163" N	70° 26' 43.5213" W	37.8
VYW01_R01_P02	379890	4553890	41° 07' 38.7564" N	70° 25' 51.2180" W	37.5
VYW01_R01_P03	383490	4550290	41° 05' 43.9349" N	70° 23' 14.4090" W	38.5
VYW01_R01_P04	384690	4549090	41° 05' 5.6473" N	70° 22' 22.1730" W	40.0
VYW01_R02_P01	377004	4554937	41° 08' 11.1427" N	70° 27' 55.7084" W	38.1
VYW01_R02_P02	377966	4553975	41° 07' 40.4790" N	70° 27' 13.7691" W	40.0
VYW01_R02_P03	378927	4553014	41° 07' 9.8426" N	70° 26' 31.8843" W	38.8
VYW01_R02_P04	379889	4552052	41° 06' 39.1700" N	70° 25' 49.9666" W	39.2
VYW01_R02_P05	382383	4549518	41° 05' 18.3331" N	70° 24' 1.3175" W	38.7
VYW01_R02_P06	383536	4548353	41° 04' 41.1618" N	70° 23' 11.1173" W	40.0
VYW01_R02_P07	384688	4547189	41° 04' 4.0160" N	70° 22' 20.9764" W	39.4
VYW01_R03_P01	375802	4553735	41° 07' 31.5172" N	70° 28' 46.3742" W	39.1
VYW01_R03_P02	377113	4552424	41° 06' 49.7348" N	70° 27' 49.2236" W	39.4
VYW01_R03_P03	378424	4551113	41° 06' 7.9442" N	70° 26' 52.0932" W	39.3
VYW01_R03_P04	379735	4549802	41° 05' 26.1453" N	70° 25' 54.9828" W	40.0
VYW01_R03_P05	381202	4548335	41° 04' 39.3628" N	70° 24' 51.1006" W	40.1
VYW01_R03_P06	382364	4547173	41° 04' 2.2994" N	70° 24' 0.5178" W	39.4
VYW01_R03_P07	383527	4546010	41° 03' 25.1976" N	70° 23' 9.9073" W	37.6
VYW01_R03_P08	384689	4544848	41° 02' 48.1213" N	70° 22' 19.3560" W	39.7
VYW01_R04_P01	374600	4552533	41° 06' 51.8856" N	70° 29' 37.0230" W	40.1
VYW01_R04_P02	375911	4551222	41° 06' 10.1102" N	70° 28' 39.8735" W	40.4
VYW01_R04_P03	377222	4549911	41° 05' 28.3265" N	70° 27' 42.7441" W	40.0
VYW01_R04_P04	378533	4548600	41° 04' 46.5345" N	70° 26' 45.6347" W	40.0
VYW01_R04_P05	380000	4547133	41° 03' 59.7597" N	70° 25' 41.7536" W	42.1
VYW01_R04_P06	381311	4545822	41° 03' 17.9502" N	70° 24' 44.6869" W	40.7
VYW01_R04_P07	382623	4544510	41° 02' 36.1005" N	70° 23' 47.5967" W	39.8
VYW01_R04_P08	383934	4543199	41° 01' 54.2744" N	70° 22' 50.5700" W	40.3
VYW01_R05_P01	373398	4551331	41° 06' 12.2481" N	70° 30' 27.6549" W	41.0
VYW01_R05_P02	374709	4550020	41° 05' 30.4796" N	70° 29' 30.5064" W	40.8

Table 2.1-1 Coordinates for the WTGs and ESPs (Continued)

Name	Easting (m)	Northing (m)	Latitude	Longitude	Water Depth (m)
WTGs					
VYW01_R05_P03	376020	4548709	41° 04' 48.7028" N	70° 28' 33.3781" W	40.7
VYW01_R05_P04	377331	4547398	41° 04' 6.9177" N	70° 27' 36.2698" W	41.4
VYW01_R05_P05	378798	4545931	41° 03' 20.1506" N	70° 26' 32.3898" W	42.0
VYW01_R05_P06	380109	4544619	41° 02' 38.3155" N	70° 25' 35.3233" W	40.2
VYW01_R05_P07	381420	4543308	41° 01' 56.5046" N	70° 24' 38.2776" W	40.9
VYW01_R05_P08	382732	4541997	41° 01' 14.6859" N	70° 23' 41.2092" W	41.0
VYW01_R06_P01	372196	4550129	41° 05' 32.6047" N	70° 31' 18.2699" W	41.4
VYW01_R06_P02	373507	4548818	41° 04' 50.8430" N	70° 30' 21.1225" W	42.0
VYW01_R06_P03	374818	4547507	41° 04' 9.0731" N	70° 29' 23.9952" W	42.5
VYW01_R06_P04	376129	4546196	41° 03' 27.2949" N	70° 28' 26.8879" W	43.0
VYW01_R06_P05	377596	4544729	41° 02' 40.5355" N	70° 27' 23.0091" W	42.3
VYW01_R06_P06	378907	4543417	41° 01' 58.7073" N	70° 26' 25.9436" W	41.0
VYW01_R06_P07	380218	4542106	41° 01' 16.9032" N	70° 25' 28.8989" W	41.8
VYW01_R06_P08	381530	4540795	41° 00' 35.0915" N	70° 24' 31.8315" W	41.7
VYW01_R07_P01	370994	4548927	41° 04' 52.9553" N	70° 32' 8.8680" W	43.0
VYW01_R07_P02	372305	4547616	41° 04' 11.2005" N	70° 31' 11.7217" W	42.8
VYW01_R07_P03	373615	4546305	41° 03' 29.4369" N	70° 30' 14.6382" W	43.4
VYW01_R07_P04	374926	4544994	41° 02' 47.6655" N	70° 29' 17.5320" W	44.2
VYW01_R07_P05	376394	4543527	41° 02' 0.9144" N	70° 28' 13.6115" W	41.8
VYW01_R07_P06	377705	4542215	41° 01' 19.0931" N	70° 27' 16.5471" W	42.3
VYW01_R07_P07	379016	4540904	41° 00' 37.2959" N	70° 26' 19.5034" W	42.7
VYW01_R07_P08	380328	4539593	40° 59' 55.4910" N	70° 25' 22.4369" W	42.2
VYW02_R01_P01	369528	4547461	41° 04' 4.5895" N	70° 33' 10.5563" W	43.0
VYW02_R01_P02	370512	4546478	41° 03' 33.2890" N	70° 32' 27.6638" W	45.5
VYW02_R01_P03	371495	4545495	41° 03' 1.9833" N	70° 31' 44.8253" W	43.5
VYW02_R01_P04	372478	4544512	41° 02' 30.6729" N	70° 31' 1.9981" W	45.3
VYW02_R01_P05	373461	4543529	41° 01' 59.3579" N	70° 30' 19.1822" W	45.2
VYW02_R01_P06	374929	4542061	41° 01' 12.5837" N	70° 29' 15.2624" W	44.3
VYW02_R01_P07	375912	4541078	41° 00' 41.2570" N	70° 28' 32.4745" W	43.6
VYW02_R01_P08	376896	4540094	41° 00' 9.8939" N	70° 27' 49.6544" W	43.6
VYW02_R01_P09	377879	4539111	40° 59' 38.5579" N	70° 27' 6.8891" W	43.3
VYW02_R01_P10	378863	4538127	40° 59' 7.1854" N	70° 26' 24.0915" W	43.2
VYW02_R02_P01	368326	4546259	41° 03' 24.9269" N	70° 34' 1.1170" W	43.1
VYW02_R02_P02	369310	4545276	41° 02' 53.6316" N	70° 33' 18.2252" W	45.0
VYW02_R02_P03	370293	4544293	41° 02' 22.3310" N	70° 32' 35.3876" W	46.6
VYW02_R02_P04	371276	4543310	41° 01' 51.0258" N	70° 31' 52.5612" W	45.0
VYW02_R02_P05	372259	4542326	41° 01' 19.6835" N	70° 31' 9.7453" W	46.5

Table 2.1-1 Coordinates for the WTGs and ESPs (Continued)

Name	Easting (m)	Northing (m)	Latitude	Longitude	Water Depth (m)
WTGs					
VYW02_R02_P06	373726	4540859	41° 00' 32.9489" N	70° 30' 5.8702" W	47.0
VYW02_R02_P07	374710	4539876	41° 00' 1.6279" N	70° 29' 23.0403" W	45.3
VYW02_R02_P08	375693	4538892	40° 59' 30.2693" N	70° 28' 40.2638" W	44.5
VYW02_R02_P09	376677	4537909	40° 58' 58.9391" N	70° 27' 57.4565" W	43.7
VYW02_R02_P10	377660	4536925	40° 58' 27.5712" N	70° 27' 14.7024" W	43.8
VYW02_R03_P01	367124	4545057	41° 02' 45.2583" N	70° 34' 51.6608" W	43.9
VYW02_R03_P02	368108	4544074	41° 02' 13.9682" N	70° 34' 8.7698" W	44.0
VYW02_R03_P03	369091	4543091	41° 01' 42.6728" N	70° 33' 25.9330" W	48.3
VYW02_R03_P04	370074	4542108	41° 01' 11.3727" N	70° 32' 43.1074" W	46.0
VYW02_R03_P05	371057	4541124	41° 00' 40.0356" N	70° 32' 0.2923" W	48.7
VYW02_R03_P06	372524	4539657	40° 59' 53.3086" N	70° 30' 56.4184" W	48.1
VYW02_R03_P07	373508	4538674	40° 59' 21.9928" N	70° 30' 13.5894" W	46.1
VYW02_R03_P08	374491	4537690	40° 58' 50.6394" N	70° 29' 30.8136" W	45.2
VYW02_R03_P09	375475	4536707	40° 58' 19.3143" N	70° 28' 48.0070" W	44.8
VYW02_R03_P10	376458	4535723	40° 57' 47.9516" N	70° 28' 5.2538" W	45.2
VYW02_R04_P01	365922	4543855	41° 02' 5.5839" N	70° 35' 42.1877" W	44.4
VYW02_R04_P02	366905	4542872	41° 01' 34.2983" N	70° 34' 59.3404" W	45.8
VYW02_R04_P03	367889	4541889	41° 01' 3.0086" N	70° 34' 16.4616" W	45.8
VYW02_R04_P04	368872	4540906	41° 00' 31.7137" N	70° 33' 33.6368" W	46.3
VYW02_R04_P05	369855	4539922	41° 00' 0.3817" N	70° 32' 50.8225" W	49.4
VYW02_R04_P06	371322	4538455	40° 59' 13.6625" N	70° 31' 46.9498" W	48.0
VYW02_R04_P07	372306	4537472	40° 58' 42.3518" N	70° 31' 4.1216" W	46.5
VYW02_R04_P08	373289	4536488	40° 58' 11.0035" N	70° 30' 21.3466" W	46.0
VYW02_R04_P09	374273	4535505	40° 57' 39.6836" N	70° 29' 38.5408" W	46.0
VYW02_R04_P10	375256	4534521	40° 57' 8.3260" N	70° 28' 55.7883" W	46.6
VYW02_R05_P01	364720	4542653	41° 01' 25.9035" N	70° 36' 32.6978" W	45.3
VYW02_R05_P02	365703	4541670	41° 00' 54.6231" N	70° 35' 49.8513" W	46.8
VYW02_R05_P03	366687	4540687	41° 00' 23.3386" N	70° 35' 6.9733" W	48.0
VYW02_R05_P04	367670	4539703	40° 59' 52.0164" N	70° 34' 24.1486" W	46.6
VYW02_R05_P05	368653	4538720	40° 59' 20.7219" N	70° 33' 41.3359" W	48.7
VYW02_R05_P06	370120	4537253	40° 58' 34.0104" N	70° 32' 37.4645" W	49.5
VYW02_R05_P07	371104	4536270	40° 58' 2.7049" N	70° 31' 54.6370" W	48.8
VYW02_R05_P08	372087	4535286	40° 57' 31.3617" N	70° 31' 11.8628" W	48.4
VYW02_R05_P09	373071	4534303	40° 57' 0.0469" N	70° 30' 29.0578" W	46.5
VYW02_R05_P10	374054	4533319	40° 56' 28.6945" N	70° 29' 46.3061" W	46.6
VYW02_R06_P01	363518	4541451	41° 00' 46.2172" N	70° 37' 23.1910" W	46.7

Table 2.1-1 Coordinates for the WTGs and ESPs (Continued)

Name	Easting (m)	Northing (m)	Latitude	Longitude	Water Depth (m)
WTGs					
VYW02_R06_P02	364501	4540468	41° 00' 14.9419" N	70° 36' 40.3454" W	46.9
VYW02_R06_P10	372852	4532117	40° 55' 49.0570" N	70° 30' 36.8071" W	47.5
EPSs					
ESP1_modif	375448.1	4553381.0	41° 07' 19.846" N	70° 29' 1.288" W	38
ESP2_modif	368748.3	4546682.5	41° 03' 38.901" N	70° 33' 43.356" W	42

NOTES:

1. Grid coordinates referenced to UTM Zone 19 north in meters, NAD83 datum.
2. Water depths may be interpolated where WTG and ESP locations have not been surveyed yet.
3. Water depths are referenced to Mean Lower Low Water.

2.2 Onshore Facilities

The Project's onshore facilities will include the Landfall Site, the onshore export cable from the Landfall Site to the onshore substation, the onshore substation itself, and the connections from the onshore substation to the existing bulk power grid. The Project's onshore components are shown on Figure 2.2-1.

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

Vineyard Wind Project

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Figure 2.2-1

Onshore Location Plat

Section 3.0

Project Structures and Facilities – General Structural and Project Design, Fabrication and Installation

3.0 PROJECT STRUCTURES AND FACILITIES - GENERAL STRUCTURAL AND PROJECT DESIGN, FABRICATION AND INSTALLATION

3.1 Offshore Facilities

The Project's offshore elements include the Wind Turbine Generators ("WTGs") and their foundations, the electrical service platforms ("ESPs") and their foundations, scour protection for all foundations, the inter-array cables, the inter-link cable that connects the ESPs, and the offshore export cables. The WTGs, the ESPs, the inter-array cables, the inter-link cable, and portions of the offshore export cables are located in federal waters. The balance of the export cable run is located in Massachusetts waters.

Lightning protection will be installed on the electrical systems, including the WTGs and ESPs.

Table 3.1-1 lists the Project Envelope and highlights the maximum number of structures or maximum dimensions (referred to as the "maximum design scenario").

Table 3.1-1 Vineyard Wind Project Envelope with Maximum Design Scenario

CAPACITY	Maximum	
Wind Farm Capacity	800 megawatt ("MW")	
WIND TURBINE GENERATORS	**Minimum**	**Maximum**
Turbine Size	8 MW	~14 MW
Total Tip Height above Mean Lower Low Water ("MLLW")[1]	191 meters ("m") (627 feet ["ft"])	255 m (837 ft)
Number of Positions (up to)[2]	106	
Number of WTGs (up to)	100	
WTG FOUNDATIONS		
Foundation Envelope	-100% monopiles or -Up to 10 jackets, remainder monopiles	
Foundation Type	Jackets (Pin Piles)	Monopiles
Number of Piles/Foundation	3-4	1
Maximum Area of Scour Protection at each Foundation	up to 1,800 square meters ("m^2") (19,375 square feet ["ft^2"])	up to 2,100 m^2 (22,600 ft^2)
Maximum Number of Foundations Installed per Day (24 hours)	1 (up to 4 pin piles)	2
ELECTRICAL SERVICE PLATFORMS		
ESP Type	400 MW Conventional ESP	800 MW Conventional ESP
Number of ESPs	2	1

Table 3.1-1 Vineyard Wind Project Envelope with Maximum Design Scenario Highlighted (Continued)

ESP FOUNDATIONS		
Foundation Types for Conventional ESP	Monopiles	Jackets
Number of Piles/Foundation	1	3-4
Maximum Area of Scour Protection at each Foundation	up to 2,100 m^2 (22,600 ft^2)	up to 2,500 m^2 (26,900 ft^2)
Maximum Height above MLLW	65.5 m (215 ft)	**66.5 m (218 ft)**
INTER-ARRAY CABLES		
Inter-array Cable Voltage	66 kilovolts ("kV")	
Maximum Length of Inter-array Cables	**275 kilometers ("km") (171 miles ["mi"])**	
EXPORT AND INTER-LINK CABLES		
Export and Inter-link Cable Voltage	220 kV	
Maximum Length of Inter-link Cable	**10 km (6.2 mi)**	
Maximum Number of Export Cables	2	
Maximum Length of Offshore Export Cables (for two export cables)	**158 km (98 mi)**	

Notes:

Maximum Design Scenario indicated by double lined box and bold text.

1. Turbine output is not necessarily proportionately linked to size, so smallest turbine size may not be an eight MW turbine.
2. Additional WTG positions are included to account for spare positions in the event of environmental or engineering challenges.

3.1.1 Wind Turbine Generators

The Project will utilize WTGs specially designed for offshore use (see Figure 3.1-1). The WTGs consists of two main components: the Rotor Nacelle Assembly ("RNA") and the tower. The WTGs will have a three-bladed rotor with a rotor diameter as listed in Table 3.1-1 below. The nacelle houses the power generating components of the turbine, including the gear box, generator, transformer, converter and other auxiliary systems. A pitch and yaw system will allow the wind turbine to optimize its performance by positioning the direction of the rotor and the angle of the blades. The brake, pitch, and yaw systems may be controlled using hydraulics. The RNA is mounted on the tower, which is mounted on a foundation and/or transition piece via a bolted connection; the foundation is further described in Section 3.1.2. The tower is typically constructed in two or three sections for offshore wind projects. Both the nacelle and the tower are steel structures coated to protect against corrosion.

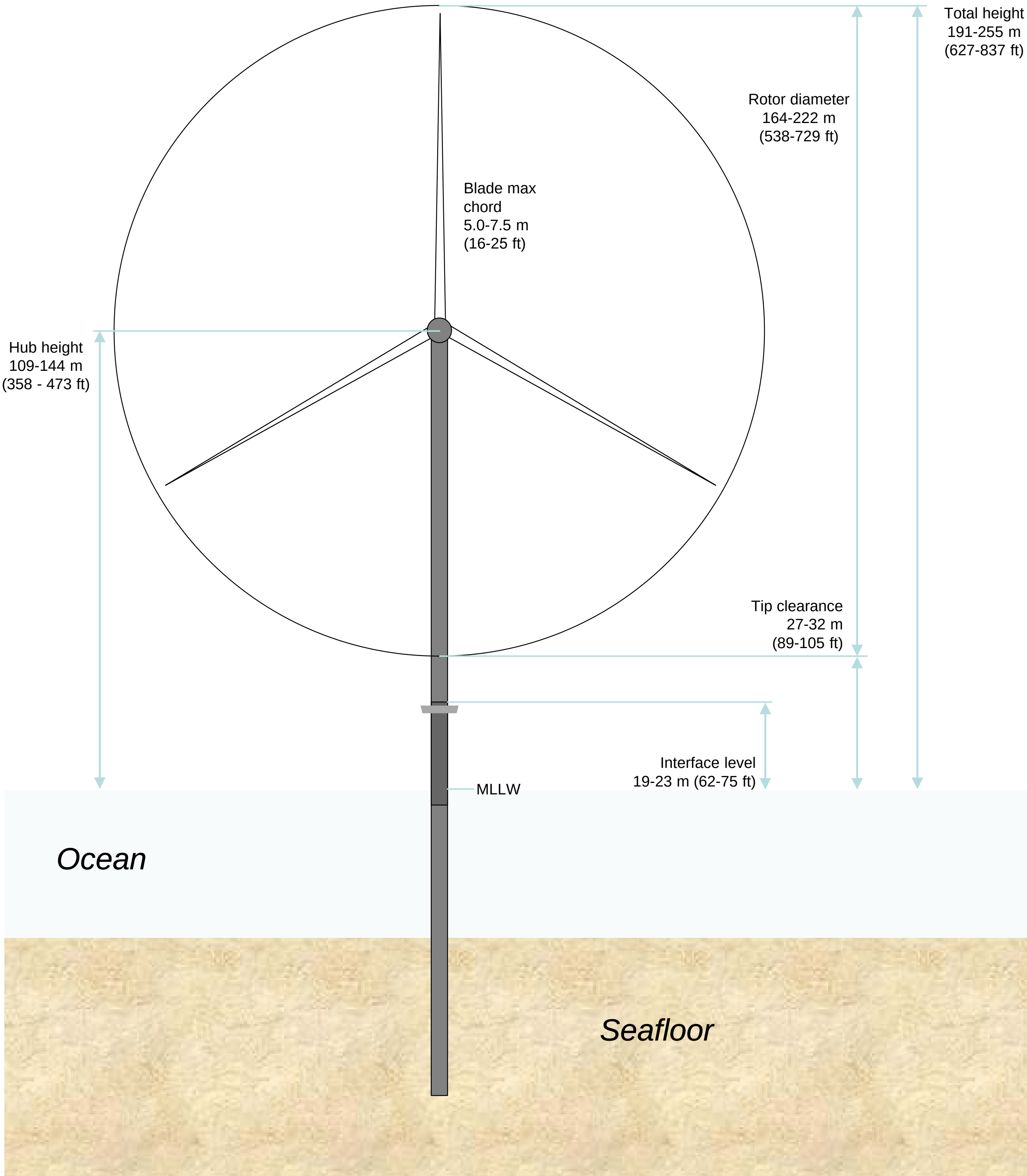

Figure 3.1-1
WTG Dimensions

For service purposes, the WTGs will have cranes in the nacelle and on the external working platform (which is mounted on the foundation and/or transition piece), that are able to lift spare parts to their proper location in accordance with operations and maintenance procedures. The WTGs will also include access ways for personnel inside the tower. An elevator will serve as the main access route. The elevator will be designed to carry personnel, tools, small equipment, and small spare parts. Ladders will serve as a secondary access route. All access routes will be designed to ensure and will comply with all relevant standards and regulations.

The wind turbine design will be verified for the specific site conditions during the Certified Verification Agent ("CVA") review process, where the design will be able to withstand wind speeds and gusts in the range of 180 kilometers per hour ("kph") (112 miles per hour [mph]) and 253 kph (157 mph), respectively. The offshore wind turbines will be designed to automatically stop power production when wind speeds exceed a maximum of 111 kph (69 mph), after which the rotor will normally idle. The exact speed at which power production will cease depends on the manufacturer's specifications. The structures will be designed for the extreme environmental conditions (including wind speed and wave height) verified by the CVA. Design wave heights are expected to be in the range of 18.3 m (60 feet).

Table 3.1-2 Envelope of WTG Parameters

WTG Parameter	Envelope
Tip height	191-255 m (627-837 ft) MLLW
Hub height	109-144 m (358-473 ft) MLLW
Rotor diameter	164-222 m (538-729 ft)
Platform level and expected interface level towards foundations	19-23 m (62-75 feet) MLLW
Tip clearance	27-32 m (89-105 ft) MLLW

Note: Elevations relative to MHHW are approximately 1 m (3 ft) lower than those relative to MLLW.

The WTGs will have maximum rotor tip height of 255 m (837 ft) above Mean Lower Low Water ("MLLW") and will include a nighttime wind turbine obstruction lighting system in compliance with Federal Aviation Administration ("FAA") and/or BOEM requirements. The obstruction lighting system will consist of two synchronized FAA "L-864" aviation red flashing obstruction lights placed on the nacelle of each WTG. If the WTGs' total tip height is 699 ft or higher, there will be at least three additional low intensity L-810 flashing red lights at a point approximately midway between the top of the nacelle and sea level. If approved by BOEM and the FAA, 30 flashes per minute will be utilized for air navigation lighting. Other temporary lighting (e.g. helicopter hoist status lights) may be utilized for safety purposes when necessary.

Vineyard Wind is working to reduce the lighting to lessen the potential impacts of nighttime light on migratory birds and to address aesthetic concerns. The Project expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights (FAA lights on both the nacelle and tower) when aircraft approach the Project. Alternatively, the Project may use a system that automatically adjusts lighting intensity in response to visibility conditions. The use of either of these systems is subject to commercial availability by turbine manufacturers, and approval by BOEM and the FAA, if applicable. A report on how often the ADLS system would be activated is included in Appendix III-N for informational purposes. If the use of ADLS is not feasible, reduced lighting for the interior will be reviewed and discussed with BOEM and the FAA. Turbines will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color; Vineyard Wind anticipates that the WTGs will be painted off-white/light grey to reduce their visibility from against the horizon. Aviation concerns are further discussed in Section 7.9 of Volume III.

Marine navigation lighting will consist of multiple yellow flashing lights at each turbine and on the corners of the ESPs. Yellow lights will be visible at five nautical miles ("nm") and/or two nm in accordance with consultation with the US Coast Guard ("USCG"). Lighting on the turbines will be located on top of the work platform design level at a height of 19-30 m (62-98 ft) above MLLW. Lighting on top of the substations will be placed at a similar height above MLLW. Daytime marking schemes will generally follow International Association of Lighthouse Authorities guidance, which involves marking each structure in the Project Area with high visibility yellow paint. Alphanumeric identification in black lettering will identify each WTG. Each turbine will also be clearly identified on National Oceanic and Atmospheric Administration charts. The high visibility yellow paint shall begin at the waterline (at all tidal conditions) and cover the WTG foundation to a height of at least 15 m (50 ft) above the waterline. Sound signals and AIS transponders are included in the Project design to enhance marine navigation safety. Further information on marine navigation, including figures showing the marking and lighting, can be found in the Navigation Risk Assessment (see Appendix III-I).[7]

3.1.1.1 Site Layout

As described in Section 1.5, the Project is being permitted using an Envelope concept. Up to 106 turbine locations are being permitted to allow for spare positions (in the event of environmental or engineering challenges). Although the Project is including 106 WTG positions in the Project Envelope, only up to 100 positions will be occupied by a WTG. The site layout for up to 106 turbine locations is shown on Figure 3.1-2. The WTGs are laid out in a grid-like pattern with spacing of 1.4-1.8 km (0.76-1.0 nm) between turbines.[8]

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7 The Project's lighting and marking scheme is being refined through ongoing consultations with USCG.

8 The listed dimensions describe the typical grid spacing. The minimum distance between nearest turbines is no less than 1.2 km (0.65 nm) and the maximum distance between nearest turbines is no more than 2.1 km (1.1 nm). The average spacing between turbines is 1.6 km (0.86 nm).

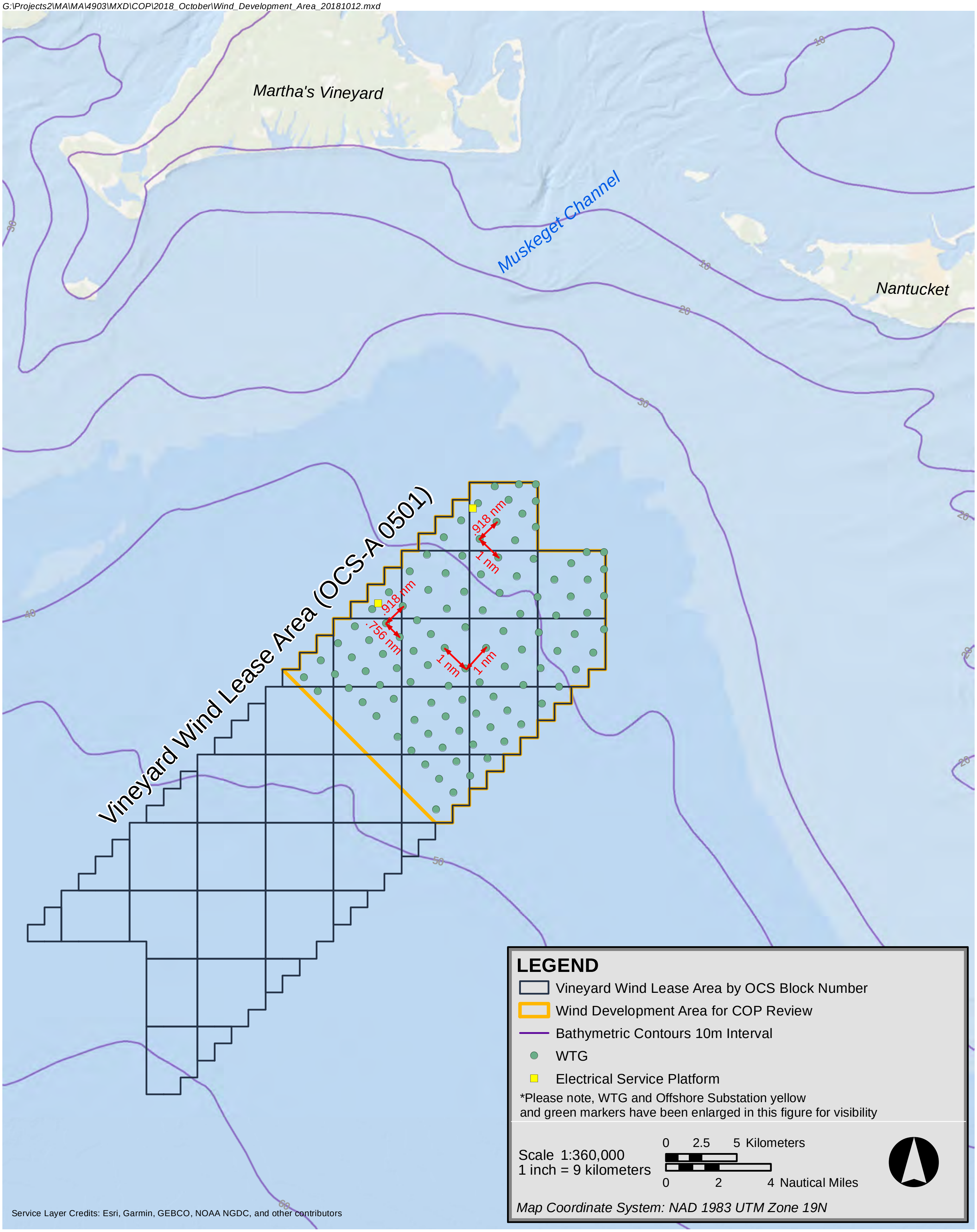

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Figure 3.1-2a

Wind Development Area for COP Review

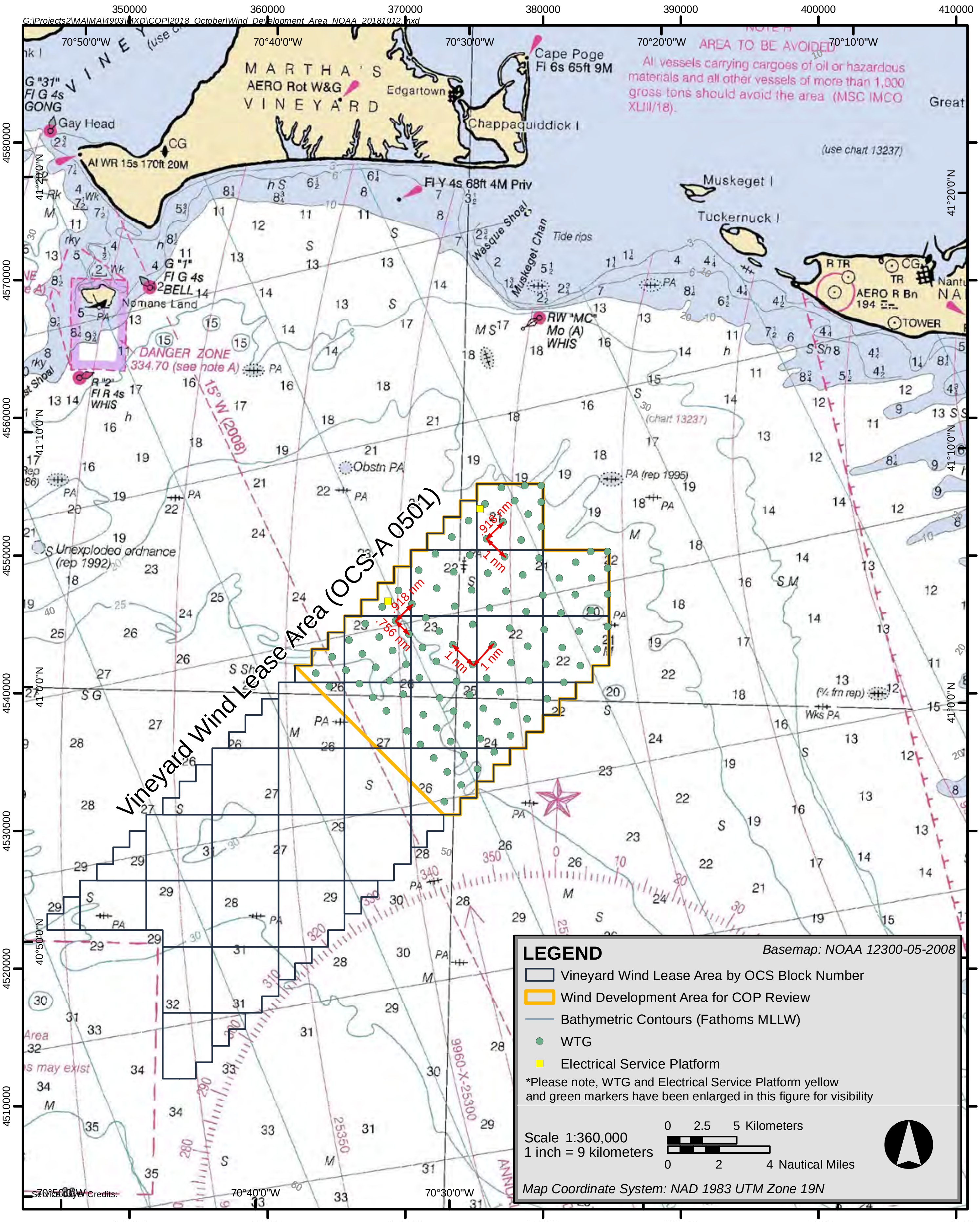

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Figure 3.1-2b

Wind Development Area for COP Review

In consultation with fishermen and the USCG, corridors in a northwest/southeast and northeast/southwest direction have been maintained.

3.1.2 WTG Foundations

The foundations supporting the WTGs will include one of the following two concepts:

- Monopiles and transition piece ("TP") (or extended monopile); and
- Jackets

As described in Section 1.5, both concepts are contained in the Project Envelope. The Maximum Design scenario considers either the installation of monopiles for all WTG foundations or the installation of up to ten jackets, with the remainder monopiles. Jackets are expected to be used in deeper water locations.

3.1.2.1 Monopiles

A monopile is a single, hollow cylinder fabricated from steel that is secured in the seabed. Monopile dimensions are shown on Figure 3.1-3 and are included in Table 3.1-3, below. Monopiles are a proven concept that has been used successfully at many offshore wind farms. As of December 2017, monopiles accounted for more than 80% of the installed foundations in Europe, with more than 3,350 units installed (Wind Europe, 2017).

A TP is typically installed between the monopile and WTG tower (see Figures 3.1-3 and 3.1-4). The TP features a connecting flange enabling the WTG tower section to be bolted/mounted on top of the TP; it also contains secondary structures, such as tower flange for mounting the WTG, boat landing, internal and external platform, and various electrical equipment needed during installation and operation (see Figure 3.1-3). In a variation of the concept, the monopile is extended to include the TP (this is referred to as an "extended monopile"; see Figure 3.1-5). In this case, secondary structures are attached after installation of the pile.

The monopile foundations for the Project will be equipped with a corrosion protection system designed in accordance with relevant standards. The monopiles will likely require the use of an anode cage to ensure sufficient corrosion protection closer to the seabed. An anode cage is a steel structure that has anodes attached to it.

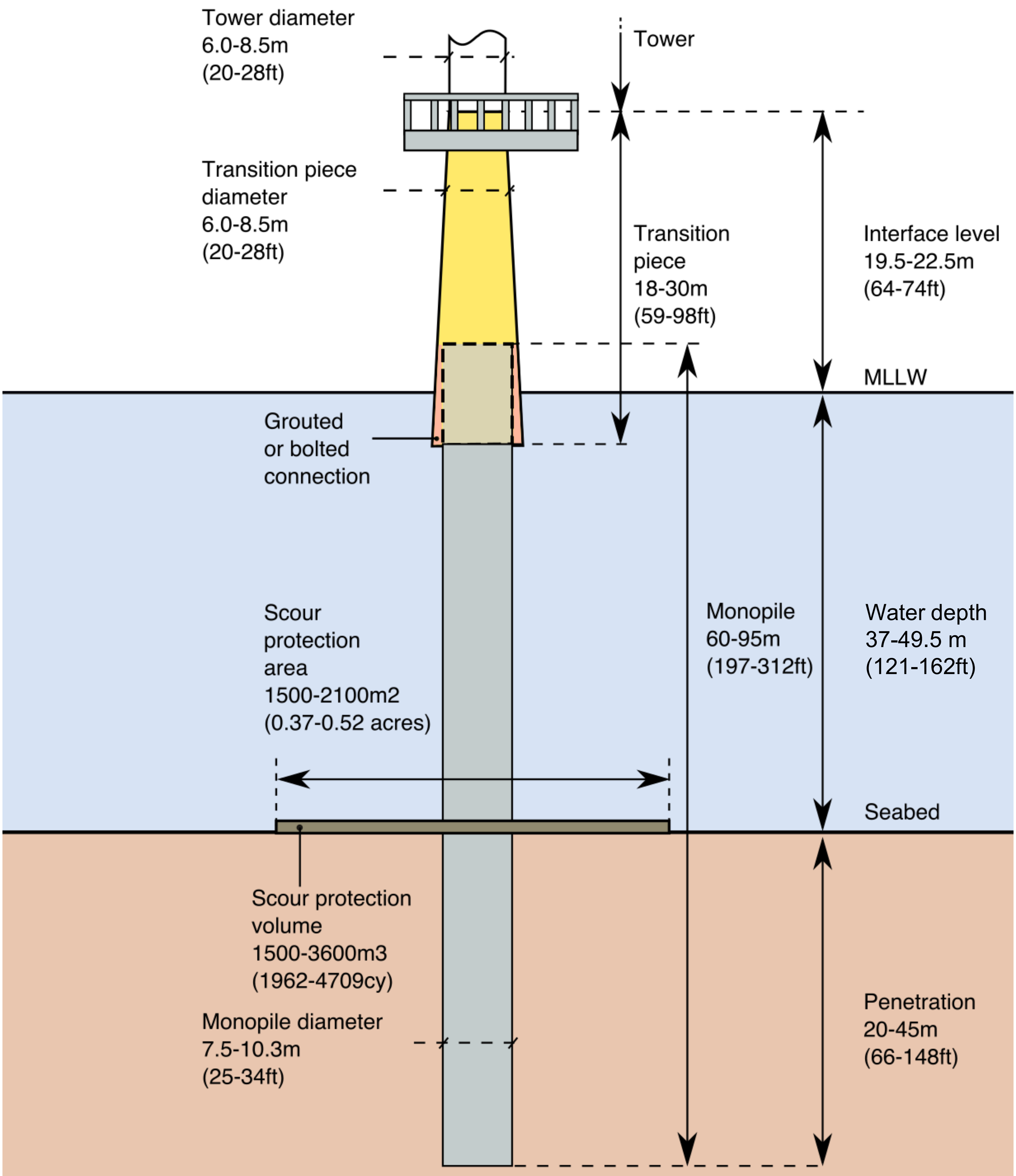

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Figure 3.1-3
WTG Monopile Foundations

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Figure 3.1-4

Photographs of Monopiles and Transition Pieces

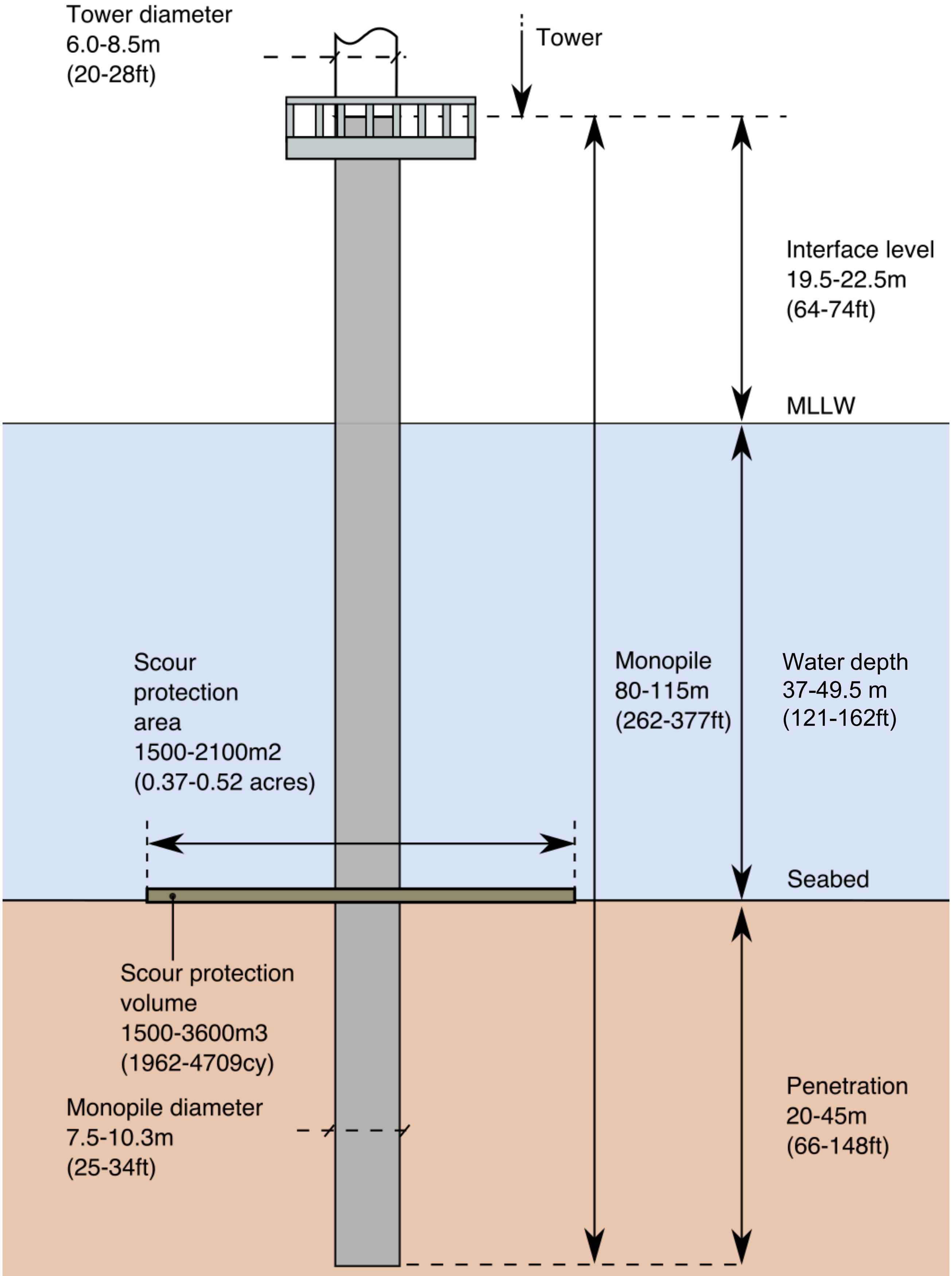

Figure 3.1-5
WTG Extended Monopile Foundation

3.1.2.2 Jackets

The jacket design concept consists of three to four piles, a large lattice jacket structure and a TP (see Figures 3.1-6 through 3.1-8). The jacket structure is supported/secured by pre-installed driven piles (one per leg). Alternatively, the jacket is secured to the sea floor via slender piles which are driven through "sleeves" or guides mounted to the base of each leg of the jacket structure.

The jacket will also contain secondary structures, such as boat landings and cable tubes. Jackets account for 12% of the number of foundations installed in 2016 in Europe, which brings their total market share to 6.6% (Wind Europe, 2017). Jackets are also widely used for other offshore applications, including in the oil and gas sectors. Further, as described for the monopiles (see Section 3.1.2.1, above), the jacket will be equipped with a corrosion protection system design in accordance with relevant standards.

The jacket is fixed to the piles and a TP is fitted to obtain the turbine loads and transfer them to the jacket structure. The TP will contain secondary structures, such as tower flange for mounting the WTG, internal and external platforms, and various types of electrical equipment needed during installation and operation.

3.1.3 Scour Protection

Scour protection is included to protect the foundation from scour development, which is the removal of the sediments near structures by hydrodynamic forces. Scour protection consists of the placement of stone or rock material around the foundation so that it can withstand the increased seabed drag created by the presence of the foundation. One of the benefits of scour protection is that it allows foundation penetration to be minimized, as the design does not have to account for significant scour development.

As shown on Figure 3.1-9, the scour protection will be one to two meters high (3-6 ft), with stone or rock sizes of approximately 10-30 centimeters (4-12 inches).

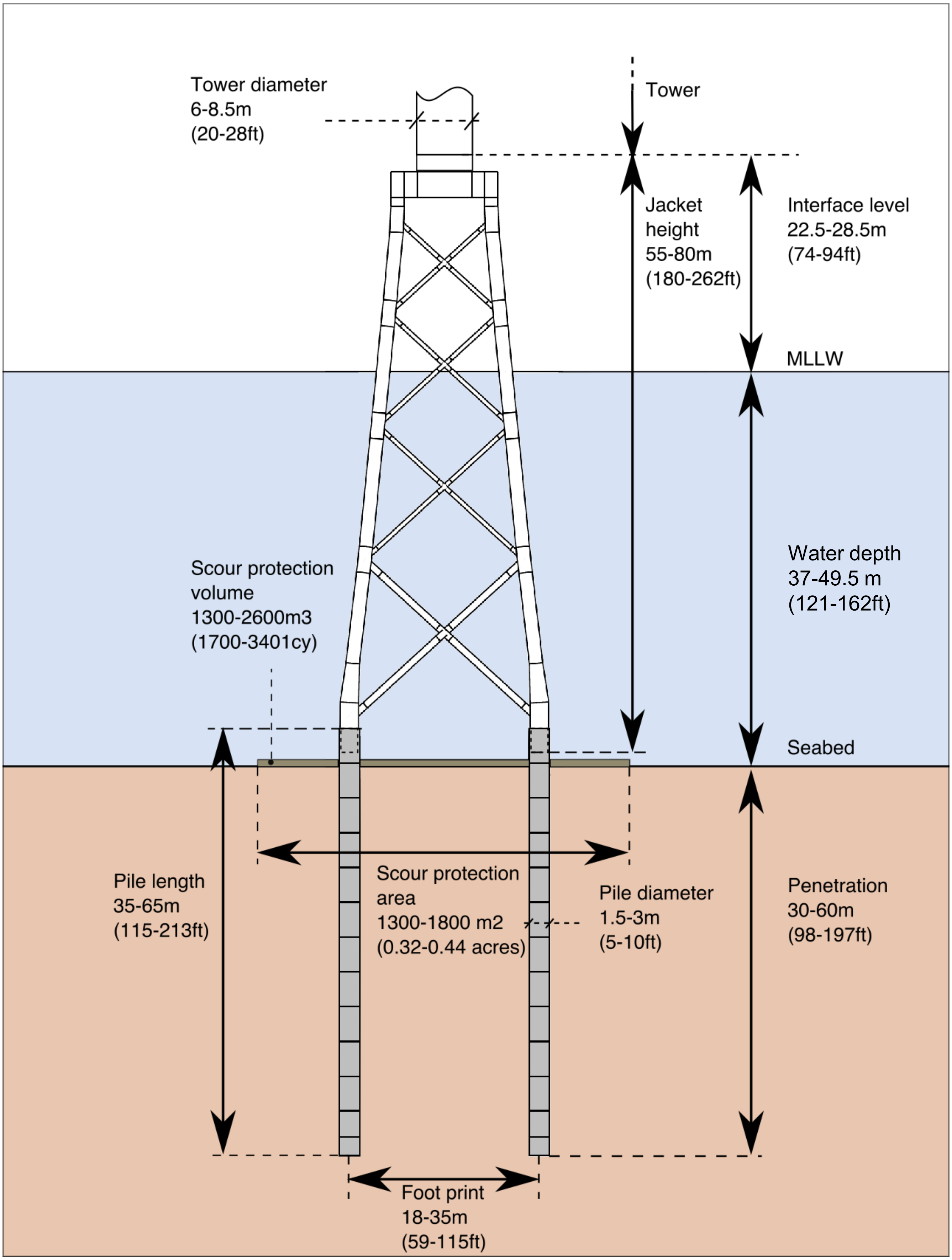

Figure 3.1-6
WTG Jacket Foundation

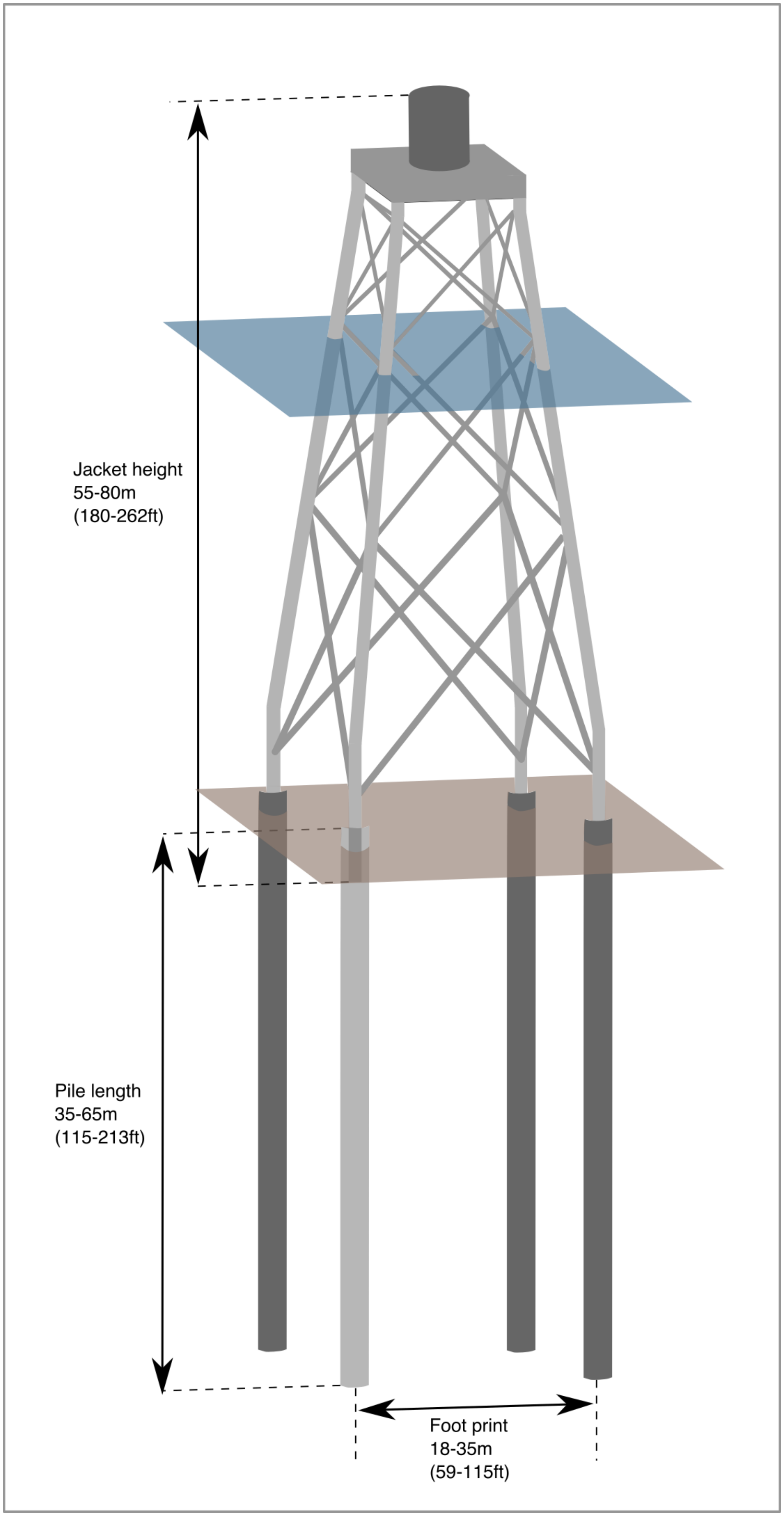

Figure 3.1-7

WTG Jacket Foundation 3D Rendering

Figure 3.1-8

Photographs of Jacket Foundations

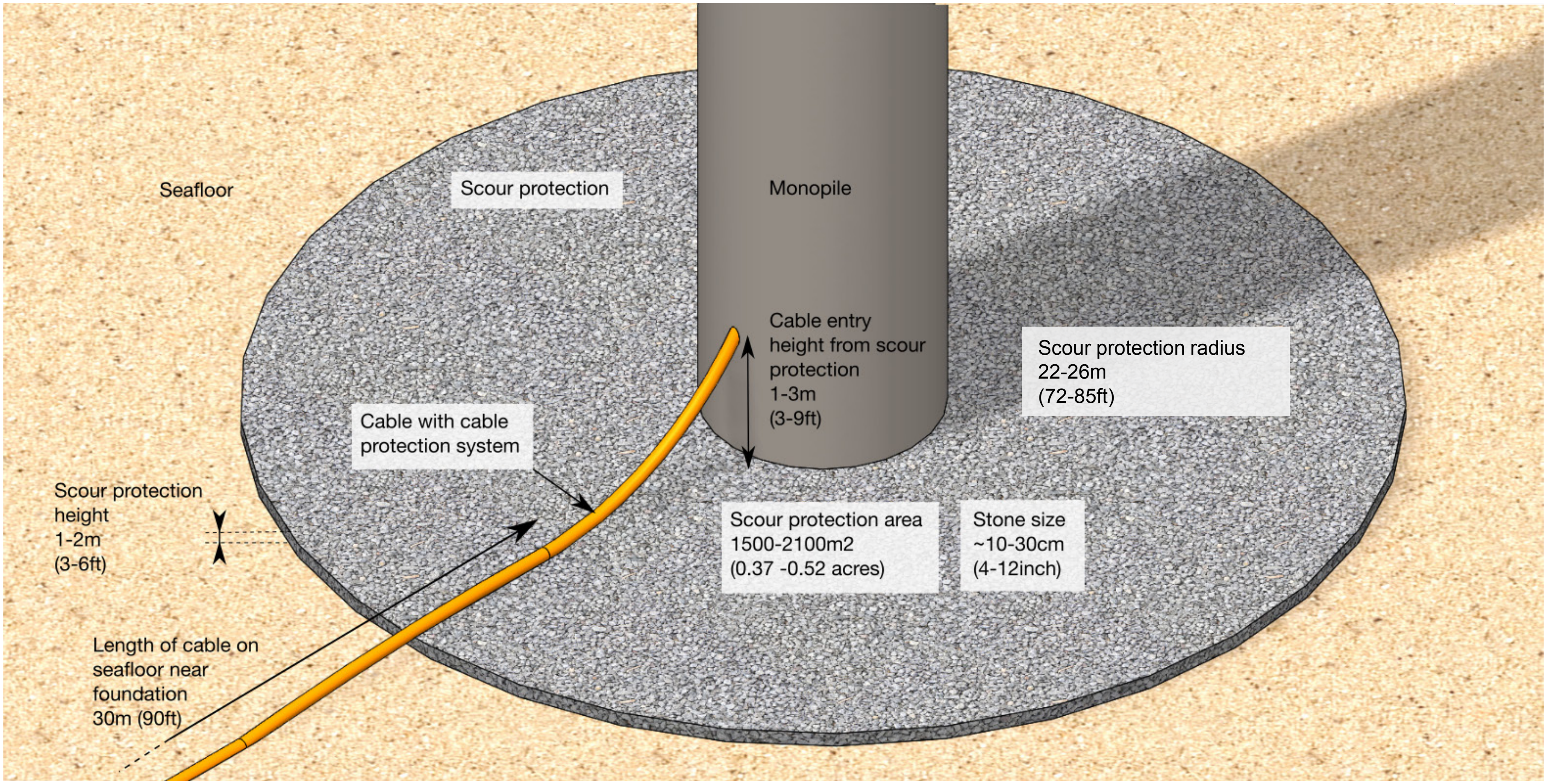

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Figure 3.1-9

Typical Scour Protection For Monopile Foundation

Table 3.1-3, below, shows the Project Envelope for the two foundation concepts and associated scour protection.

Table 3.1-3 Envelope of WTG Foundation Dimensions

Concept	Monopile		Jackets
	Monopile	Extended Monopile	Piles (3-4 piles)
Length	60-95m (197-312 ft)	80-115 m (262-377 ft)	35-65 m (115-213 ft)
Diameter (maximum)	7.5-10.3 m (25-34 ft)	7.5-10.3 m (25-34 ft)	1.5-3.0 m (5-10 ft)
Penetration	20-45 m (66-148 ft)	20-45 m (66-148 ft)	30-60 m (98-197 feet)
Bottom Pile Wall Thickness	70-100 millimeters ("mm") (2.8-3.9 inches)	70-100 mm (2.8-3.9 inches)	40-55 mm (1.6-2.2 inches)
	Transition Piece	**Transition Piece**	**Jacket Structure (including Transition Piece)**
Length	18*-30 m (59-98 ft)	(N/A)	55-80 m (180-262 ft)
Diameter	6.0-8.5 m (20-28 ft)	(N/A)	18-35 m (59-115 ft)
Interface elevation	19-23 m MLLW (62-75 ft MLLW)	(N/A)	22.5-28.5** m MLLW (74-94 ft MLLW)
	Scour Protection	**Scour Protection**	**Scour Protection**
Scour protection volume	1,500-3,600 m^3/mT (1,962-4,709 cubic yards ["cy"])	1,500-3,600 m^3/mT (1,962 – 4,709 cy)	1,300-2,600 m^3/mT (1,700-3,401 cy)
Scour protection area	1,500-2,100 m^2 (0.37 -0.52 acres)	1,500-2,100 m^2 (0.37 -0.52 acres)	1,300-1,800 m^2 (0.32-0.44 acres)

* Length to account for the possibility of a bolted connection.

** Interface elevation is set up to account for the possibility of an interface placed above the tower access door.

3.1.4 Electrical Service Platforms

For the 800 MW Project, there will be one 800 MW conventional ESP or two 400 MW conventional ESPs. The potential locations for the ESPs are shown on Figure 3.1-2. Similar to the WTG foundations, two options are considered for the ESP foundations: monopile or jacket (Figures 3.1-10 through 3.1-13).

The ESPs will serve as the common interconnection point for the WTGs within the array. Each WTG will interconnect with an ESP via a 66 kV submarine cable system. These cable systems will interconnect with circuit breakers and transformers (66 kV to 220 kV) located on the ESPs to increase the voltage level and transmit electricity through the offshore cable system to the final connection point to the bulk power grid. Additional information about the offshore cable systems is included in Sections 3.1.5 and 3.1.6.

Additional equipment on the ESPs is subject to final design but is anticipated to include the following: 220 kV AC switchgear for connection to the onshore substation, switchgear for connection with the wind turbines, transformer oil spill tanks, shunt reactors, auxiliary systems, cooling systems, fire pumps, seawater utility pumps for systems such as fresh water and cooling, fire detection and firefighting equipment, cranes (as required), rescue and evacuation facilities and equipment (such as life rafts or boats, lifejackets), supervisory control and data acquisition ("SCADA") equipment, and communications and navigation systems.

An HVAC system may be installed in the ESPs to protect the equipment and personnel from extreme temperatures. In addition, an emergency generator and/or battery may also be installed on the ESPs to provide emergency power.

Figures 3.1-10 through 3.1-13 provide illustrative dimensions for conventional ESPs on a standard monopile/transition piece foundation, an extended monopile foundation, and a jacket foundation (2D and 3D versions), respectively. Photographs of ESPs can be found in Figure 3.1-14. ESPs may also include a helipad for maintenance work and are anticipated to include at least one boat landing. Project Envelope dimensions for the ESPs are shown in Table 3.1-4 below.

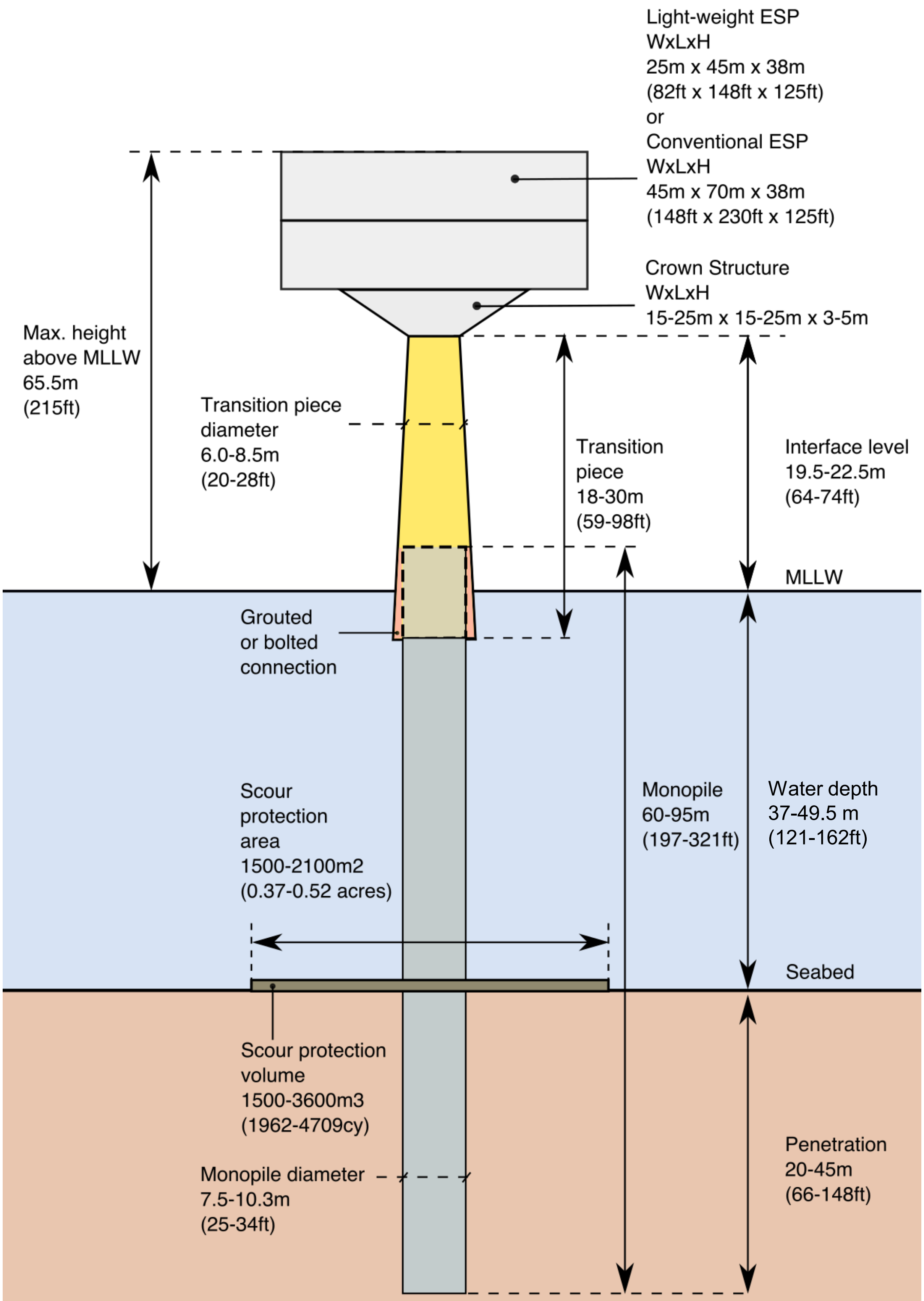

Figure 3.1-10
ESP Monopile Foundation

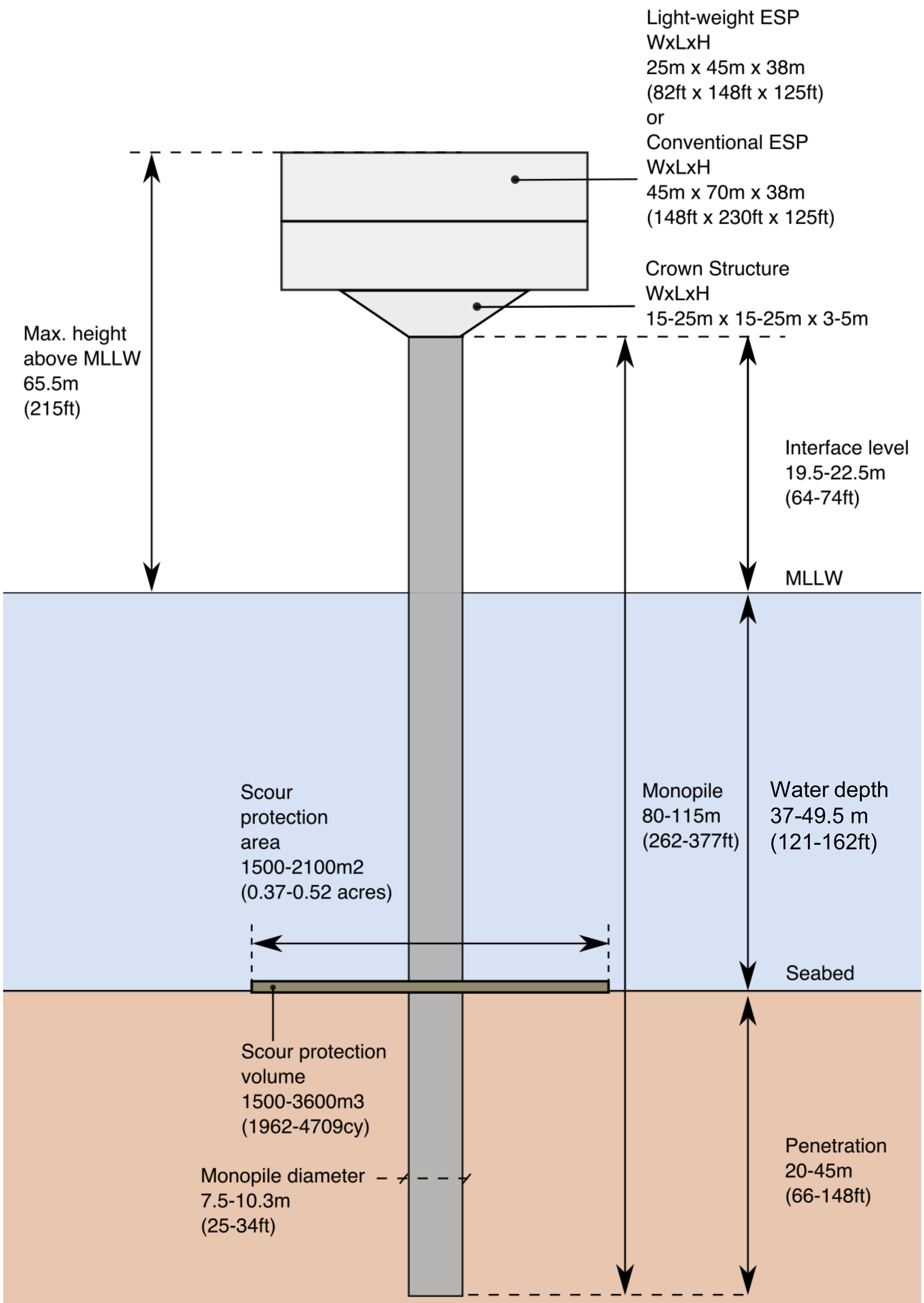

Figure 3.1-11
ESP Extended Monopile Foundation

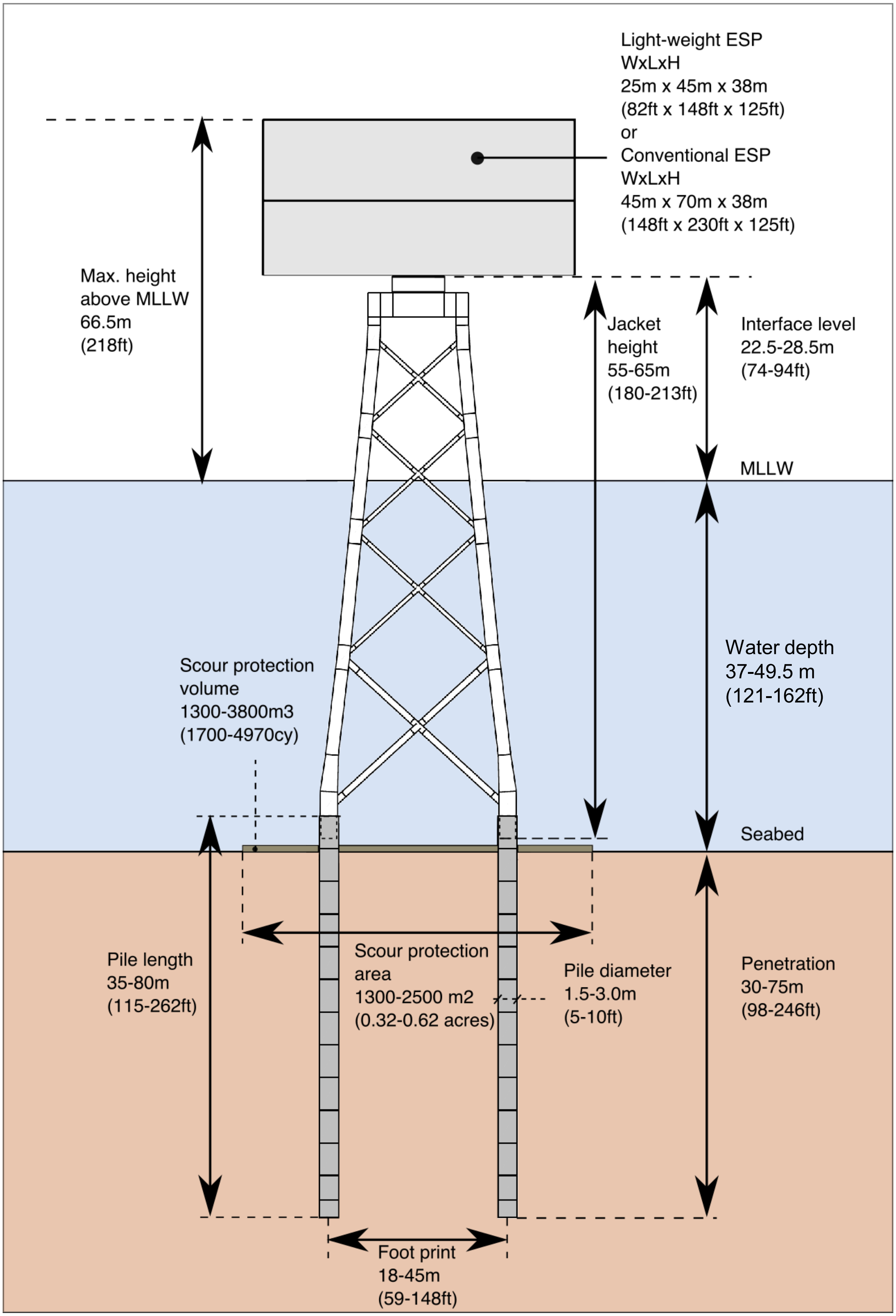

Figure 3.1-12
ESP Jacket Foundation

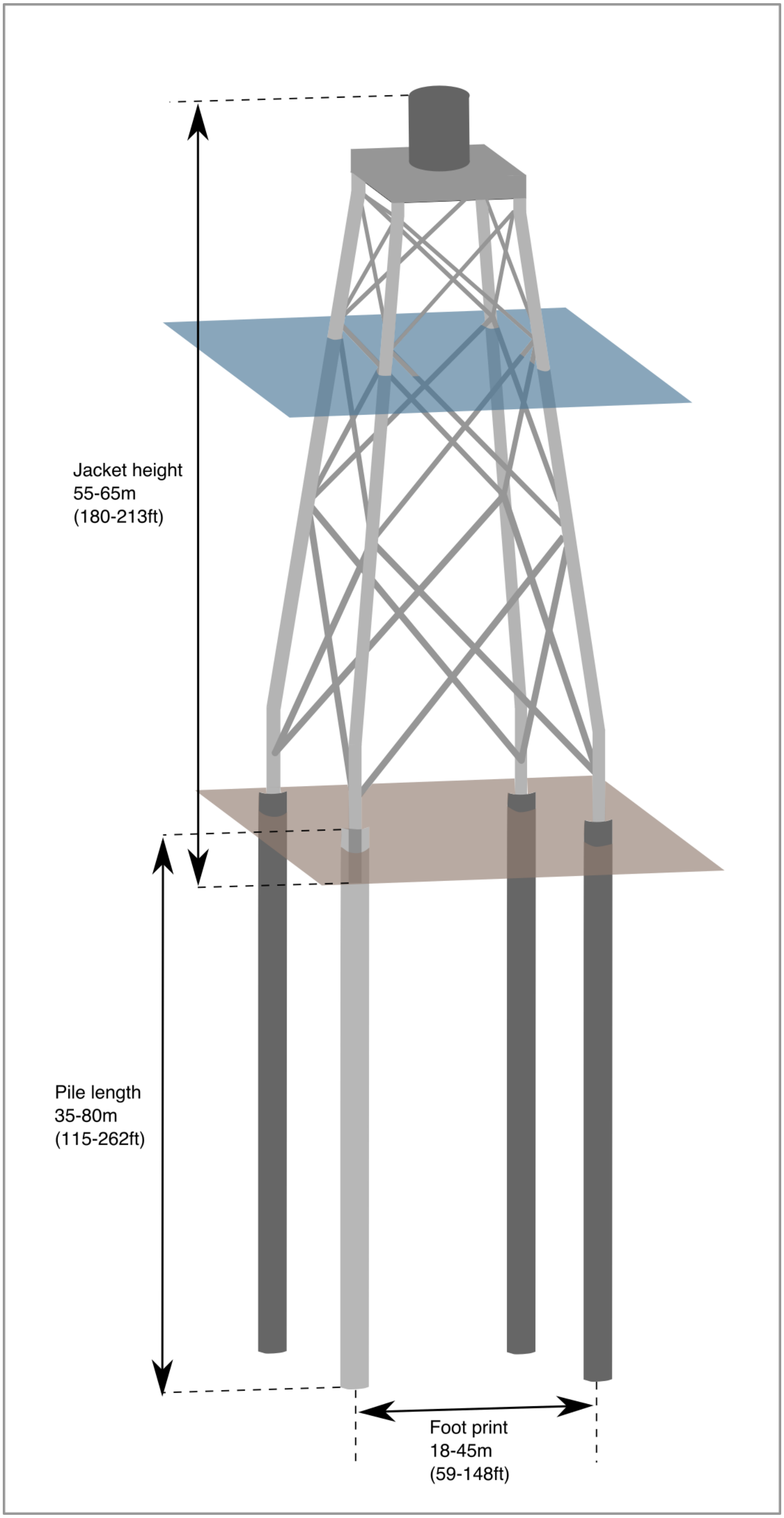

Figure 3.1-13
ESP Jacket Foundation 3D Rendering

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Figure 3.1-14

Photographs of Electrical Service Platforms

Table 3.1-4 ESP Dimensions

Foundation Concept	Monopile		Jackets
	Monopile	Extended Monopile	Piles (3-4 piles)
Length	60-95m (197-312 ft)	80-115 m (262-377 ft)	35-80 m (115-262 ft)
Diameter (maximum)	7.5-10.3 m (25-34 ft)	7.5-10.3 m (25-34 ft)	1.5-3.0 m (5-10 ft)
Penetration	20-45 m (66-148 ft)	20-45 m (66-148 ft)	30-75 m (98-246 feet)
Bottom Pile Wall Thickness	70-100 mm (2.8-3.9 inches)	70-100 mm (2.8-3.9 inches)	60-80 mm (2.4-3.1 inches)
	Transition Piece	Transition Piece	Jacket Structure (including Transition Piece)
Length	18*-30 m (59-98 ft)	(N/A)	55-65 m (180-213 ft)
Diameter	6.0-8.5 m (20-28 ft)	(N/A)	18-45 m (59-148 ft)
Interface elevation	19.5-22.5 m MLLW (64-74 ft MLLW)	(N/A)	22.5-28.5** m MLLW (74-94 ft MLLW)
	Scour Protection	Scour Protection	Scour Protection
Scour protection volume	1,500-3,600 m^3 (1,962-4,709 cy)	1,500-3,600 m^3 (1,962 – 4,709 cy)	1,300-3,800 m^3 (1,700-4,970 cy)
Scour protection area	1,500-2,100 m^2 (0.37 -0.52 acres)	1,500-2,100 m^2 (0.37 -0.52 acres)	1,300-2,500 m^2 (0.32-0.62 acres)
	Crown Structure	Crown Structure	
Dimension (WxLxH)	15-25m x 15-25m x 3-5m (49-82 ft x 49-82 ft x 10-16.4 ft)	15-25m x 15-25m x 3-5m (49-82 ft x 49-82 ft x 10-16.4 ft)	(N/A)
Topside Component			
Dimensions for ESP (WxLxH)***	45m x70m x 38m (148ft x 230ft x 125ft)		
Complete ESP	**Monopile /Extended Monopile**		**Jackets**
Max Height above MLLW	65.5 m MLLW (215 ft MLLW)		66.5 m MLLW (218 ft MLLW)

* Length to account for the possibility of a bolted connection.

** Interface elevation is setup to account for the possibility of an interface placed above the tower access door.

***Dimensions for a conventional ESP are applicable to a 400 MW or an 800 MW ESP. Dimensions include possible helideck but do not include antennae.

3.1.5 Export Cables and Inter-Link Cables

3.1.5.1 Offshore Export Cable Corridor

The wind farm will connect to the onshore electrical grid via two offshore export cables that will travel north from the Offshore Project Area and make landfall onshore. Utilizing the Envelope concept for this part of the Project, there is one primary Offshore Export Cable Corridor ("OECC") with two route options through Muskeget Channel and two potential Landfall Sites. (see Figure 3.1-15). The two potential Landfall Sites under consideration are Covell's Beach in Barnstable and New Hampshire Avenue in Yarmouth (see Figure 3.1-15). The OECC will pass through Muskeget Channel, turn west, and will make landfall at Covell's Beach or New Hampshire Avenue. The maximum length per cable is approximately 70-80 km (43-50 mi), which gives a total maximum length of export cables, assuming two cables, of 158 km[9] (98 mi).

3.1.5.2 Export Cable Separation Distances

A typical separation distance of 100 m (330 ft) will be maintained between the two cables to allow room for repairs, if needed (Figure 3.1-16). A total corridor width of 810 m (2,657 ft) will be maintained to allow for optimal routing of the cables. In some areas where more maneuverability may be required during construction, a corridor width of 1,000 m (3,280 ft) is planned. For sections where the cable crosses sensitive habitat areas or where a narrower corridor is needed for other reasons (e.g. where shoreline constrictions do not allow access), the recommended cable spacing may be decreased. Figure 3.1-15 shows the OECC.

3.1.5.3 Export Cable Design

Cable Design

Each offshore export cable will be comprised of a three-core 220 kV alternating current ("AC") cable for power transmission and one or two fiber optic cables for communication, temperature measurement, and protection of the high-voltage system (see Figure 3.1-17). The offshore export cables will be buried beneath the seafloor at a target depth of 1.5-2.5 m (5-8 ft); the minimum target burial depth is 1.5 m (5 ft) (see Section 4.2.3.3 for a description of cable installation techniques). The three copper or aluminum conductors will each be encapsulated by cross-linked polyethylene insulation. Waterproof sheathing will prevent the infiltration of water.

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[9] Cable length is measured from the Landfall Site to one of the two potential ESP locations and includes an additional allowance for micro-siting.

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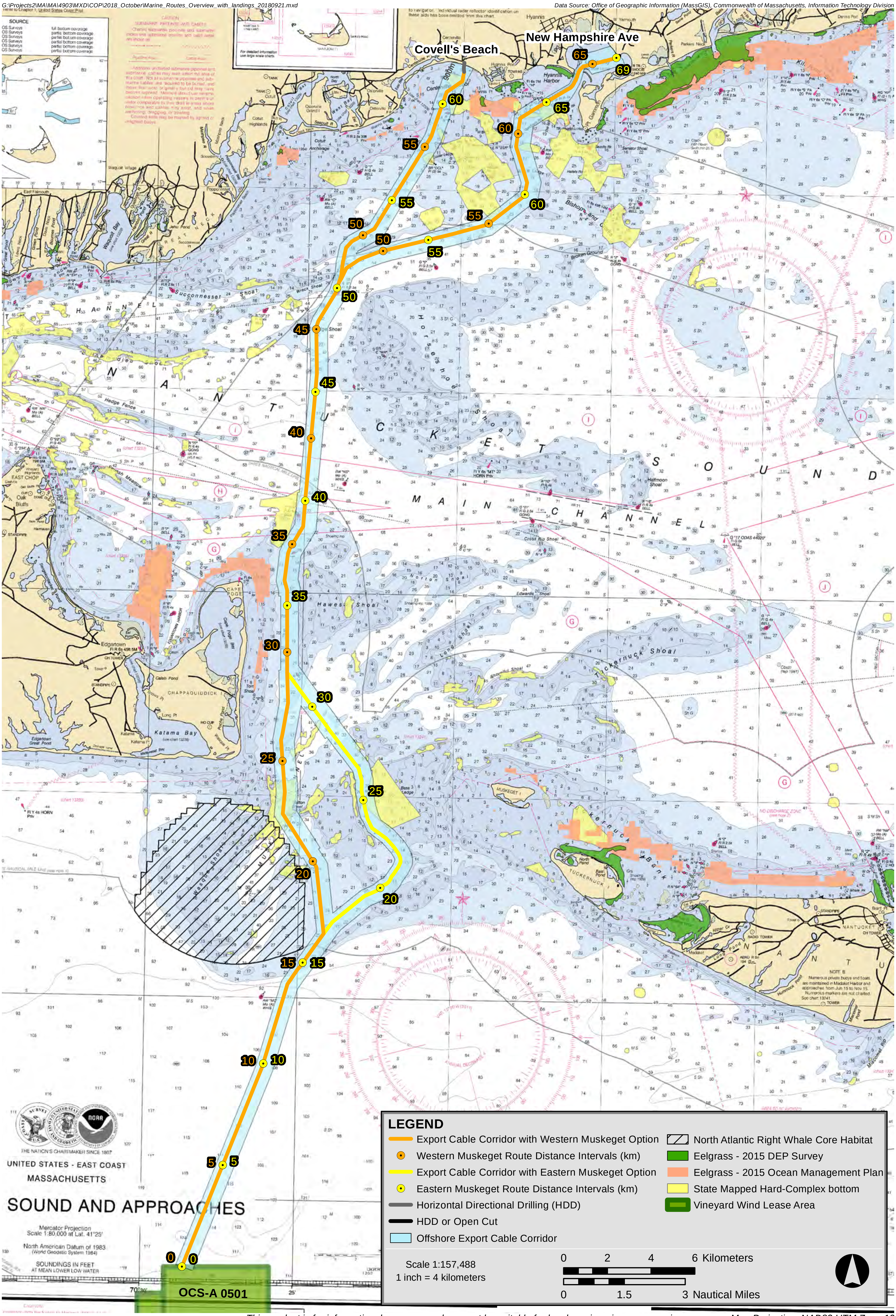
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes. Map Projection: NAD83 UTM Zone 19

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Figure 3.1-15a

Offshore Export Cable Corridor

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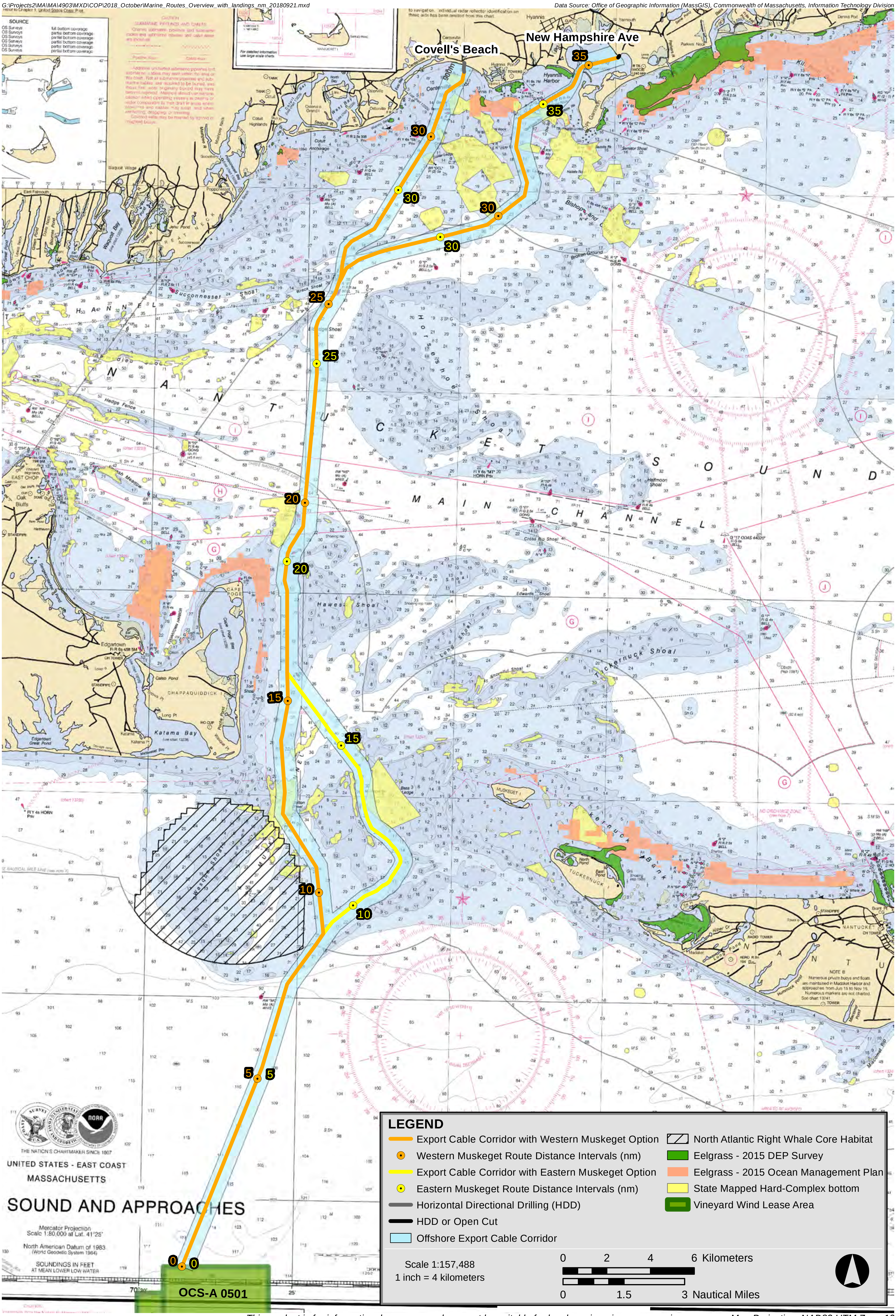
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes. Map Projection: NAD83 UTM Zone 19

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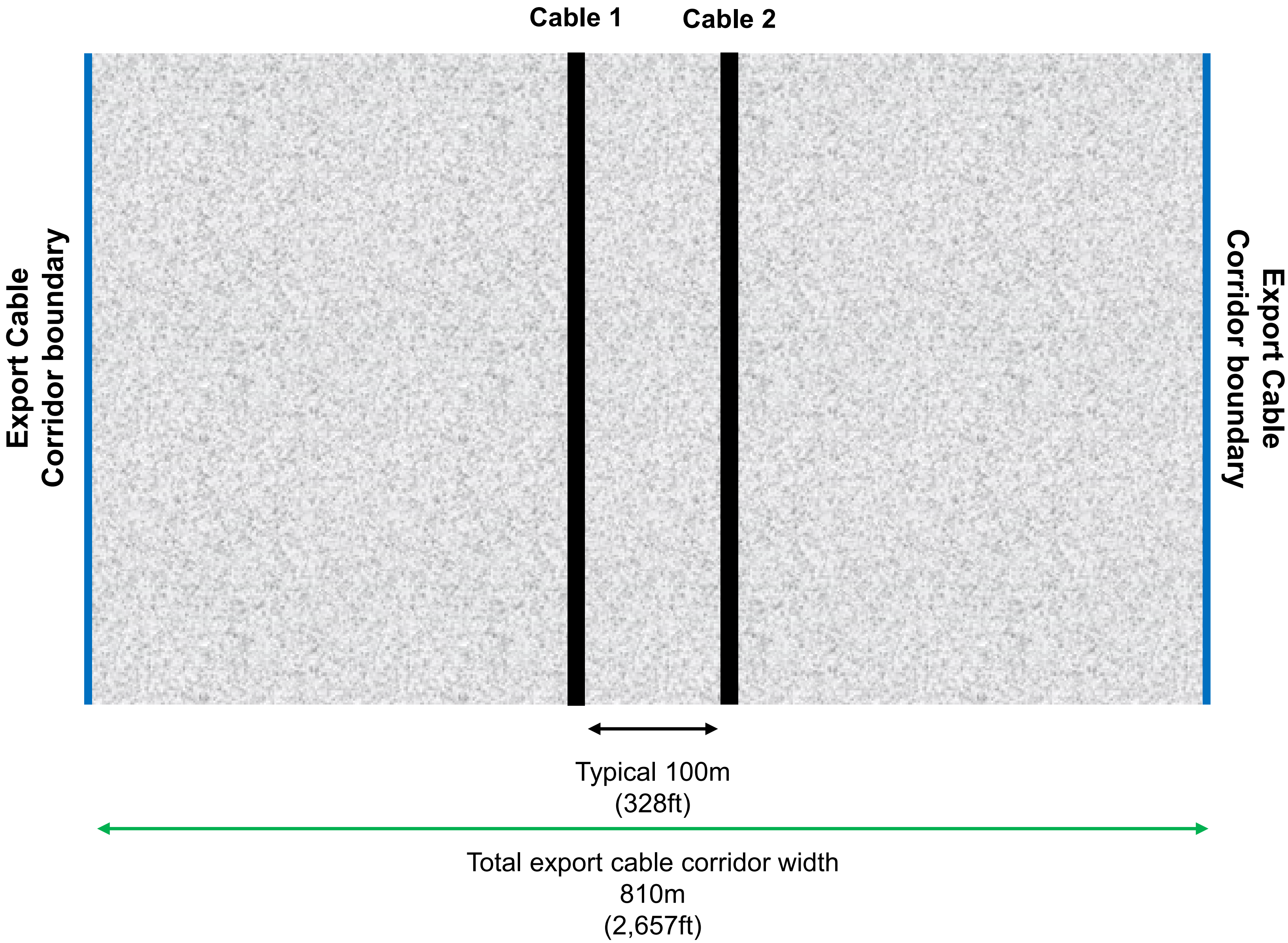
Figure 3.1-15b

Offshore Export Cable Corridor



Note: A 810 m wide corridor is planned. However, the corridor may up to 1,000 m wide in areas where more maneuverability is required during construction. In addition, the corridor width may be decreased where the cable crosses sensitive habitat areas or where shoreline constrictions do not allow access.

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Figure 3.1-16

Offshore Export Cable Spacing

Design:

1 Conductor (Al or Cu)

2 Inner semi-conducting layer

3 XLPE insulation

4 Outer semi-conducting layer

5 Swellable tape

6 Lead sheath

7 PE oversheath

8 Fibre optic cable

9 Filler profiles

10 Bedding (PP)

11 Armouring

12 Outer sheath (PP)

Figure 3.1-17

Typical Submarine Cable Cutaway

As already noted, two offshore export cables will be used for the Project. Additionally, if 400 MW conventional ESPs are used, the two ESPs will be inter-linked using the same 220 kV cable. All designs would provide sufficient redundancy, thus improving reliability, and would also ensure sufficient transmission capacity under conditions where full wind speeds are sustained for a long period of time.

Cable Protection

All offshore export and inter-array cables will be protected through the use of protection conduits put in place at the approach to the foundations and ESPs (see Figure 3.1-9). This protection consists of different components of composite material that protect the cables from fatigue loads and mechanical loads as they approach and enter the structures (for a distance of approximately 30 m [98 ft] outside the foundation). The cable protection system will be mounted around the cable on board the installation vessel and secured to the cable with a pull-in head.

In addition, in the event sufficient burial depths cannot be achieved or the cables need to cross other infrastructure (e.g., existing cables, pipes, etc.), alternative cable protection methods will be used. These alternative methods are:

- Rock placement, which involves laying rocks on top of the cable to provide protection.

- Concrete mattresses, which are prefabricated flexible concrete coverings that are laid on top of the cable. Alternately, the mattresses may be filled with grout and/or sand (referred to as grout/sand bags); this method is generally applied on smaller scale applications than concrete mattresses.

- Half-shell pipes or similar products made from composite materials (e.g., Subsea Uraduct from Trelleborg Offshore) or cast iron with suitable corrosion protection. Half-shell pipes come in two halves and are fixed around the cable to provide mechanical protection. Half-shell pipes or similar solutions are generally used for short spans, at crossings or near offshore structures, where there is a high risk from falling objects. The pipes do not provide protection from damage due to fishing trawls or anchor drags.

Vineyard Wind conservatively estimates that up to 10% of the total length of the offshore export cable system could require one of these alternative protection measures. The estimated length and area of offshore cables potentially requiring protection is presented in Table 6.5-5 of Volume III. Vineyard Wind intends to avoid or minimize the need for cable protection to the greatest extent feasible through careful site assessment and thoughtful selection of the most appropriate cable installation tool to achieve sufficient burial; therefore, the 10% value is expected to be a conservative estimate. For additional details, see the Initial Cable Burial Performance Assessment included as Appendix A of the COP Addendum.

3.1.6 Inter-array Cables

As already noted, the WTGs will be connected to the ESPs via 66 kV inter-array cables. These inter-array cables will be buried beneath the seafloor at a target depth of 1.5-2.5 m (5-8 ft); the minimum target burial depth is 1.5 m (5 ft) (see Section 4.2.3.6 for a description of inter-array cable installation). The expected cable type is the same three-core AC cable to be used for the offshore export cables, as described above in Section 3.1.5.3. The maximum outer diameter of these cables is anticipated to be 155-165 mm (6.1-6.5 inches). As they transmit different amounts of power, three different cross sections are envisaged for the cable: the likely copper or aluminum core cross sections are 240, 500, and 630 square millimeters ("mm^2"); however, a maximum size of 800 mm^2 may be considered to account for updates in technology.

The inter-array cables will connect radial "strings" of six to 10 WTGs to the ESPs. The design and optimization of the inter-array cable system will occur during final design of the Project, and will consider cable design and capacity, ground conditions, wind farm operating conditions, and installation conditions. This means Vineyard Wind is permitting an Envelope approach for the inter-array cables that will include any potential layout within areas of the WDA that have been surveyed.

One potential inter-array cable layout is provided on Figure 3.1-18 for illustrative purposes. As shown in here, the farthest WTG will have one outgoing connection and each subsequent WTG will have both an incoming and outgoing cable. As noted previously, the Project Envelope for the inter-array cable layout includes any portion of the WDA that has been surveyed; this survey area (which corresponds to the Area of Potential Effect) is shown on Figure 3.1-19. The maximum anticipated length of the inter-array cables for an 800 MW Project is approximately 275 km (171 mi).

As explained above in Section 3.1.5.3, all export and inter-array cables will be protected through the use of protection conduits at the approach to the foundations and ESPs. Additionally, for cases where the cables cannot be buried to a sufficient depth, the same protection methods described in Section 3.1.5.3 will be used. Vineyard Wind estimates that up to 10% of the total length of the inter-array cable could require one of these alternative protection measures.

3.2 Onshore Facilities

The Project's onshore facilities include the Landfall Site, the onshore export cable from the Landfall Site to the onshore substation, the onshore substation itself, and the connections from the substation to the existing bulk power grid.

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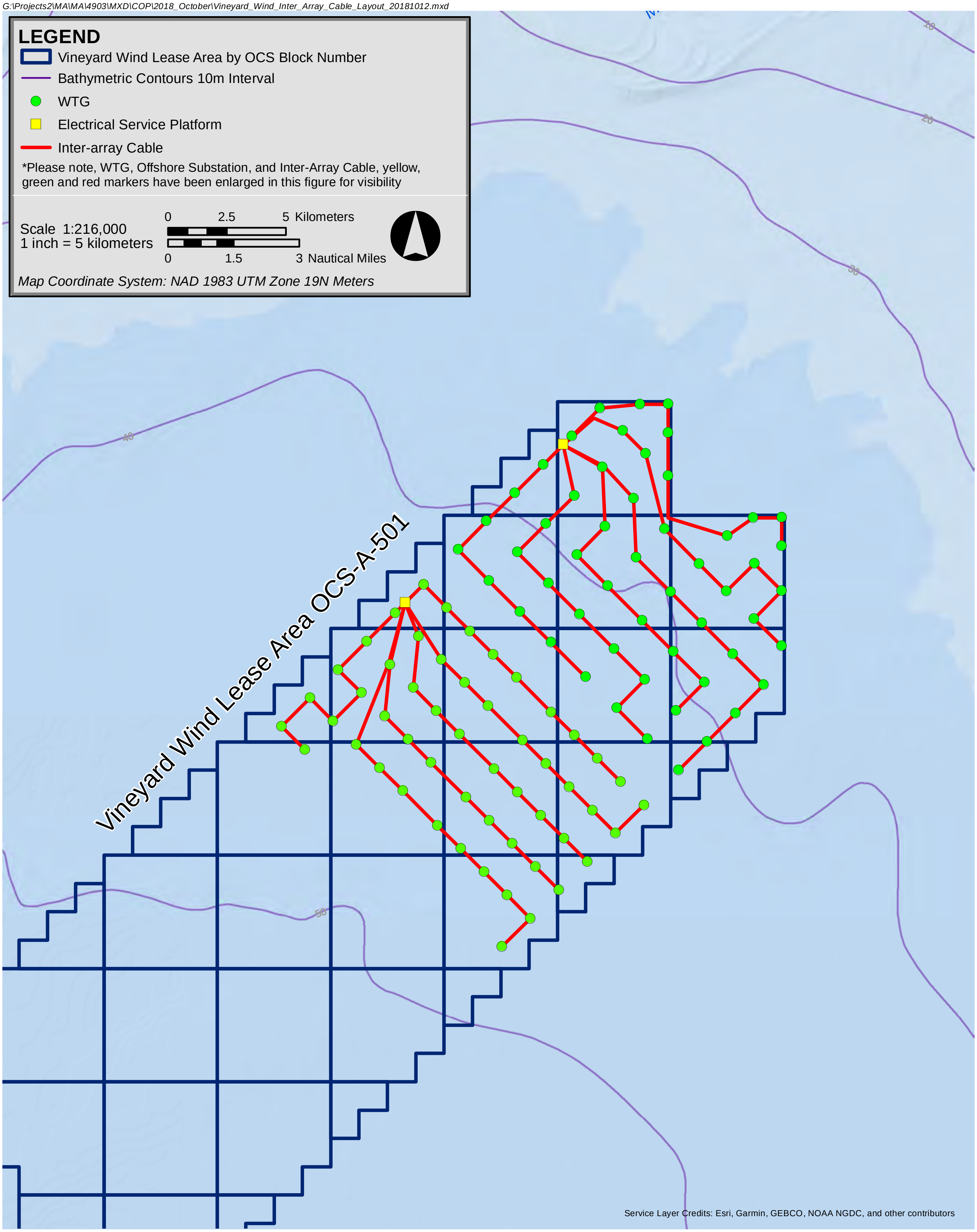

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Figure 3.1-18a

Vineyard Wind Turbine Layout: Inter-array Cable Layout Example

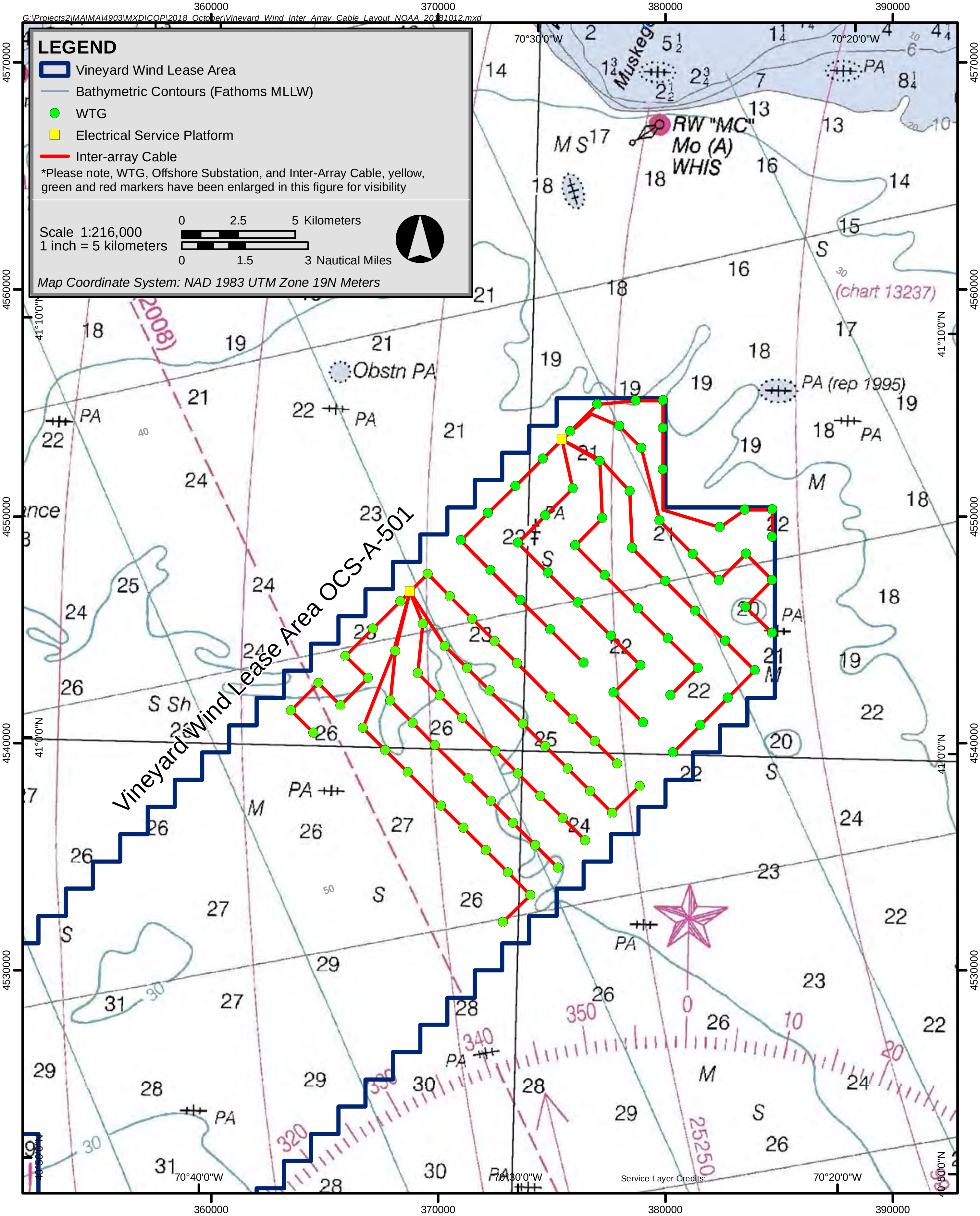

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Figure 3.1-18b

Vineyard Wind Turbine Layout: Inter-array Cable Layout Example

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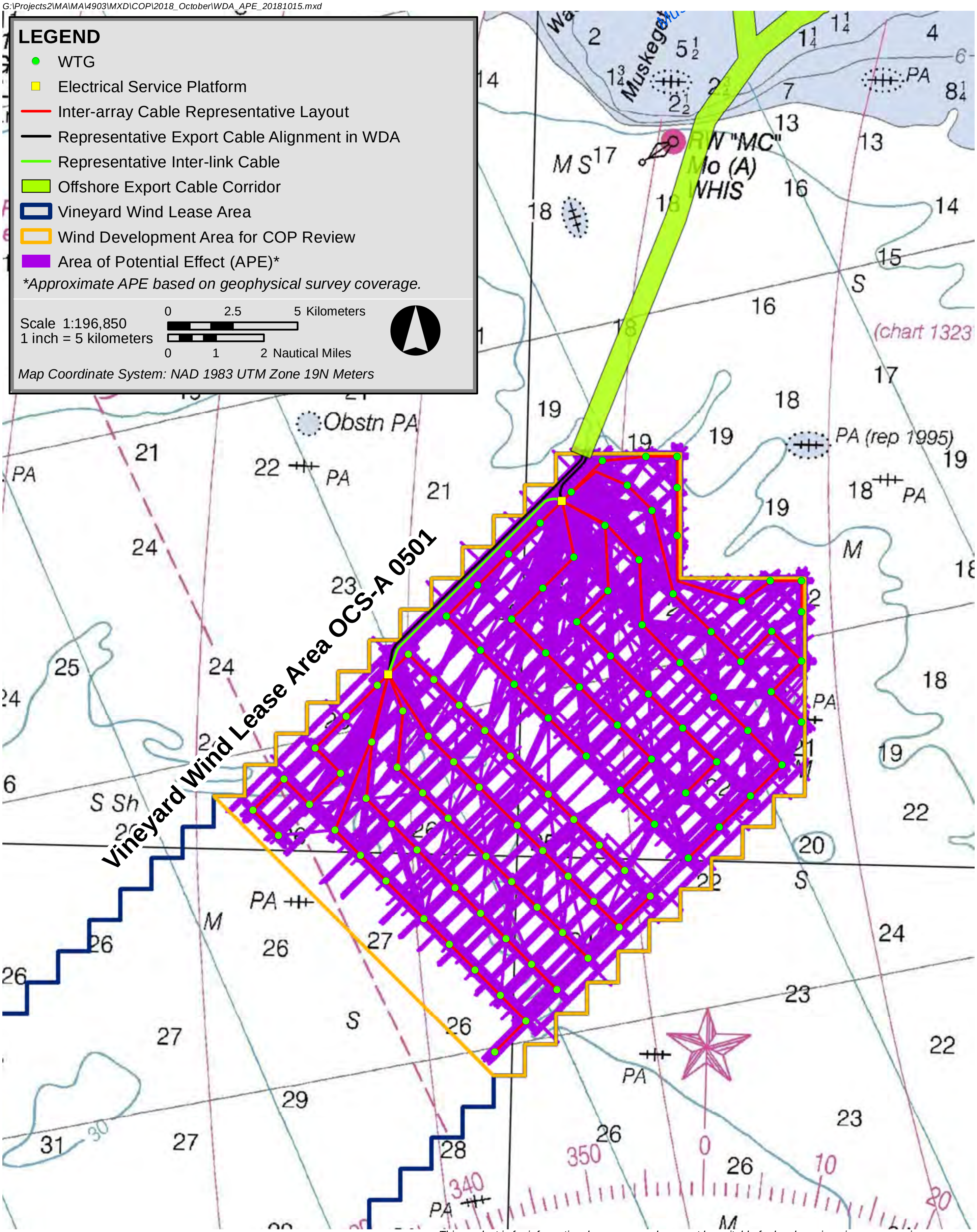

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Figure 3.1-19
WDA Area of Potential Effect

3.2.1 Landfall Site

A thorough evaluation of potential Landfall Sites resulted in the identification of two options that are included in the Project Envelope (see Figure 3.1-15); however, ultimately, a single Landfall Site will be used for both cables. Each of the potential Landfall Sites is considered a good candidate for cable landing given their superior egress and favorable inland routing to the Barnstable Switching Station via public roads and existing utility right-of-way ("ROW"):

- Covell's Beach in Barnstable: The Covell's Beach Landfall Site is located on Craigville Beach Road near the paved parking lot entrance to a public beach that is owned and managed by the Town of Barnstable. This Landfall Site is considered advantageous for its relatively protected location within the Centerville Harbor bight.

- New Hampshire Avenue in Yarmouth: The New Hampshire Avenue Landfall Site is located inside Lewis Bay where a road dead-ends just west of Englewood Beach at a low concrete bulkhead. A paved parking area is located approximately 92 m (300 ft) north of the dead-end where construction staging operations could occur.

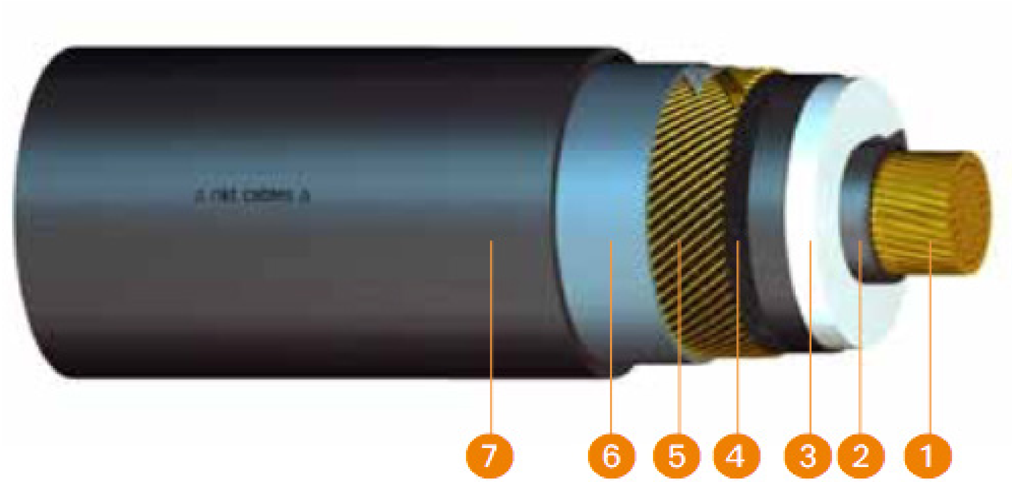
As the offshore export cables near the shoreline, horizontal directional drilling will be used to bring the cables beneath the nearshore area, the tidal zone, the beach and adjoining coastal areas, to one of the two Landfall Sites identified above. Alternately, the direct bury method is also under consideration for the New Hampshire Avenue Landfall Site. Construction methods for each Landfall Site are further discussed in Section 4.2.3.8.

3.2.2 Offshore to Onshore Transition

After the offshore export cables are brought to shore at one of the Landfall Sites, the physical connection between the offshore export cables and the onshore export cables will be made in one or more underground concrete transition vaults. From the surface, the only visible components of the cable system will be the manhole covers.

Inside the vaults, each three-core submarine cable will be separated and spliced into three separate single-core cables. A manufacturer's cutaway of the landside cable is provided as Figure 3.2-1; three of these cables make up a single 220 kV AC circuit. The onshore export cables will be placed within a single duct bank, which is installed underground for the entire length of the Onshore Export Cable Route (discussed below in Section 3.2.3). The duct bank is constructed using heavy wall PVC pipes encased in concrete.

The layout of conduits within the duct bank, and hence the duct bank dimensions, will vary somewhat along the Onshore Export Cable Route. These conduits will be arrayed four conduits wide by two conduits deep (flat layout) or two conduits wide by four conduits deep (upright layout), with the total duct bank measuring approximately 1.5 m (five feet) wide and 0.8 m (2.5 feet) deep or vice versa.



Design:

1. Conductor (Al or Cu)
2. Inner semi-conducting layer
3. XLPE insulation
4. Outer semi-conducting layer
5. Wire screen (Al or Cu)
6. Lead sheath
7. PE oversheath

Figure 3.2-1

Onshore Cable Cutaway

The top of the duct bank typically has a minimum of 0.9 m (three feet) of cover comprised of properly compacted sand topped by pavement.

Once the duct bank is in place, the cables (one cable per sleeve) are pulled into place via underground splice vaults and associated manholes, which are placed every 457-607 m (1,500-2,000 ft) or more along the duct bank. The splice vaults are typically two-piece (top and bottom) pre-formed concrete "boxes" with holes at both ends to connect with the PVC piping and admit the cables.

3.2.3 Onshore Export Cable Routes

The Onshore Export Cable Route will provide a connection from the underground vault at the Landfall Site to the new onshore substation. The Project Envelope includes two main Onshore Export Cable Routes: one from the Covell's Beach Landfall Site to the onshore substation and a second from the New Hampshire Avenue Landfall Site to the onshore substation. The proposed Onshore Export Cable Routes will allow the onshore export cables to be located entirely underground, primarily beneath public road layouts with some shorter stretches in existing electric or railroad ROWs. The underground Onshore Export Cable Routes are on the order of 9-10 km (5.4-6 mi) in length. Each potential route is shown on Figure 2.2-1.

3.2.4 Onshore Substation and Grid Connection

As previously noted, the Project includes the construction of a new onshore substation. The Project's onshore substation site is located on the eastern portion of a previously developed site adjacent to an existing substation within the Independence Park commercial/industrial area in Barnstable. It consists of approximately 0.03 km^2 (8.55 acres) of mostly wooded land, but the site also includes previously , disturbed land, portions of an existing building (the Cape Cod Times Production Center), a small building on the northern portion of the site, paved circulation roads, landscaped dividers, and parking lots for the former Cape Cod Times Production Center.

The onshore substation site is bordered to the north by the Barnstable Switching Station, to the west by part of the former Cape Cod Times building, to the south by Independence Drive, and to the east by an electric transmission corridor (see Figure 2.2-1). The buried duct bank will enter the Project onshore substation site by way of an access road that provides access to the electric transmission corridor from Mary Dunn Road. The Project connection into the bulk power grid will likely be made via available positions at Eversource's Barnstable Switching Station, located just to the north of the onshore substation site, though Vineyard Wind is also including the option to connect at the West Barnstable Switching Station.

The Project's substation will house up to four 220 kV /115 kV "stepdown" transformers,[10] switchgear, and other necessary equipment. A battery may also be installed at the onshore substation to store power.

3.2.5 Construction Facilities

Vineyard Wind has signed a letter of intent to the use the New Bedford Marine Commerce Terminal ("New Bedford Terminal"), owned by the Massachusetts Clean Energy Center ("MassCEC"), to support Project construction. The 26-acre New Bedford Terminal is located on the City's extensive industrial waterfront and was purpose built to support offshore wind energy projects. The terminal is just upstream of the Army Corps of Engineers hurricane barrier and has ready access to interstate highways. An aerial photo of the New Bedford Terminal and the surrounding marine industrial area is provided as Figure 3.2-2.

Vineyard Wind plans to use the New Bedford Terminal to offload shipments of components, prepare them for installation, and then load components onto jack-up barges or other suitable vessels for delivery to the lease area for installation.[11] Some component fabrication and fitup may also take place at New Bedford Terminal.

However, given the scale of the Project and the possibility that one or more other offshore wind projects may be using portions of the New Bedford Terminal at the same time, Vineyard Wind may need to stage certain activities from other Massachusetts or North Atlantic commercial seaports. (At this juncture, the Project may use a port facility in nearby Rhode Island to offload, store, and stage the turbine blades or other components for delivery to the offshore Wind Development Area, as needed.) Consequently, one or more of the ports listed in Table 3.2-1 may be used during construction of the Project. These ports are shown on Figure 3.2-3.

Each port facility being considered for the Project is located within an industrial waterfront area and was selected for further evaluation, in part, based on the port's existing infrastructure and capacity to host construction and installation activities. The greatest distance from a potential port to the WDA is 188 nautical miles (this value represents the distance between the WDA and the point where a vessel leaving a potential Canadian port enters the US Exclusive Economic Zone)[12].

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[10] If a connection is made at West Barnstable, the Project onshore substation would include step-up transformers (220 kV to 345 kV).

[11] Monopiles may not be loaded onto vessels for transport but may instead be pulled by tugs while floating in the water.

[12] Vessels traveling from Europe to New Bedford may travel farther through US waters (approximately 300 nautical miles).

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Vineyard Wind Project

Figure 3.2-2

New Bedford Marine Commerce Terminal

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

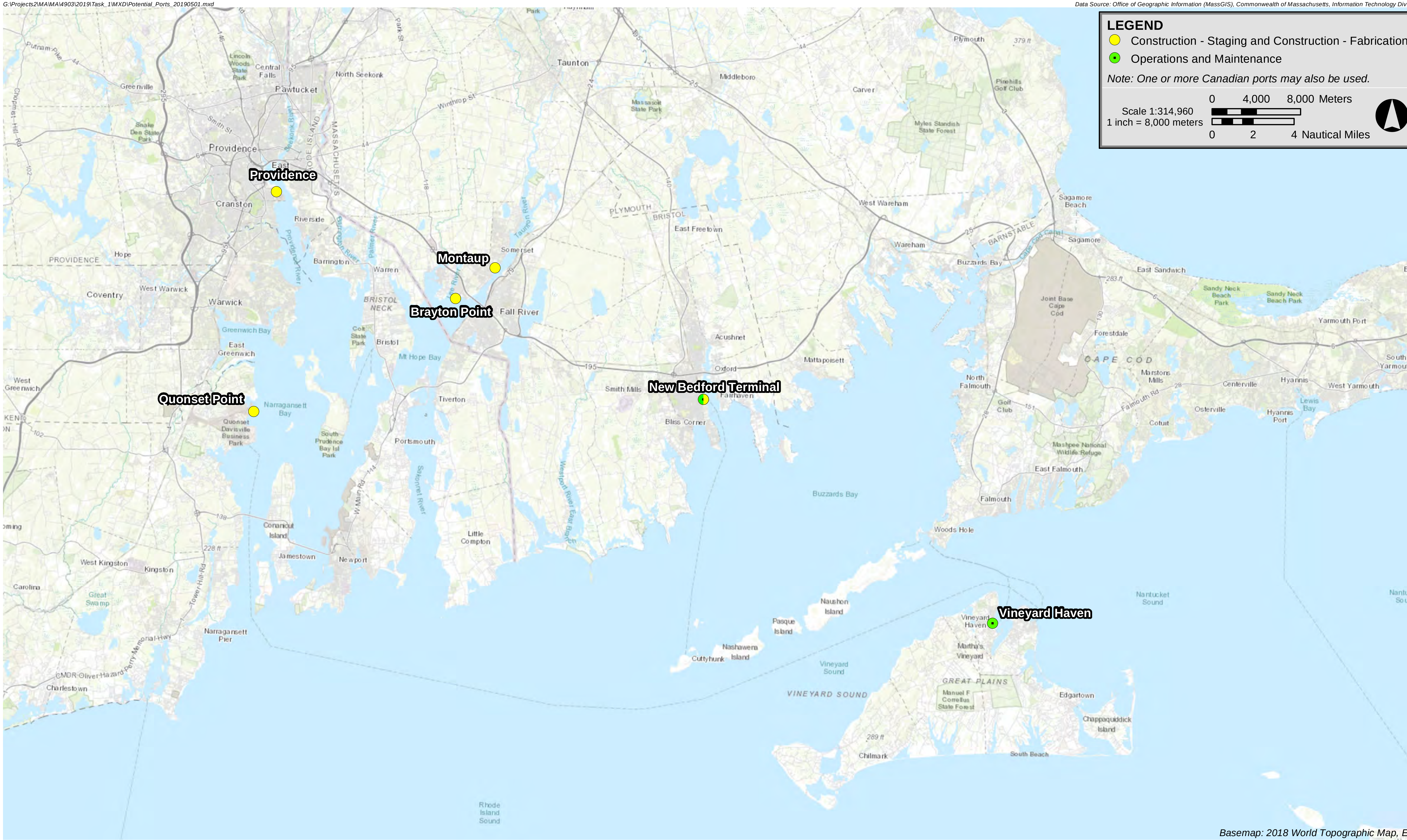

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Figure 3.2-3

Possible US Ports Used During Construction and O&M

The construction and installation phase will likely require port facilities with high load-bearing ground and deck capacity, adequate vessel berthing parameters, and suitable laydown and fabrication space. Site-specific modifications performed by the site owner/lessor may be required to meet those requirements. Grading and resurfacing of land-side areas, for example, may be required to accommodate materials and equipment used during construction and installation. The port facility may also require shoreline stabilization, maintenance dredging, and installation of miscellaneous equipment to berth construction and installation vessels. New structures to accommodate workforce and equipment needs may also be required.

Table 3.2-1 describes the ports that may be used during construction. See Table 3.2-2 in Section 3.2.6 for a discussion of ports used by the Project during O&M. Vineyard Wind will not direct or implement any port improvements that may be made. Rather, Vineyard Wind will consider whether the ports are suitable for Vineyard Wind's needs if and when any necessary upgrades are made by the owner/lessor.

Table 3.2-1 Possible Ports Used During Construction

Port
Massachusetts Ports
New Bedford Marine Commerce Terminal
Other areas in New Bedford Port
Brayton Point
Montaup
Rhode Island Ports
Providence
Quonset Point
Canadian Ports*
Sheet Harbor
St. John
Halifax

Note: Ports used during Operations and Maintenance are described in Table 3.2-2.

*Analysis of potential Canadian ports that may be used is ongoing.

Additionally, the MassCEC recently finalized a study that identified and characterized other Massachusetts port facilities which could be used to support offshore wind energy construction projects. Vineyard Wind is committed to continuing to work cooperatively with the MassCEC and will work to integrate the results of this study into construction planning efforts.

3.2.6 Operations & Maintenance Facilities

Once the first increment of the Vineyard Wind project is installed, tested, and commissioned, the Project will enter an up to 30-year operating phase. In support of project operations and the necessary maintenance activities, Vineyard Wind will develop Operations and Maintenance Facilities (O&M Facilities) that will include management and administrative team offices, a control room, office and training space for technicians and engineers, shop space, and warehouse space for parts and tools. These functions will be co-located, if feasible.

The O&M Facilities will also include pier space for Crew Transport Vessels ("CTV") and other larger support vessels. CTVs are purpose built to support offshore wind energy projects; they are typically about 23 m (75 ft) in length and set up to safely and quickly transport personnel, parts, and equipment (see Figure 3.2-4 for a photo of a representative CTV). CTVs are typically used in conjunction with helicopters. Helicopters can be used when rough weather limits or precludes the use of CTVs as well as for fast response visual inspections and repair activities, as needed. The helicopter(s) used to support operations and maintenance activities would ideally be based at a general aviation airport in reasonable proximity to the O&M Facilities.

Larger support vessels are typically a Service Operations Vessel ("SOV"). These larger vessels have onboard crew and maintenance team quarters, shop facilities, a large open deck, appropriate lifting and winch capacity, and, in some instances, a helipad. These vessels are typically 80-90 m (~260-300 ft) in length. SOVs are usually diesel electric powered with dynamic positioning.

Vineyard Wind plans to locate the Project's O&M Facilities in Vineyard Haven on Martha's Vineyard. However, Vineyard Wind intends to use port facilities at both Vineyard Haven and the New Bedford Terminal to support O&M activities (see Table 3.2-2). Smaller vessels (e.g. CTVs or SOVs) used for O&M activities will likely be based out of Vineyard Haven. Larger vessels used for major repairs during O&M (e.g. jack-up vessels, heavy cargo vessels, etc.) would likely use the New Bedford Terminal.

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Figure 3.2-4

Crew Transfer Vessel (CTV) Examples

Table 3.2-2 Possible Ports Used During O&M

Port	Types of Improvements That May Be Required (To Be Completed by Port Owner/Operator Prior to Use by Vineyard Wind)
Massachusetts Ports	
New Bedford Marine Commerce Terminal	N/A. The New Bedford Terminal was specifically developed to accommodate offshore wind development.
Vineyard Haven	Improvements to existing marine infrastructure (e.g., dock space for CTVs, access, etc.) and to structures (office and warehouse space). It is expected that any needed improvements would be coordinated with the lessor.

3.3 Fabrication

Project components will be fabricated by skilled manufacturers in the US, Europe, or elsewhere. Fabrication for the Project is summarized in Table 3.3-1 below.

Table 3.3-1 Summary of Fabrication for the Project

Project Component	Description
Monopiles	A large diameter steel pile built up by cylindrical steel cans joined by circumferential welds.
Transition Pieces	A structure made of various steel structures welded together, with a platform that is mounted onto the end of the monopile to provide a stable platform for the wind turbine.
Jackets and Transition Pieces	A large lattice type structure jointed by x-bracing of cylindrical steel joined by welding.
Tower	Steel component placed on top of the transition piece. It consists of sections which are bolted together with flange joints.
Nacelle	The top section of the tower. The nacelle is made of fiberglass covering the structural part made of steel.
Hub	Steel component that supports the three blade bearings and transfers the forces from the blades to the generator.
Blades	Blades are composed of carbon and fiberglass.
220 kV Cables	Copper or aluminum triple-core cables.
66 kV Cables	Copper or aluminum core cables.
ESP Foundations	See monopiles and jackets above.
ESP Topside Structure	Upper part of the ESP including the transformers and other electrical equipment.

Section 4.0

Project Activities

4.0 PROJECT ACTIVITIES

4.1 Construction Schedule

An overview of a representative construction and commissioning schedule for an 800 MW project is provided in Section 1.4.3, specifically Figure 1.5-1.

4.2 Deployment and Construction

4.2.1 Deployment Overview

Deployment of the necessary vessels and construction equipment will be sequenced in a manner similar to the construction schedule provided in Section 4.1. The installation sequence and construction methodology are generally described in Section 1.5. A more detailed discussion is provided in Section 4.2.3.

4.2.2 Health, Safety & Environmental Protection Features during Deployment and Installation

Vineyard Wind is firmly committed to Project safety and full compliance with applicable health, safety, and environmental protection regulations and codes. This commitment extends to all phases of the Project, commencing with deployment, into the construction/installation phases and through the O&M phase.

The challenges of large-scale construction in a marine environment require that health, safety and environmental protection are rigorously and continually assessed at every stage of the Project. Members of the Vineyard Wind team have many years of experience with safely constructing such projects in the North Sea, the Baltic Sea and other challenging environments. This experience will be applied to the planning, design, procurement and execution of the Vineyard Wind Project.

For the deployment and installation, Vineyard Wind's Safety Management System ("SMS") (Appendix I-B) and related Environmental Management System will be utilized. All equipment suppliers and construction firms will be evaluated per the contractor qualification requirements stipulated in the Project's SMS to ensure compliance with regulatory and Project requirements. The evaluation includes a comprehensive gap analysis review of the equipment supplier and/or construction firm's SMS and Environmental Management System to satisfy Vineyard Wind that work can performed in compliance with the Project's SMS.

A Project specific SMS that includes the site-specific health, safety and environmental policies and procedure requirements will be developed. The Safety Management System will contain the minimum requirements for working on-site, which all parties will have to adhere to. The SMS will include, but not be limited to the following:

- The Project's HSE policy
- Requirements for preparing safe systems of work
- Training requirements and requirements for personal protective equipment
- Vessel requirements
- Requirements to carry out HSE inspections of own works
- Reporting to authorities and to the Project
- Hazardous work identified on the Project

Before starting any work on-site, all contractors and construction firms will need to attend a pre-job meeting for a final check that safe systems of work are in compliance with the Project's SMS and that all health and safety requirements are understood. This will also be inspected regularly by the Vineyard Wind EH&S representatives on-site. Furthermore:

Before any vessels are contracted, they will undergo a vessel inspection to make sure that they are compliant (e.g., IMCA audit). This also includes a check of their Safety Management System and Environmental Management System. Any findings of deficiency or non-compliance will be rectified before work begins. Vessels will also be checked to ensure it is 'fit for purpose' for the work they are expected to carry out.

Vessel owners and construction firms will receive a package of the relevant site information in order for them to carry out their work safely. This can include site layout, geotechnical data, and environmental data such as water depths, wind climate, wave climate (including wind wave misalignment and wind speed-wave height correlation), tidal elevation and currents, extreme sea state and extreme wave height, severe sea state and severe wave height, normal sea state, wave breaking, additional parameters, ice, seismic conditions, ship impact, and wave run up.

Safe systems of work such as risk assessments, method statements, lifting plans, towing arrangements, permit to work system (e.g., lifting operations, confined space working) will be in place before work begins. The safe systems of work will be based on regulatory HSE requirements, Project requirements and best practice. During the planning phase for the Project, HSE workshops will be held where planned procedures are tested for interfaces and unsafe practices.

The safe systems of work will be reviewed and approved by Vineyard Wind and the Marine Warranty Surveyor. During the execution of work, Vineyard Wind representatives will regularly check that the work is carried out according to the safe systems of work.

The information in the safe systems of work will be communicated to employees working on-site through toolbox talks. These toolbox talks will be regularly reviewed and attended by Vineyard Wind representatives.

Management and handling of hazardous substances used on the Project will be reviewed ensure compliance with regulatory requirements. This includes checking that appropriate containers, labeling and equipment are used. Where possible, a hazardous substance will be substituted with a more environmentally-friendly alternative.

Vineyard Wind will implement a system for reporting safety observations and near misses. All construction firms will be encouraged to report any observations and share their experiences with Vineyard Wind to avoid reoccurring unsafe acts.

A marine coordination center will be established to control vessel movements throughout the Offshore Project Area. Expected daily vessel movements, crew transfer vessel manifests, and no-go zones on-site will be handled by the marine coordinator. In addition, daily coordination meetings will be held by Vineyard Wind to coordinate between construction operations and avoid unnecessary simultaneous operations at the staging terminals and including routes to the Offshore Project Area.

The Marine Coordinator will implement communication protocols with external vessels at the harbor and offshore, during project construction. The Marine Coordinator will use tools such as radio communications and guard vessels to address vessels entering construction zones. The Marine Coordinator will also work in advance of, and during Project construction, to coordinate activities within and near the harbor(s) with non-Project vessels. Communication protocols will be developed as part of the Project's SMS.

Before construction and installation activities begin, an Oil Spill Response Plan ("OSRP"), Emergency Response Plan ("ERP"), and Safety Management System will be completed (see Appendices I-A and I-B) and issued to the vessels and construction firms. The OSRP and ERP will provide a method/process for communication protocol, coordination, containment, removal and mitigation of foreseen incidents that may occur on the Project. These plans will minimize confusion and indecision, prevent extensive damage to the Project or injury to personnel, and minimize exposure to personnel within or outside of the Project.

In the event of an actual spill or incident, it will be the vessels and construction firms' plans that will be used to contain and/or stop an incident in compliance with the requirements of the projects OSRP. As such, these plans will be checked and reviewed by Vineyard Wind to make sure that they are in accordance with regulatory and Project requirements and that a spill plan is in place. In addition, routine training and exercises regarding the content of the OSRP and ERP will be carried out regularly to prepare personnel to respond to emergencies, should they occur.

4.2.3 Construction Approach

4.2.3.1 Introduction

The discussion of construction and installation approaches is organized by offshore and onshore elements of the Project. The discussion of offshore elements follows the overall plan of installation set forth in the construction schedule, beginning with scour protection and proceeding through installation of offshore export cables, foundations, Electrical Service Platforms ("ESPs"), inter-array cables, and Wind Turbine Generators ("WTGs"). As shown on Figure 1.5-1, and 4.1-1, there is considerable overlap in the installation periods for each of these Project elements.

4.2.3.2 Scour Protection

As described in Section 3.1.3, a circular pad of stones or rocks will be placed on the seabed at each foundation location (WTG and ESP) prior to the installation of the foundations. Stone and rock are the most widely used scour protection in the offshore wind industry. Scour protection dimensions are presented above in Table 3.1-3.

The scour protection installation is done in a multi-step process:

1. A pre-construction survey of the bottom bathymetry is conducted.

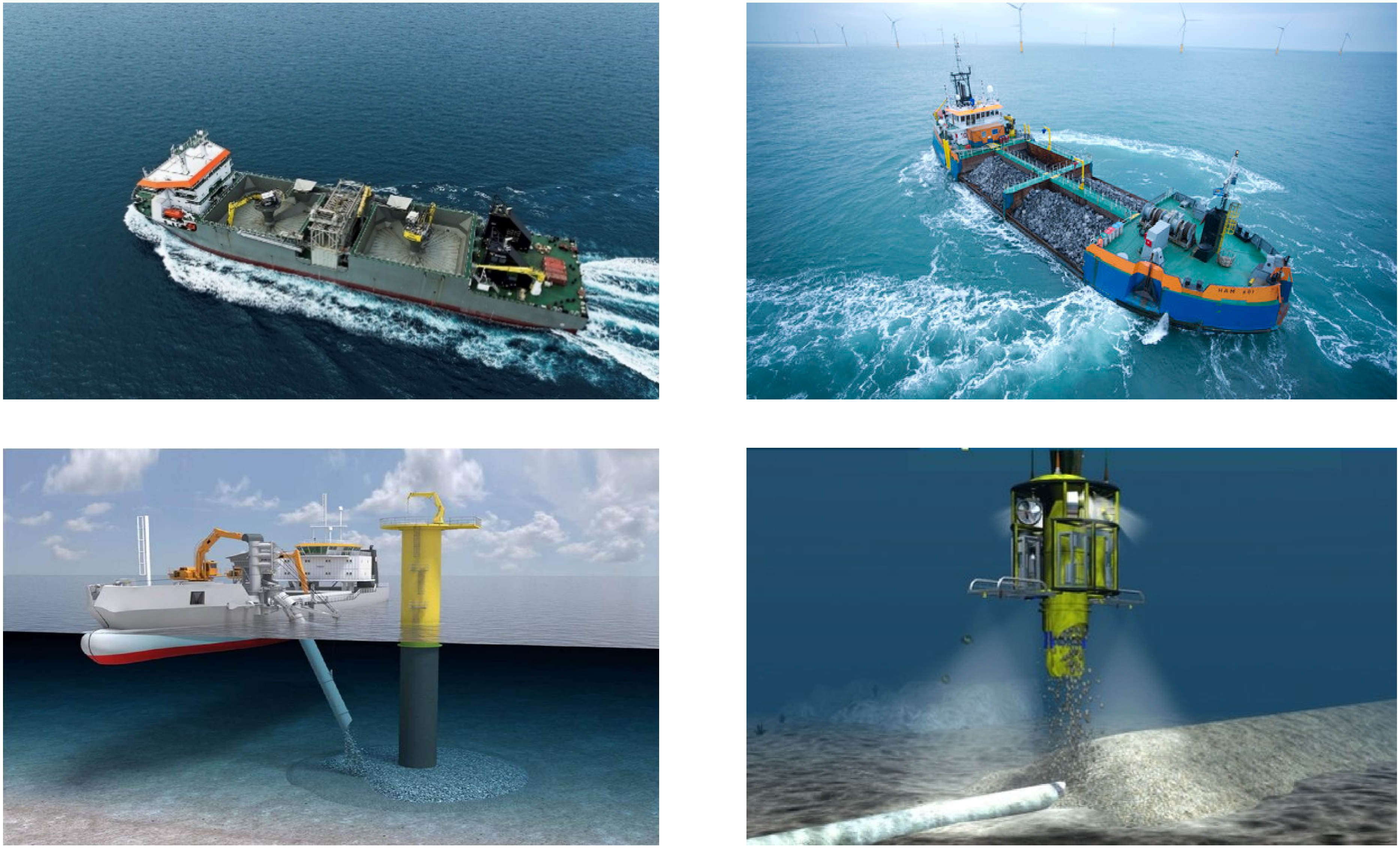
2. The scour protection material is transported to the site.

3. The scour protection material is placed prior to installation of foundations. If needed, a mud mat may be placed below the scour protection.

4. A post-lay seabed survey of bottom bathymetry is conducted; additional material is added if needed to provide the necessary coverage and thickness.

5. If needed, in limited locations, additional scour protection material may be placed locally to protect the portions of the export or inter-array cables.

Several techniques for placing scour protection exist, including fall pipes, side dumping, and placement using a crane/bucket. The fall pipe method, in which a pipe extends from the vessel to the seafloor in the vicinity of the intended foundation location, is the most precise technique and will be used whereever possible. The fall pipe technique may include a remotely operated vehicle ("ROV") guided lower end. The installation vessel will move along a predetermined pattern to ensure even distribution of the stone and/or rock material. Figure 4.2-1 provides illustrations of typical scour protection vessels.



Note: Figures of scour protection placement are for illustrative purposes only. As described in Section 4.2.3.2 of Volume I, scour protection will be placed prior to foundation installation.

Figure 4.2-1

Scour Protection Installation Vessels

4.2.3.3 Offshore Export Cables

4.2.3.3.1 Overview

The offshore export cables will transmit power from the ESP(s) to the cable Landfall Site. The offshore export cables will likely be transported directly to the Offshore Export Cable Corridor in a cable laying vessel or on a barge and installed by the vessel upon arrival. Vessel types under consideration for cable installation are presented in Table 4.2.3.

In accordance with normal industry practice, a pre-lay grapnel run will be performed in all instances to locate and clear obstructions, such as abandoned fishing gear and other marine debris. Additionally, some dredging may be required prior to cable laying due to the presence of sand waves. The upper portions of sand waves may be removed via mechanical or hydraulic means in order to achieve the proper burial depth below the stable sea bottom. Following the pre-lay grapnel run and any required dredging, offshore export cable laying is expected to be performed primarily via simultaneous lay and burial using jet plowing.[13] However, depending on bottom conditions, water depth, and contractor preferences, other methods may be used in certain areas to ensure proper burial depth. Impacts from cable installation will include an up to 1 m (3.3 ft) wide cable installation trench and an up to 1-2 m (3.3 – 6.6 ft) wide temporary disturbance zone from the skids or tracks of the cable installation equipment, which will slide over the surface of the seafloor. The skids or tracks have the potential to disturb benthic habitat; however, they are not expected to dig into the seabed, and therefore the impact is expected to be minor relative to the trench.

The offshore export cables can either be installed from the shore towards the Wind Development Area ("WDA") or in the opposite direction. The installation will likely require at least one joint (splice) due to the overall distance of the route (70-80 kilometers ["km"] or 38 – 43 nautical miles ["nm"]). At the ESP(s), the cable will be pulled in. The cable entry protection system is not yet defined, but the entry system will be installed in the interface between the ESP and offshore export cable.

One cable crossing is planned over an existing National Grid power cable from the south shore of Cape Cod to Nantucket if the New Hampshire Ave Landfall Site is used (see Figure 4.2-2). The specifics of this crossing will be developed with National Grid as Project planning continues. At this stage of the Project, it is anticipated that the cable crossing may include the following steps:

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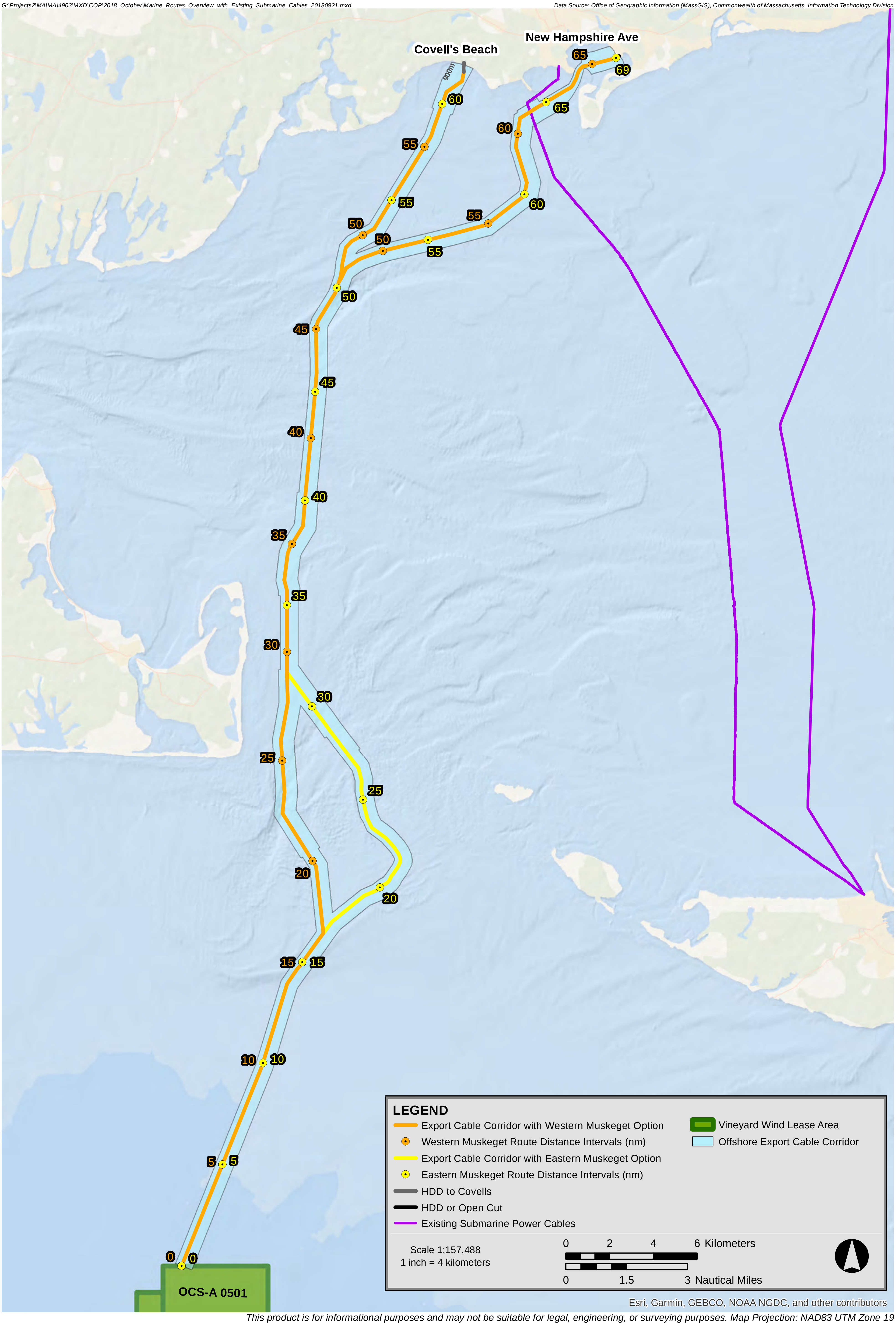
[13] As described in Section 4.2.3.6, the inter-array cables are expected to be installed using a pre-lay/jet plowing approach.

G:\Projects2\MA\MA\4903\MXD\COP\2018_October\Marine_Routes_Overview_with_Existing_Submarine_Cables_20180921.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes. Map Projection: NAD83 UTM Zone 19

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Figure 4.2-2

National Grid Cable Crossing

- The existing National Grid power cable will be carefully surveyed and inspected using an ROV, diver, or similar. Any survey will be defined, planned, executed, evaluated and documented according to the rules and regulations set forth by National Grid with agreement by Vineyard Wind.

- Any existing debris surrounding the crossing points will be carefully removed. The plan and procedures for this work will be agreed upon with National Grid.

- Depending on the depth of the National Grid cable and National Grid's requirements, there may be a concrete mattress or other means of protection placed between the National Grid cable and Vineyard Wind's proposed cables. Alternately, if there is sufficient vertical distance between National Grid's cable and Vineyard Wind's proposed cables and it is acceptable to National Grid, there may be no manmade physical barrier between the cables.

- The new export cables will be protected with either additional concrete mattresses, controlled rock placement, or a similar physical barrier. Cable protection measures will be designed to protect the export cables against mechanical impact from above and respect the vertical distance and physical barrier (if any) to the National Grid power cable. The design of the crossing structure will be defined, planned, executed, evaluated and documented according to the rules and regulations set forth by National Grid, and in order to minimize the risk of fouling or snagging of fishing equipment.

- If necessary, scour protection consisting of additional rocks and/or fond mattresses will be carefully placed on and around the crossings.

- Final as-built surveys of the completed crossings will be undertaken. The surveys will be documented according to the rules and regulations set forth by and agreed upon with National Grid. As-built positions will be provided to NOAA for charting purposes.

4.2.3.3.2 Detailed Description of Cable Installation

Pre-lay Grapnel Run

The pre-lay grapnel run will consist of a vessel towing equipment that will hook and recover obstructions such as fishing gear, ropes, and wires from the seafloor.

Dredging

As described in Volume II, marine surveys completed in the summer of 2017 confirmed that portions of the Offshore Export Cable Corridor ("OECC") contain sand waves. Portions of the sand waves may be mobile over time; therefore, the upper portions of the sand waves may need to be removed so that the cable laying equipment can achieve the proper burial depth below the sand waves and into the stable sea bottom.

For each of the two export cables, a 20 meter ("m") (66 feet ["ft]) wide corridor will be dredged. This dredge corridor includes the up to 1 m (3.3 ft) wide cable installation trench and the up to 1-2 m (3.3-6.6 ft) wide temporary disturbance zone from the tracks or skids of the cable installation equipment. For two cables, total dredging may impact up to 279,400 square meters ("m^2") (69 acres)[14] and may include up to 164,000 cubic meters (214,500 cubic yards) of dredged material. The dredge volumes are dependent on the final route and cable installation method. Figure 4.2-3 provides the maximum extent of dredging. The average dredge depth is 0.5 m (1.6 ft) and may range up to 4.5 m (14.7 ft) in localized areas. The total vertical APE within sand waves is up to 8 m (26.2 ft), which includes up to 4.5 m (14.7 ft) of dredging, followed by cable installation to a depth of up to 2.5 m (8 ft), plus a conservative 1 m (3.3 ft) allowance.

Dredging could be accomplished by several techniques. European offshore wind projects have typically used a trailing suction hopper dredge ("TSHD"). Dredges of this type are also commonly used in the US for channel maintenance, beach nourishment projects, and other uses (Figure 4.2-4). For this Project, a TSHD would be used to remove a 20 m (65.6 ft) wide section of a sand wave (for each of the two cables) that is deep enough to allow subsequent installation of the cable using one of the techniques described below. Should a TSHD be used, the sand removed would be discharged from the vessel within the 810 m (2,657 ft) wide cable corridor. It is anticipated that the TSHD would dredge along the OECC until the hopper was filled to an appropriate capacity, then the TSHD would sail several hundred meters away (while remaining within the 810 m [2,657 ft] corridor) and bottom dump the dredged material. No dredging or dumping of dredged materials will be permitted within hard bottom habitat.

A second dredging technique involves jetting (also known as mass flow excavation). Jetting uses a pressurized stream of water to push sand to the side (Figure 4.2-4). The jetting tool draws in seawater from the sides and then jets this water out from a vertical down pipe at a

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14 Impacts will occur from the cable installation's up to one meter (3.3 ft wide) cable installation trench, up to two meter (6.6 ft) wide skid/track disturbance zone, and dredging's 20 m [66 ft] wide corridor. To avoid double- counting impacts, dredge areas are calculated outside of a two meter (6.6 ft) wide cable installation corridor.

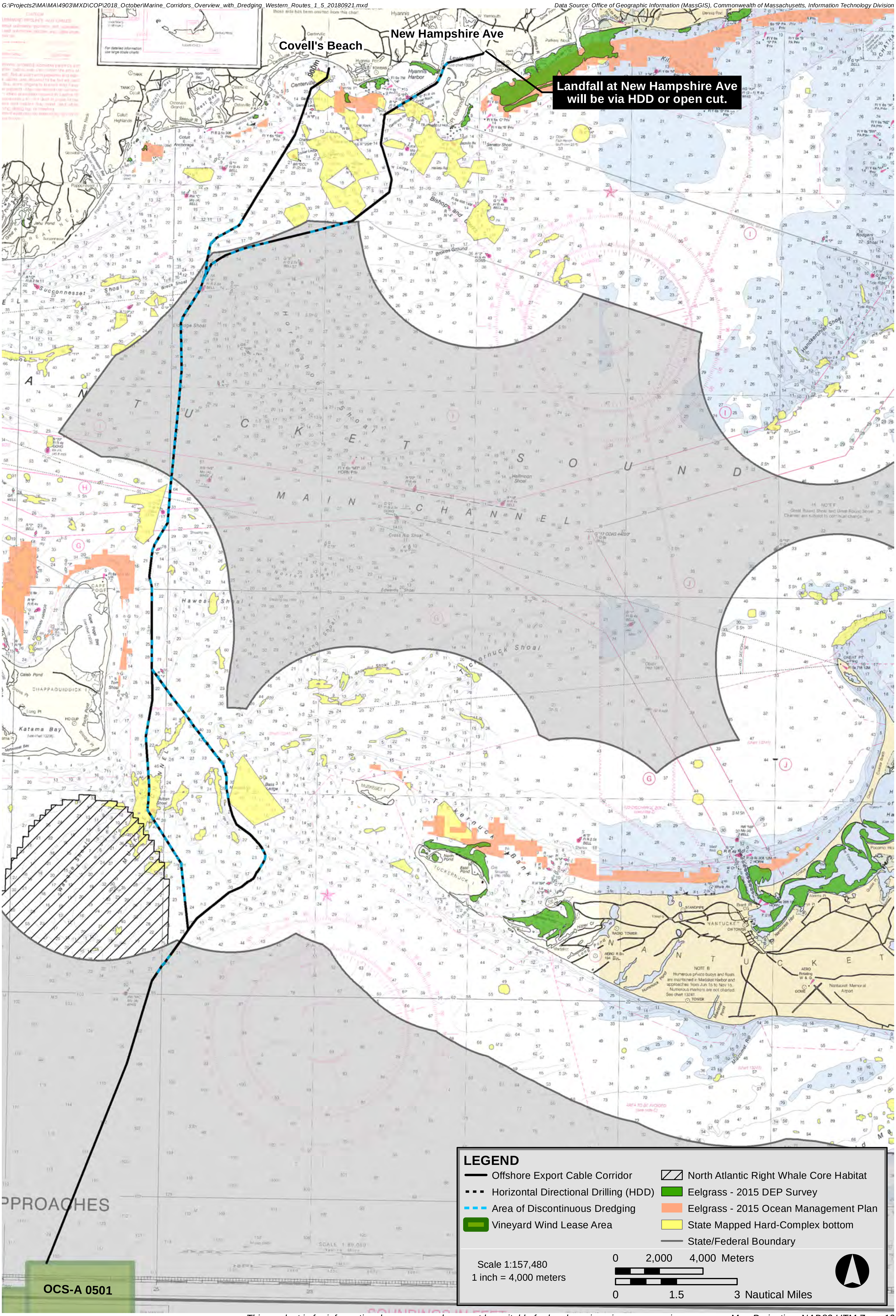

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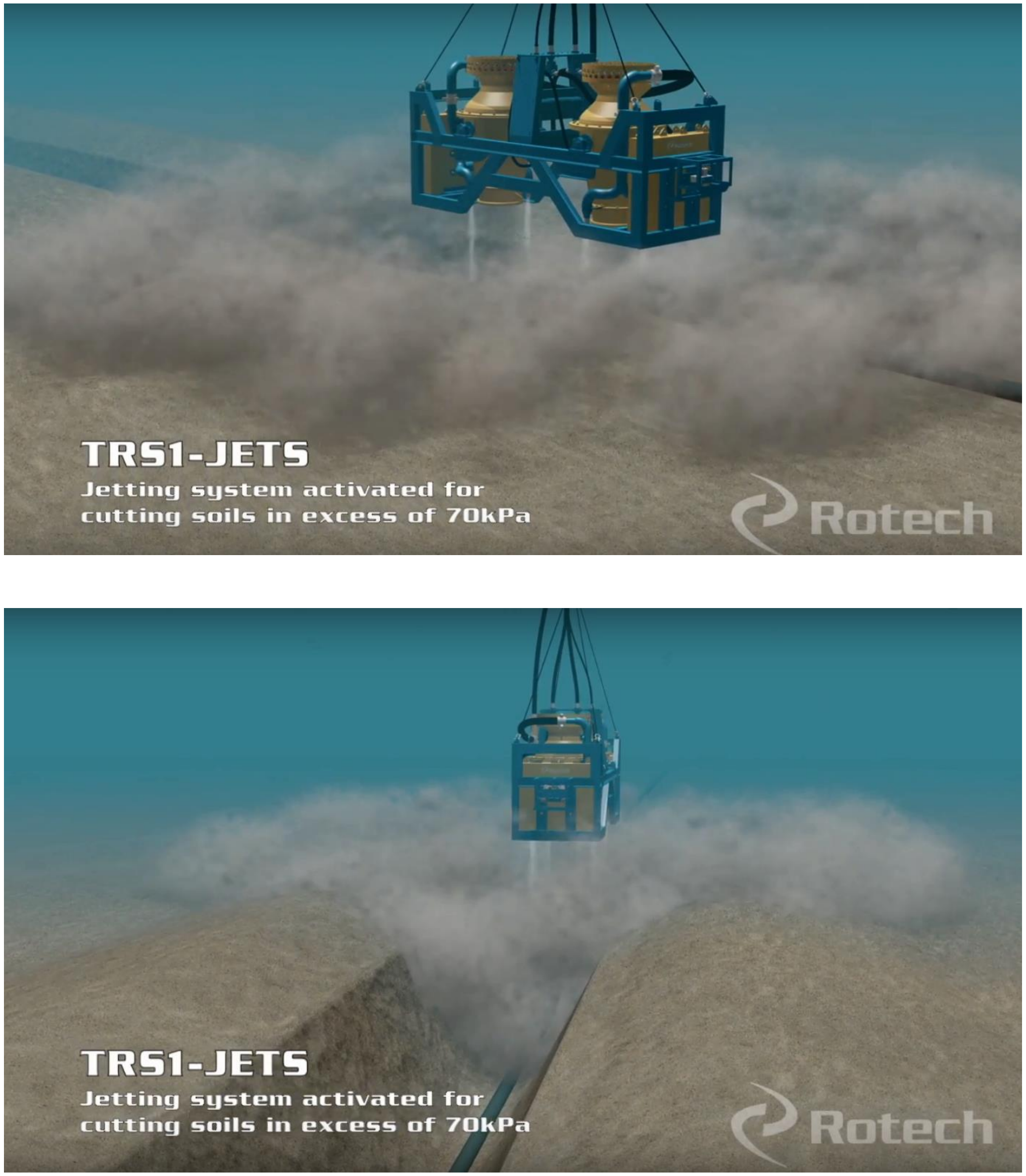
Figure 4.2-3
Export Cable Corridor Dredge Volumes



Source: http://www.rotech.co.uk/subsea-video-gallery.html

Jetting

Source: https://www.flickr.com/photos/jaxstrong/albums/72157637944233765

Trailing Suction Hopper Dredge

specified pressure and volume. The down pipe is positioned over the cable alignment, enabling the stream of water to fluidize the sands around the cable, which allows the cable to settle into the trench. This process causes the top layer of sand to be sidecasted to either side of the trench; therefore, jetting would both remove the top of the sand wave and bury the cable. Typically, a number of passes are required to lower the cable to the minimum target burial depth.

A TSHD can be used in sand waves of most sizes, whereas the jetting technique is most likely to be used in areas where sand waves are less than 2 m (6.6 ft) high. Therefore, the sand wave dredging could be accomplished entirely by the TSHD on its own, or the dredging could be accomplished by a combination of jetting and TSHD, where jetting would be used in smaller sand waves and the TSHD would be used to remove the larger sand waves.

Cable Installation

The majority of the export and inter-link cable is expected to be installed using simultaneous lay and bury via jet plowing. Likewise, the majority of the inter-array cable is expected to be installed via jet plowing after the cable has been placed on the seafloor. However, other methods may be needed in areas of coarser or more consolidated sediment, rocky bottom, or other difficult conditions in order to ensure a proper burial depth. The three most common methods are described below under "Typical Techniques," additional techniques that may be used more rarely are described below under "Additional Possible Techniques."

The inter-array and offshore export cables will have a target burial depth of 1.5-2.5 m (5-8 ft); the minimum target burial depth is 1.5 m (5 ft). As noted in Sections 3.1.5.3 and 3.1.6, approximately 10% of the inter-array, inter-link, and export cable may not achieve the proper burial depth and will require cable protection.

Typical Techniques

- Jet plowing (jet trenching): This tool may be based from a seabed tractor or a sled deployed from a vessel. This tool typically has one or two arms, or booms, which extend into the seabed and discharge pressurized seawater as the tool moves along the cable route (either simultaneously as the cable is laid on the seafloor or after the cable has been laid), fluidizing the sediment and allowing the cable to sink by its own weight to the appropriate depth or to be placed at depth by the tool. Sediment naturally settles out of suspension thereby backfilling the narrow trench.

- Mechanical plowing: A mechanical plow is deployed from a vessel and uses a cutting edge(s) and moldboard to mechanically push through the seabed while feeding the cable into the trench created by the plow. This narrow trench infills itself behind the tool, either by collapse of the trench walls and/or by natural infill, usually over a relatively short period of time.

- Mechanical trenching: Mechanical trenching (chain or wheel cutter) is typically only used only in the more resistant sediments. A rotating chain or wheel with cutting teeth or blades removes the sediment. The cable is laid into the trench behind the trencher and the trench collapses naturally to cover the cable, or, if required, another tool can be used to push the sediment over the cable to fill the trench.

Additional Possible Techniques

- Shallow-water cable installation tractor: This system uses one of the techniques described above, but is deployed from a tractor that operates in shallow water where vessels cannot efficiently operate. The cable is first laid on the seabed, and then a tractor drives over or alongside the cable while operating an appropriate burial tool to complete installation. The tractor is controlled and powered from a self-elevating platform that holds equipment and operators above the waterline.

- Pre-trenching: A "V"-shaped trench is excavated by a plow or similar device, and the sediment is placed next to the trench. The cable is then laid in the trench. Separately or simultaneously to laying the cable, the sediment is returned to the trench and covers the cable.

- Boulder clearance: In areas of the route where large boulders could be encountered, boulder clearance may be employed prior to cable installation. Boulder clearance leaves the route clear of large boulders, facilitating installation and better ensuring proper burial. Boulder clearance is accomplished either by means of a grab that lifts individual boulders clear of the route, or using a plow-like tool which is moved along the route to push boulders to the side of the area where cable is to be installed.

- Precision installation: In situations where a large tool is not able to operate, or in situations where a specialized installation tool cannot complete installation, a diver or remotely-operated vehicle ("ROV") may be used to complete installation. The diver or ROV may use small jets or other small tools to complete installation.

- Jetting (mass flow excavation): Jetting can be used for cable installation as well as dredging. As described above, jetting uses a pressurized stream of water to push sand to the side. The jetting (mass flow excavation) tool draws in seawater from the sides and then jets this water out from a vertical down pipe at a specified pressure and volume. The down pipe is positioned over the cable alignment, enabling the stream of water to fluidize the sands around the cable, which allows the cable to settle into the trench. This process causes the top layer of sand to be sidecasted to either side of the trench; therefore, jetting would both remove the top of the sand wave and bury the cable. Typically, a number of passes are required to lower the cable to the minimum target burial depth. Jetting is not to be confused with a jet plow used for typical cable installation described above.

Anchor Usage During Cable Installation

To facilitate offshore export cable installation, anchoring may occur along the OECC.[15] It is currently anticipated that anchoring may be used along more challenging portions of the offshore export cable, such as in the stronger currents of Muskeget Channel and the shallower waters of Lewis Bay, though anchoring may occur at any point within the OECC shown in Figure 2.1-1. Vessel anchors will be required to avoid known eelgrass beds (including those near Spindle Rock) and will avoid other sensitive seafloor habitats (hard/complex bottom) as long as it does not compromise the vessel's safety or the cable's installation. Contractors will be provided with a map of sensitive habitats with areas to avoid prior to construction and shall plan their mooring positions accordingly.

Cable Splicing

Due to the length of the OECC (70-80 km or 37-43 nm) and the shallow nearshore installation techniques, the offshore export cables will likely require at least one joint (splice). Upon reaching the joint location, a cable will be retrieved from the seabed and brought inside the cable laying vessel or other specialized vessel. Inside a controlled environment (i.e., a jointing room) aboard the vessel, the two ends of the cable will be spliced together. Once cable splicing is completed, the offshore export cable is lowered to the seafloor. Depending on the design of the cable and joint, the splicing process may take several days, in part, because the jointing process must be performed during good weather.

4.2.3.4 Foundations (Monopile and Jacket)

Monopile Foundations

Seabed preparation may be required prior to foundation installation. This could include the removal of large obstructions at the seabed, or to avoid excessive seabed gradients.

After fabrication, the monopile foundation components (monopile, transition piece, and any secondary items) will be transported to a marshalling port (see Section 3.2.5) or directly to the offshore site.

The installation concept and method of bringing components to the WDA will be based on supply chain availability and final contracting. The monopiles (or jackets) are expected to be installed by one or two heavy lift or jack-up vessel(s). The main installation vessel(s) will likely remain at the WDA during the installation phase and transport vessels, tugs and/or

[15] Within the WDA, anchored vessels will not be used as primary construction and installation vessels. Any anchoring that does take place within the WDA will occur within the Area of Potential Effect as described in Volume II-C.

feeder barges will provide a continuous supply of foundations to the WDA. If Jones Act compliant vessels are available, the foundation components could be picked up directly in the marshalling port by the main installation vessel(s).

At the WDA, using a crane, the main installation vessel will upend the monopile, place it in the gripper frame, and then lower the monopile to the seabed. The gripper frame, which, depending upon its design, may be placed on the seabed scour protection materials, stabilizes the monopile's vertical alignment before and during piling. Once the monopile is lowered to the seabed, the crane hook is released and the hydraulic hammer is picked up and placed on top of the monopile. Figure 4.2-5 shows a vessel lowering a monopile and typical jack-up installation vessels.

The pile driving will then commence, beginning with a soft-start. This will ensure that the monopile remains vertical while also allowing any motile marine life to leave the area before the pile driving intensity is increased. The intensity (i.e., hammer energy level) will be gradually increased based on the resistance that is experienced from the sediments. The expected hammer size for monopiles is up to 4,000 kilojoules ("kJ"); energy use, however, is anticipated to be less than 4,000 kJ.

The typical pile driving operation is expected to take less than approximately three hours to achieve the target penetration depth. It is anticipated that a maximum of two piles can be driven into the seabed per day. If two installation vessels are used for monopile installation, it is not anticipated that two monopiles will be driven into the seabed concurrently. No drilling of monopiles is anticipated, but it could be required if a large boulder or monopile refusal is encountered. If drilling is required, a rotary drilling unit will be mobilized to the monopile top. The interior sediment will then be drilled out and deposited on the seabed adjacent to the scour protection material until the monopile is no longer obstructed. Thereafter monopile installation will recommence, until the monopile reaches target depth. Similarly, use of a vibratory hammer is not anticipated, but could be used if deemed appropriate by the installation contractor.

After installation of the monopile, the transition piece will be picked up and placed on the monopile. The connection between the monopile and the transition piece will be either grouted or bolted. If the main connection is established by bolts, grout is foreseen in a "skirt" holding the boat landing, with the following purposes:

- ♦ Support for the lower part of the boat landing
- ♦ Protecting against water ingress to the bolted connection
- ♦ Corrosion protection underneath the skirt

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Figure 4.2-5

Foundation Installation Vessels

Grout material will be mixed either on the installation vessel or a separate grouting vessel. Grout will be pumped through hoses into the transition piece structure to fill the annulus between the monopile and the transition piece and will be contained at the lower extremity of the transition piece by a high strength rubber grout seal. The design will ensure that any overflow of grout during grouting will be directed to the inside of the foundation.

Grout Spill Management

When grout is used (either for the connection between the monopile and transition piece or as a "skirt" holding the boat landing), the following grout spill management procedures will be used to mitigate the potential for any grout release:

- The grout level will be monitored visually and when grout reaches the top of the monopile, grouting will be halted.
- Special couplings will be attached to the grout hoses to mitigate grout spill when grout hoses are removed after grouting, where feasible. For monopiles, hoses will be disconnected on the upper TP platform to avoid losses of grout into the water column.
- Water and grout from cleaning of hoses and other equipment will be collected on the vessel and disposed of properly on land.
- The risk for accidental grout spill in the sea due to grout seal failure will be mitigated by pressure testing grout seals.

If the time between the installation of the monopile and transition piece is longer than a few days, the amount of marine growth must be assessed and marine growth may need to be removed with a high pressure washing tool or similar equipment prior to installing the transition piece.

Jacket Foundation Installation

After fabrication, the jackets and pin piles will be transported to a marshalling port (see Section 3.2.5) or directly to the Offshore Project Area. The installation concept and method of bringing components to the WDA will be the same as for the monopile.

The jacket, including transition piece and pin piles, will be transported to the Offshore Project Area on feeder barges/vessels. The jacket will be lifted off the feeder vessel and lowered to the seabed with the correct orientation. Next, the pin piles will be lifted and driven through the pile sleeves to the engineered depth. The maximum anticipated hammer size for jacket foundations is 3,000 kJ; energy use, however, is anticipated to be far less than the hammer size. Once all piles are driven to the target depth, they will be fixed in the pile sleeves, most likely by the use of grouting. Grout material will be mixed either on the installation vessel or a separate grouting vessel. Grout will then be pumped through hoses into the jacket structure to fill the annulus between the sleeves and piles and will be contained at the lower extremity of the sleeve by a high strength rubber grout seal. The grout level will be monitored visually using underwater cameras and when grout reaches the top of the sleeve, grouting will be halted. Grout spill management protocols are similar to those described above for monopile foundations will also be used for jacket foundations. It is also possible that piles may be driven prior to lowering the jacket by using a frame to orient the piles.

The pile driving will then commence, beginning with a soft-start, as described above for the monopiles. It is anticipated that a maximum of one complete jacket can be installed per day. If two installation vessels are used for jacket installation, it is not anticipated that two jacket piles will be driven into the seabed concurrently. No drilling is anticipated, but it could be required if pile refusal is encountered. Similarly, use of a vibratory hammer is not anticipated, but could be used if deemed appropriate by the installation contractor.

4.2.3.5 Electrical Service Platforms

Each ESP is comprised of two primary components: the topside with the electrical components and the foundation substructure. Either a monopile or jacket will be used for the foundation. Seabed preparation may be required prior to foundation installation. This could include the removal of large obstructions at the seabed, or to avoid excessive seabed gradients. The ESP foundation installation concept is similar to the foundation for the wind turbines: a monopile is driven vertically into the seabed with a transition piece or similar connection structure mounted on the pile to provide a stable platform to support the weight of the ESP topside.

If a jacket is chosen as foundation for the ESP, the jacket will be lifted off the vessel and lowered to reach the seabed in the right location and with the correct orientation. Next, the pin piles will be lifted and driven through the pile sleeves to the engineered depth. Once all piles are driven to the target depth, they will be fixed in the pile sleeves by use of grouting. It is also possible that piles may be driven prior to jacket installation. Grout spill management protocols similar to those described above for WTG foundations will also be used for ESP foundations.

The ESP - either the 400 MW or 800 MW conventional ESP – can be transported directly to the Offshore Project Area. Alternatively, it could be transported to a harbor (see Section 3.2.5) and moved offshore on a barge. The installation of the topside is anticipated to be carried out by a vessel that also installs the foundations. The vessel will position itself next to the foundation. The ESP topside will arrive on the feeder vessel or barge and the installation vessel crane will lift the topside and place it on the foundation. The ESP topside and the foundation will be connected either using bolted connections, welding, or a combination of bolts and welding. Figure 3.1-14 shows construction work being performed on an ESP. After the ESP mechanical installation is complete, the 66 kilovolt ("kV") inter-array cables and the 220 kV offshore export cables will be pulled into place and terminated at the ESP. These cables will be routed through J-tubes, or similar means, located on the surface of the foundation/substructure or can be routed through the inside of the foundation/substructure.

4.2.3.6 Inter-array Cables

The 66 kV inter-array cables will be used to connect "strings" of six to 10 WTGs to the offshore ESP (see Figure 3.1-16). Each inter-array cable begins at either an ESP or a WTG and terminates at the next WTG on the string. The inter-array cable installation follows scour protection and foundation installation, and normally precedes WTG installation at a given WTG location. Prior to inter-array cable installation, in accordance with normal industry practice, a pre-lay "grapnel run" will be made in all instances to locate and clear obstructions such as abandoned fishing gear and other marine debris.

The inter-array cables could be transported in a cable laying vessel and directly installed at site upon arrival, or they could be stored onshore then be transferred to a cable laying vessel. For the inter-array cables, the expected installation method is to lay the cable section on the seafloor and then subsequently bury the cable using a jet plow (this is referred to as "post-lay burial"). The jet plow technique is described above in Section 4.2.3.3.

At either end, the inter-array cable crosses the scour protection pad and is brought into a J-tube (see Figure 3.1-9) or similar connection, for subsequent linking to the WTG. Cable pull-in will be conducted at each foundation location and followed by cable termination works. As described in Section 3.1.6, cable protection measures may be required for sections of the inter-array cables where burial was not possible and for the transition from seabed to WTG foundation.

4.2.3.7 Wind Turbine Generators

WTG installation involves feeder barges transporting components from the port to the installation vessel(s). The WTGs are expected to be installed by one or two main installation vessels, which may be a jack-up or a dynamic positioning ("DP") vessel. The tower will first be erected followed by the nacelle and finally the hub, inclusive of the blades. Alternatively, the nacelle and hub will be installed in a single operation followed by the installation of individual blades. In case the tower consists of more than one section, the sections will be joined with a bolted connection.

Commencement of the WTG installation phase represents the most intense period of vessel traffic in the Offshore Project Area, with wind turbine foundations, array cables, and wind turbines being installed in parallel.

WTG installation will be followed by the commissioning period where the WTGs will be prepared for operation and energized. Wind turbine commissioning involves conducting the necessary tests of the electrical infrastructure and WTGs ahead of passing the WTG to the operations and maintenance teams for the duration of its service life. The WTG commissioning and testing phase will be conducted in parallel with the WTG installation phase.

4.2.3.8 Landfall Site

As described in Section 3.2.1, the Project has identified two possible Landfall Sites: Covell's Beach parking lot in the Town of Barnstable and New Hampshire Ave/Lewis Bay in the Town of Yarmouth. In both cases, the ocean to land transition can be made by use of horizontal directional drilling ("HDD"). The HDD rig would be setup in a parking lot or other previously disturbed area, and the drill would be advanced seaward. The length of the drill or bore would depend on the width of the dune and beach area, any nearshore sensitive resources, such as eelgrass, as well as bathymetry and geologic conditions. Two bores would be needed, one for each offshore cable. At the offshore end of each bore site, a temporary cofferdam or other method (e.g., gravity cell) may be used to facilitate cable pull-in. Once the bores are completed, each offshore cable is pulled though a bore to an underground concrete vault. In the vault, the three-core submarine cable is separated and jointed to the single core onshore export cable (three single core cables per circuit).

The Lewis Bay/New Hampshire Ave landing area may be suitable for a direct lay approach in lieu of the HDD installation. The New Hampshire Ave landing area is unique in that the shoreline area has been entirely altered with manmade structures (road, sea wall, riprap, etc.). Moreover, there is no eelgrass or other sensitive habitat in the shallow water immediately offshore from the end of New Hampshire Ave. Use of a direct lay approach, as opposed to the more equipment intensive and time-consuming HDD, would also minimize any temporary disturbances to the nearby neighbors. It should be noted that the surrounding area is comprised of seasonal homes and cottages, hence offseason work would minimize the neighborhood disturbance under either approach (see Section 1.5.3 for a more detailed discussion of the seasonal limitations on the construction schedule).

4.2.3.9 Onshore 220 kV Underground Transmission

As described in Section 3.2.2 and 3.2.3, 220 kV underground transmission cabling will be used to connect the landfall site to a 220 kV to 115 kV step down substation and the subsequent interconnection to the 115 kV Barnstable Switching Station.

The construction of the duct bank includes the following steps:

- Survey and mark splice vault locations; survey and mark duct bank location.
- Set up erosion and siltation controls, including silt sacks or similar protection for existing storm drains.
- Set up traffic management measures, in coordination with local police and public works officials.

- Open roads and install duct bank.
- Repave roads as agreed with local town.
- Clean up work area, remove erosion controls.

The duct bank installation is done with conventional construction equipment (e.g., hydraulic excavator, loader, dump trucks, flatbed trucks to deliver PVC pipe, crew vehicles, cement delivery trucks, and paving equipment).

Once the duct bank is in place, the 220 kV cables (one cable per sleeve) will be pulled into place from underground vaults along the cable route. This work is done using a cable reel transport vehicle, a pulling rig and the necessary crew and support vehicles. Installation of the in-road underground cabling will typically be performed during the off-season, where feasible, to minimize traffic disruption.

4.2.3.10 Onshore Substation

As described in Section 3.2.4, the Project's onshore substation is planned for a 0.03 km^2 (8.55 acre) leased site directly to the south of the existing Eversource 115 kV Barnstable Switching Station. The Barnstable Switching Station is located just south of Route 6, in a largely commercial/industrial area north of the Hyannis Airport.

Construction of the onshore substation will include the following steps:

- Install perimeter construction fencing, a security gate, and erosion controls.
- Prepare the site for construction.
- Construct transformer foundations, containment sumps, and spread footings for other equipment.
- Deliver and place major equipment using appropriate heavy-load vehicles and equipment.
- Deliver and place other electrical equipment and a prefabricated control house.
- Complete buswork, bring the 220 kV transmission into the site, and bring the 115 kV cabling to the adjacent Barnstable Switching Station.
- Complete cabling, control wiring, and installation of protection systems.
- Test and commission the onshore substation.

Construction and commissioning of the onshore substation is scheduled to take approximately 18 months.

4.2.4 Vessels, Vehicles, and Aircraft

Construction of the Project will require the use of an array of vessels. A much more limited number of vessels will be used to support routine operations and maintenance activities. Helicopters may be used to supplement crew transport and for Project support during both construction and operations.

Construction of the onshore export cable and onshore substation will require a number of different vehicles. These will primarily be vehicles used for conventional civil construction as well as conventional utility cable pulling equipment. Specialized heavy haul vehicles will be required to transport the substation transformers and other large, heavy components.

Different aspects of the construction will require a specific suite of vessels. For each major element of construction (scour protection, foundation installation, WTG installation, cable laying, etc.), the expected types have been provided in Table 4.2-1. Table 4.2-1 is organized by major construction element and includes the basic data on anticipated vessel type and use. All specifications are subject to change. Vessel data, for example, is highly speculative at this stage of the Project. Vessel details are anticipated to be further refined in the Fabrication and Installation Report ("FIR"). Due to variable availability and limitations associated with the Jones Act, vessels may even be changed out just prior to or during construction.

For the construction of the 800 megawatt ("MW") Project, the average number of vessels on-site during construction is anticipated to be approximately 25. See Section 7.8 of Volume III and the Navigational Risk Assessment in Appendix III-I for further discussion of vessel activity during construction.

Table 4.2-1 Vessels Used for Construction

Role	Vessel Type	#	Approx. Size		Displacement		Approximate Vessel Speed		Type of Propeller System	Approximate Fuel Capacity	Marine Sanitation Device	Crew Size	Vessel Examples
			Width	Length	Gross Tonnage	Deadweight	Operational Speed	Maximum Transit Speed					
Foundation Installation													
Marine Mammal Observers and Environmental Monitors	Fishing Vessel/ Crew Transfer Vessel	2-6	~7 m (23 ft)	~20 m (66 ft)	N/A	N/A	10 kn	25 kn	Blade propeller system / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	~2	[redacted]
Scour Protection Installation	Fall Pipe Vessel	1	30-45 m (98 - 148 ft)	130 - 170 m (427 - 558 ft)	15,000-28,000 t (16,535-30,865 US tons)	25,000 t (27,558 US tons)	10 kn	14 kn	Blade propeller system / blade thrusters	N/A	IMO compliant	20-60	[redacted]
Overseas Foundation Transport	Heavy Cargo Vessel, Deck Carrier, and/or Semi-submersible Vessel	2-4	24-56 m (79 - 184 ft)	120 - 223 m (394 - 732 ft)	12,000-25,000 t (13,228-27,558 US tons)	10,000-62,000 t (11,023-68,343 US tons)	13 - 18 kn	13 - 18 kn	Blade propeller system / blade thrusters	260,000 - 1,800,000 L (68,680 - 475,510 gal)	MSD: Type II and Type III, IMO compliant	15-25	[redacted]
Foundation Installation (Possibly Including Grouting	Jack-up, Heavy Lift Vessel, or Semi-submersible Vessel	1-2	40-56 m (131 - 184 ft)	180-220 m (591 - 722 ft)	20,000-50,000 t (22,046-55,116 US ton)	10,000-80,000 t (11,023-88,185 US ton)	0 - 10 kn	12-14 kn	Blade propeller system / blade thrusters	N/A	IMO compliant	25-220	[redacted]
Noise Mitigation Vessel	DP-2 Support Vessel or Anchor Handling Tug Supply Vessel	1	~15 m (49 ft)	65 - 90 m (213 - 295 ft)	1,900-3,000 t (2,094-3,307 US tons)	2,200-3,000 t (2,425-3,307 US tons)	10 kn	13 kn	Blade propeller systems / blade thrusters	~740,000 L (195,490 gal)	IMO compliant	5-14	[redacted]
Acoustic Monitoring	Multipurpose Support Vessel or Tug Boat	1	~10 m (33 ft)	~30 m (98 ft)	50- 500 t (55-551US tons)	20 t (22 US tons)	14 kn	14 kn	Blade propeller systems / blade thrusters	~215,000 L (56,800 gal)	Non-IMO	5-10	[redacted]
Secondary Work, Snagging, and Possibly Grouting	DP-2 Support Vessel or Tug Boat	1	~10 m (33 ft)	30 - 80 m (98 - 262 ft)	500 - 900 t (551-992 US tons)	120 t (132 US tons)	14 kn	14 kn	Blade propeller systems / blade thrusters	~215,000 L (56,800 gal)	IMO compliant	10-100	[redacted]
Crew Transfer	Crew Transfer Vessel	3	7-12 m (23 - 39 ft)	20-30 m (66 - 98 ft)	100-150 t (110-165 US tons)	20-75 t (22-83 US tons)	25 kn	25 kn	Blade propeller systems / blade thrusters	~8,000 (2,110 gal)	IMO compliant	2-10	[redacted]
Transport of Foundations to WDA	Barge	2-5	~25 m (82 ft)	100 m (328 ft)	N/A	9,600 t (10,582 US tons)	N/A	N/A	N/A	N/A	N/A	N/A	[redacted]

Table 4.2-1 Vessels Used for Construction (Continued)

Role	Vessel Type	#	Approx. Size		Displacement		Approximate Vessel Speed		Type of Propeller System	Approximate Fuel Capacity	Marine Sanitation Device	Crew Size	Vessel Examples
			Width	Length	Gross Tonnage	Deadweight	Operational Speed	Maximum Transit Speed					
Foundation Installation (continued)													
Transport of Foundations to WDA	Tugs	3-4	~10 m (33 ft)	~35 m (115 ft)	200-500 t (220-551 US tons)	200-300 t (220-331 US tons)	10 kn	10 - 14 kn	Blade propeller systems / blade thrusters	~215,000 L (56,800 gal)	IMO compliant	5-10	[redacted]
Tugboat to Support Main Foundation Installation Vessel(s)	Site Tug	1	6-10 m (20 - 33 ft)	16-35 m (52 - 115 ft)	75-500 t (83-551 US tons)	50-200 t (55-220 US tons)	10 kn	10 - 14 kn	Blade propeller systems / blade thrusters	~215,000 L (56,800 gal)	not specified	5-10	[redacted]
ESP Installation													
ESP Installation	Floating Crane vessel or Semi-submersible Vessel	1	40-90 m (131 - 295 ft)	180-220 m (591 - 722 ft)	N/A	10,000 - 48,000 t (11,023-52,911 US tons)	10 - 12 kn	14 kn	N/A	N/A	Non-IMO	20-220	[redacted]
ESP Transport	Heavy Cargo Vessel, Deck Carrier, and/or Semi-submersible Vessel	1-2	24-40 m (79 - 131 ft)	20-223 m (66 - 732 ft)	12,000-50,000 t (13,228-55,116 US tons)	10,000-62,000 t (11,023-68,343 US tons)	13 - 18 kn	13 -18 kn	Blade propeller systems / blade thrusters	260,000 - 1,800,000 L (68,680 - 475,510 gal)	MSD: Type II and Type III, IMO compliant	15-25	[redacted]
ESP Transport (if required)	Tugs	2-4	~10 m (33 ft)	~35 m (115 ft)	200-500 t (220-551 US tons)	200-300 t (220-331 US tons)	14 kn	14 kn	Blade propeller systems / blade thrusters	~215,000 L (56,800 gal)	IMO compliant	5-10	[redacted]
Crew Transfer	Crew Transfer Vessel	1	7 - 12 m (23 - 39 ft)	20 - 30 m (66 - 98 ft)	100-150 t (110-165 US tons)	20-75 t (22-83 US tons)	25 kn	25 kn	Blade propeller systems / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	2-10	[redacted]

Table 4.2-1 Vessels Used for Construction (Continued)

Role	Vessel Type	#	Approx. Size: Width	Approx. Size: Length	Displacement: Gross Tonnage	Displacement: Deadweight	Approximate Vessel Speed: Operational Speed	Approximate Vessel Speed: Maximum Transit Speed	Type of Propeller System	Approximate Fuel Capacity	Marine Sanitation Device	Crew Size	Vessel Examples
ESP Installation (continued)													
Service Boat	Crew Transfer Vessel	1	7 - 12 m (23 - 39 ft)	20 - 30 m (66 - 98 ft)	100-150 t (110-165 US tons)	20-75 t (22-83 US tons)	25 kn	25 kn	Blade propeller systems / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	2-10	[redacted]
Refueling Operations to ESP	Crew Transfer Vessel	1	7-12 m (23 - 39 ft)	20-30 m (66 - 98 ft)	100-150 t (110-165 US tons)	20-75 t (22-83 US tons)	25 kn	25 kn	Blade propeller systems / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	2-10	[redacted]
Crew Hotel Vessel During Commissioning	Jack-up or Floatel Vessel	1	~40 m (131 ft)	~55 m (180 ft)	500 t (551 US tons)	N/A	0 kn	6 kn	Blade propeller systems / blade thrusters	~280,000 L (73,970 gal)	Non-IMO	20-100	[redacted]
			10 - 12 m (33 - 39 ft)	70 - 100 m (230 - 328 ft)	800-9,000 t (882-9,921 US tons)	120-4,500 t (132-4,960 US tons)	10 kn	13.5 kn	Blade propeller systems / blade thrusters	N/A	IMO compliant	50-201	
Offshore Export Cable Installation													
Pre-Lay Grapnel Run	Multipurpose Support Vessels	1	8 - 15 m (26 - 49 ft)	30 - 70 m (98 - 230 ft)	700-4,000 t (772-4,409 US tons)	2,200 - 2,500 t (2,425-2,756 US tons)	10 kn	15 kn	Blade propeller system / blade thrusters	~120,000 L (31,700 gal)	IMO compliant	2-25	[redacted]
Pre-Installation Surveys	Multi-role survey vessel or Smaller Support Vessels	1	6 - 26 m (20 - 85 ft)	13 - 112 m (43 - 367 ft)	1,500-15,000 t (1,653-16,535 US tons)	400-3,000 t (441-3,307 US tons)	18 – 22 kn	25 - 30 kn	Blade propeller system / blade thrusters, except smaller support vessels which are jet drive propulsion	8,000 – 52,000 liters ("L") (2,110 – 13,800 gallons ["gal"])	IMO compliant	25-70, except smaller support vessels which are 2-8	[redacted]
Laying of the Cables (and potentially burial)	Cable Laying Vessel	1	22 - 35 m (72 - 115 ft)	80 - 150 m (262 - 492 ft)	7,000-16,500 t (7,716-18,188 US tons)	1,200-1,5000 t (1,323-16,535 US tons)	5 kn	14 kn	Blade propeller system / blade thrusters	~1,200,000 L (317,010 gal)	IMO compliant	15-45	[redacted]
Boulder Clearance	Cable Laying Support Vessel	1	15 - 20 m (49 - 66 ft)	75 -120 m (246 - 394 ft)	2500-8000 t (2756-8818 US tons)	2,000-7,000 t (2,205-7,716 US tons)	5 kn	12 kn	Blade propeller system / blade thrusters	~960,000 L (253,610 gal)	IMO compliant	20-60	[redacted]
Support Main Vessel with Anchor Handling	Anchor Handling Tug Supply Vessel	1	6 - 15 m (20 - 49 ft)	16 - 65 m (52 - 213 ft)	75-1,900 t (83-2,094 US tons)	50-2,200 t (55-2,425 US tons)	10 - 14 kn	10 - 14 kn	Blade propeller system / blade thrusters	120,000 - 150,000 L (31,701 - 39,626 gal)	not specified	5-20	[redacted]

Table 4.2-1 Vessels Used for Construction (Continued)

Role	Vessel Type	#	Approx. Size		Displacement		Approximate Vessel Speed		Type of Propeller System	Approximate Fuel Capacity	Marine Sanitation Device	Crew Size	Vessel Examples
			Width	Length	Gross Tonnage	Deadweight	Operational Speed	Maximum Transit Speed					
Offshore Export Cable Installation (continued)													
Trenching Vessel	Purpose Built Offshore Construction/ROV/Survey Vessel	1	~25 m (82 ft)	~128 m (420 ft)	N/A	~7,500 t (8,267 US tons)	10 kn	15 kn	Blade propeller system / blade thrusters	~2,000,000 L (528,344 gal)	IMO compliant	N/A	[redacted]
Crew Transfer	Crew Transfer Vessel	1	7 - 12 m (23 - 39 ft)	20 - 30 m (66 - 98 ft)	100-150 t (110-165 US tons)	20-75 t (22-83 US tons)	25 kn	25 kn	Blade propeller systems / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	2-10	[redacted]
Place Rock or Concrete Mattresses	Rock/Mattress Placement Vessels	1	30 - 45 m (98 - 148 ft)	130 - 170 m (427 - 558 ft)	15,000-28,000 t (16,535-30,865 US tons)	25,000 t (27,558 US tons)	10 kn	14 kn	Blade propeller system / blade thrusters	N/A	IMO compliant	20-60	[redacted]
Dredging	Dredging Vessels	1	~30 m (98 ft)	~230 m (755 ft)	33,423 t (36,843 US tons)	59,798 t (65,916 US tons)	10 kn	16 kn	Blade propeller system / blade thrusters	N/A	IMO compliant	30-60	[redacted]
Inter-Array Cable Installation													
Pre-Lay Grapnel Run	Multipurpose Support Vessel	1	8 - 15 m (26 - 49 ft)	30 - 70m (98 - 230 ft)	700-4,000 t (772-4,409 US tons)	2,200 - 2,500 t (2,425-2,756 US tons)	15 kn	15 kn	Blade propeller system / blade thrusters	~120,000 L (31,700 gal)	IMO compliant	2-25	[redacted]
Pre-Installation Surveys	Multi-role survey vessel or Smaller Support Vessels	1	6 - 26 m (20 - 85 ft)	13 - 112 m (43 - 367 ft)	1,500-15,000 t (1,653-16,535 US tons)	400-3,000 t (441-3,307 US tons)	18 – 22 kn	25 - 30 kn	Blade propeller system / blade thrusters, except smaller support vessels which are jet drive propulsion	8,000 – 52,000 liters ("L") (2,110 – 13,800 gallons ["gal"])	IMO compliant	25-70, except smaller support vessels which are 2-8	[redacted]
Laying of the Cables (and potentially burial)	Cable Laying Vessel	1	22 - 35 m (72 - 115 ft)	80 - 150 m (262 - 492 ft)	7,000-16,500 t (7,716-18,188 US tons)	1,200-15,000 t (1,323-16,535 US tons)	5 kn	14 kn	Blade propeller system / blade thrusters	~1,200,000 L (317,010 gal)	IMO compliant	15-45	[redacted]
Burial Support Vessel	Cable Laying Support vessel	1	15 - 20 m (49 - 66 ft)	75 - 120 m (246-394 ft)	2,500-8,000 t (2,756-8,818 US tons)	2,000-7,000 t (2,205-7,716 US tons)	12 kn	12 kn	Blade propeller system / blade thrusters	~960,000 L (253,610 gal)	IMO compliant	20-60	[redacted]
Crew Transfer	Crew Transfer Vessel	2	7 - 12 m (23 - 39 ft)	20 - 30 m (66 - 98 ft)	100-150 t (110-165 US tons)	20-75 t (22-83 US tons)	25 kn	25 kn	Blade propeller systems / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	2-10	[redacted]
Cable Termination and Commissioning	Cable Laying Support vessel	1	15 - 20 m (49 - 66 ft)	75 - 120 m (246 - 394 ft)	2,500-8,000 t (2,756-8,818 US tons)	2,000-7,000 t (2,205-7,716 US tons)	12 kn	12 kn	Blade propeller system / blade thrusters	~960,000 L (253,610 gal)	IMO compliant	20-60	[redacted]
Trenching Vessel	Purpose Built Offshore Construction/ROV/Survey Vessel	1	~25 m (82 ft)	~128 m (420 ft)	N/A	~7,500 t (8,267 US tons)	10 kn	15 kn	Blade propeller system / blade thrusters	~2,000,000 L (528,344 gal)	IMO compliant	N/A	[redacted]

Table 4.2-1 Vessels Used for Construction (Continued)

Role	Vessel Type	#	Approx. Size		Displacement		Approximate Vessel Speed		Type of Propeller System	Approximate Fuel Capacity	Marine Sanitation Device	Crew Size	Vessel Examples
			Width	Length	Gross Tonnage	Deadweight	Operational Speed	Maximum Transit Speed					
Inter-Array Cable Installation (continued)													
Place Rock or Concrete Mattresses	Rock/Mattress Placement Vessels	1	30 - 45 m (98 - 148 ft)	130 - 170 m (427 - 558 ft)	15,000-28,000 t (16,535-30,865 US tons)	25,000 t (27,558 US tons)	10 kn	14 kn	Blade propeller system / blade thrusters	N/A	IMO compliant	20-60	[redacted]
WTG Installation													
Nacelle and Tower Transport	Heavy Lift Vessels	1-4	~20 m (66 ft)	~150 m (492 ft)	8,600 t (9,480 US tons)	9,400 t (10,362 US tons)	18 kn	18 kn	Blade propeller system / blade thrusters	~1,090,000 L (287,950 gal)	IMO compliant, MSD Type II	17-19	[redacted]
Blade Transport	Heavy Cargo Vessel	1-5	~15 m (49 ft)	~130 m (427 ft)	6,300 t (6,945 US tons)	8,000 t (8,818 US tons)	14 kn	14 kn	Blade propeller system / blade thrusters	~455,000 L (120,200 gal)	IMO compliant	15-18	[redacted]
Feeding WTG Components from Harbor to WDA	Jack-up Vessels[16]/Feeder Barges	2-6	6-50 m (20 - 164 ft)	35 - 100 m (115 - 328 ft)	4,000 t (4,409 US tons)	2,000-8,000 t (2,205-8,818 US tons)	0 -10 kn	14 kn	Blade propeller system / blade thrusters	215,000 - 280,000 L (56,800 - 73,970 gal)	IMO compliant	15-80	[redacted]
Vessel and Feeder Concept Assistance	Harbor Tug	1-6	6-10 m (20 - 33 ft)	15-35 m (49 - 115 ft)	75-500 t (83-551 US tons)	50-200 t (55-220 US tons)	10 kn	14 kn	Blade propeller system / blade thrusters	~215,000 L (56,800 gal)	N/A	4-8	[redacted]
WTG Installation	Jack-up Crane Vessel	1-2	35-55 m (115 - 180 ft)	85-165 m (279 - 541 ft)	15,000-25,000 t (16,535-27,558 US tons)	4,500-20,000 t (4,960-22,046 US tons)	0 -10 kn	12 kn	Blade propeller system / blade thrusters	N/A	IMO compliant	80-150	[redacted]
Crew Transfer	Crew Transfer Vessel	3	~7 m (23 ft)	~20 m (66 ft)	N/A	N/A	10 kn	25 kn	Blade propeller system / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	~2	[redacted]
WTG Commissioning													
Crew Transfer	Crew Transfer Vessel	1-4	6-12 m (20 - 39 ft)	15-30 m (49 - 98 ft)	10-50 t (11-55 US tons)	6-20 t (7-22 US tons)	25 kn	25 kn	Blade propeller system / blade thrusters	~8,000 L (2,110 gal)	N/A	2-10	[redacted]
Main Commissioning Vessel	Service Operation Vessel	1	~18 m (59 ft)	~80 m (262 ft)	N/A	~2,500 t (2,756 US tons)	10 – 12 kn	13 kn	Blade propeller system / blade thrusters	1,140,000 L (301,156 gal)	N/A	~27	[redacted]
Miscellaneous Construction Activities													
Refueling Vessels	Crew Transfer Vessel or Multipurpose Support Vessel	1	~7 m (23 ft)	~20 m (66 ft)	N/A	N/A	25 kn	25 kn	Blade propeller system / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	~2	[redacted]
Guard Vessels	Crew Transfer Vessel	1	~7 m (23 ft)	~20 m (66 ft)	N/A	N/A	25 kn	25 kn	Blade propeller system / blade thrusters	~8,000 L (2,110 gal)	IMO compliant	~2	[redacted]

16 Jacking-up in ports may occur.

Table 4.2-1 Vessels Used for Construction (Continued)

Role	Vessel Type	#	Approx. Size		Displacement		Approximate Vessel Speed		Type of Propeller System	Approximate Fuel Capacity	Marine Sanitation Device	Crew Size	Vessel Examples
			Width	Length	Gross Tonnage	Deadweight	Operational Speed	Maximum Transit Speed					
Miscellaneous Construction Activities (continued)													
Geophysical and Geotechnical Survey Operations	Multi-role survey vessel or Smaller Support Vessels	1	6-26 m (20 - 85 ft)	13- 112 m (43 - 367 ft)	1,500-15,000 t (1,653-16,535 US tons)	400-3,000 t (441-3,307 US tons)	18 – 22 kn	25 - 30 kn	Blade propeller system / blade thrusters, except smaller support vessels which are jet drive propulsion	8,000 – 52,000 liters ("L") (2,110 – 13,800 gallons ["gal"])	IMO compliant	25-70, except smaller support vessels which are 2-8	[redacted]

Notes:

Vessel descriptions/dimensions are based on the specification sheets for the example vessels listed. Not all specification sheets provided information for each category; values provided may not be representative of all example vessels listed.

"t" = metric tons

With respect to construction of the onshore substation and underground onshore export cables, a complement of conventional construction equipment and vehicles will be used. Portions of the onshore substation site will be cleared and graded using conventional land clearing equipment. Construction of the onshore substation itself will begin with excavation/foundation placement, again using standard equipment (e.g., hydraulic excavators, backhoes, form trucks, concrete delivery trucks and support vehicles). The balance of the work includes delivering and setting the major components (transformers, breakers, etc.), erection of the bus system, and all of the necessary cabling/insulator installation. This element of the onshore substation work involves special over-the-road delivery trucks for the heavy/oversize components, normal delivery vehicles for other materials and parts, a large crane to set the transformers, rough terrain cranes, a variety of mobile lifts, and support vehicles.

Construction and installation of the underground onshore export cable system involves one complement of equipment for construction of the duct bank (excavators, dump trucks, delivery trucks, front end loader, concrete delivery trucks, crew vehicles, etc.), and a second complement of vehicles to support the cable pulling and splicing (cable reel trucks, winch, crew vehicles, etc.).

With respect to all construction activities, but particularly in relation to scour protection and cable installation, additional geophysical work will likely be conducted to ensure adequate understanding of seabed conditions, particularly in areas of seabed change. Geophysical equipment may also be utilized to ensure proper installation of project components such as scour protection. Geophysical instruments may include, but are not limited to, side scan sonar, bathymetry, magnetometers, and sub-bottom profilers.

4.2.5 Waste Generation and Disposal

Construction and commissioning of the Project will generate some quantity of solid wastes and some small quantity of liquid wastes. The solid waste will primarily consist of short lengths of cable trimmings as well as material and equipment packaging or protective wrappings. Nearly all of these materials will be collected for subsequent recycling. Similarly, small lots of leftover paints and finishes will be properly removed for reuse, recycling or proper disposal. The Project does not expect to need a National Pollutant Discharge Elimination System ("NPDES") permit for offshore construction and commissioning activities. However, a NPDES construction general permit will be required for elements of the onshore construction, since it involves disturbance of more than one acre of land area.

The vessels supporting the offshore construction and future operations and maintenance will be equipped with appropriate sanitary systems. Table 4.2-2 below describes potential wastes to be produced by the Project.

Table 4.2-2 List of Wastes Expected to be Produced During all Project Phases

Type of waste and composition	Approximate total amount discharged	Maximum Discharge Rate	Means of storage or discharge method
Sewerage from vessel	95-114 L/person/day (25-30 gal/person/day)	N/A	Tanks / Sewage Treatment Plant
Domestic water	114-151 L/person/day (30-40 gal/person/day)	N/A	Tanks or discharged overboard after treatment
Drilling cuttings, mud, or borehole treatment chemicals, if used	Dependent on final selection of HDD technique	N/A	N/A
Uncontaminated bilge water	Volume subject to vessel type	Rate subject to vessel size and equipment	Tanks or discharged overboard after treatment
Deck drainage and sumps	Volume subject to vessel type	Rate subject to vessel size and equipment	Discharged overboard after treatment
Uncontaminated ballast water	Volume subject to vessel type	Rate subject to vessel size and equipment	Discharged overboard
Uncontaminated fresh or seawater used for vessel air conditioning	N/A	N/A	Discharged overboard
Solid trash or debris	As generated	As generated	Onshore landfill (location to be determined ["TBD"])
Chemicals, solvents, oils, greases	Volume subject to vessel type	Rate subject to vessel size and equipment	Incineration or onshore landfill (location TBD)

1. Final discharge volumes and rates will be provided in the FIR following execution of contract with the construction contractor and the assignment of a Marine Coordinator.

4.2.6 Chemical Products Used

As planning and design proceeds, a detailed chemical and waste management plan will be developed and provided to BOEM. This plan will describe how each waste stream will be handled and stored, together with plans for proper disposal, recovery, recycling, or reuse. Examples of potential chemical products to be used are provided in Table 4.2-3 below.

Table 4.2-3 List of Potential Chemical Products Used

Chemical Type	Product Description	Source/Location	Approximate Volume (Liter [L] or Kilogram [kg])	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Transformer Oil (WTG and ESP)	Bio-degradable oil or highly refined mineral oil	Main 220/66 kV Transformers, 220 kV shunt reactors, 66 kV aux. transformers & 66 kV grounding reactor	6,500 L per WTG 466,400 L on ESPs[17]	To be included at time of WTG and ESP installation During the O&M phase vessels will be transferring the oil to the offshore positions, either in cans/containers that can be hoisted to the foundation platform or in tanks/containers from which it can be pumped via a hose from the vessel	Not anticipated; only changed if needed	To be brought designated O&M port and disposed according to regulations and guidelines
Lubrication Oil (ESP)	Lubricant Oil	Crane Emergency generator	Crane: To be defined during detailed design Emergency generator: 55 L	During the O&M phase vessels will be transferring the oil to the offshore positions, either in cans/containers that can be hoisted to the foundation platform or in tanks/containers from which it can be pumped via a hose from the vessel	Expected every 5-8 years	To be brought designated O&M port and disposed according to regulations and guidelines
General Oil (WTG and ESP)	Different kinds of oil	WTGs: Hydraulics, gear box, yaw gears, transformers, etc. Might also be used for passive damper located in tower ESPs: Hydraulic oil for crane	8,000 L per WTG 3,000 L to be replaced as part of scheduled maintenance 1320 L on ESPs	To be included at time of WTG and ESP installation During the O&M phase vessels will be transferring the oil to the offshore positions, either in cans/containers that can be hoisted to the foundation platform or in tanks/containers from which it can be pumped via a hose from the vessel	Expected every 5-8 years	To be brought designated O&M port and disposed according to regulations and guidelines

[17] For ESPs, quantities of chemicals are given for the higher value of one 800 MW ESP or two conventional 400 MW ESPs, with the exception of grout, which is given per position.

Table 4.2-3 List of Potential Chemical Products Used (Continued)

Chemical Type	Product Description	Source/Location	Approximate Volume (Liter [L] or Kilogram [kg])	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Grease (WTG)	Refill of grease for main bearing, yaw bearing, blade bearing	Bearings including yaw bearing and blade bearing	1,000 L per WTG	To be included at time of WTG installation During O&M vessels will be transferring cans to site	Expected every year	To be brought designated O&M port and disposed according to regulations and guidelines
Diesel Fuel (WTG and ESP)	Fuel for the emergency diesel generator (if any)	Diesel storage tank	3,000 L per WTG 21,560 L on ESPs	To be included at time of WTG and ESP installation Potentially via hose from vessel or container placed at TP	Only as required	To be brought designated O&M port and disposed according to regulations and guidelines
Fire extinguishing Agents (WTG and ESP)	Inert gas extinguishing system (e.g., NOVEC, nitrogen, or similar)	Various rooms	To be defined during detailed design	To be included at time of WTG and ESP installation	Not anticipated; only changed if needed	To be brought designated O&M port and disposed according to regulations and guidelines
Fire extinguishing Agents (WTG and ESP)	Manual extinguishers: powder, CO_2, foam	Various locations	WTG: To be defined during detailed design 11,000 L foam on ESPs	To be included at time of WTG and ESP installation	Depends on fabrication	To be brought designated O&M port and disposed according to regulations and guidelines

Table 4.2-3 List of Potential Chemical Products Used (Continued)

Chemical Type	Product Description	Source/Location	Approximate Volume (Liter [L] or Kilogram [kg])	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Fire extinguishing Agents (WTG and ESP)	Other types (if any)	Various locations	To be defined during detailed design	To be included at time of WTG and ESP installation	Not anticipated; only changed if needed	To be brought designated O&M port and disposed according to regulations and guidelines
Sulphur Hexafluoride ("SF6") (WTG and ESP)	SF6	WTG GIS switch gears ESP GIS switch gears	~13 kg per WTG ~4,120 kg on ESPs	To be included at time of WTG and ESP installation	Not replaced	To be brought designated O&M port and disposed according to regulations and guidelines
Paint & Coating (WTG and ESP)	Corrosion protection of steel structure paints & varnishes	Steel structure, various locations	To be defined during detailed design	To be included at time of WTG and ESP installation; additional paint only needed for repairs	Only for repairs	To be brought designated O&M port and disposed according to regulations and guidelines
Coolants or refrigerants (such as water or glycol) (WTG and ESP)	Air handling unit, HVAC system	Heating, Ventilation, and Air Conditioning (HVAC) unit, Air Handling Unit	1,600 L per WTG Approx. 700 L to be replaced as part of scheduled maintenance 176 L on ESPs	To be included at time of WTG and ESP installation	Expected every 5-8 years	To be brought designated O&M port and disposed according to regulations and guidelines

Table 4.2-3 List of Potential Chemical Products Used (Continued)

Chemical Type	Product Description	Source/Location	Approximate Volume (Liter [L] or Kilogram [kg])	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Grout (WTG and ESP)	Grout	Grout for connection between monopile and transition piece	Up to 40,000 L per WTG and ESP position	To be included at time of WTG and ESP installation	Not anticipated; only changed if needed	To be brought back to port and disposed according to regulations and guidelines

4.3 Operations & Maintenance

4.3.1 Purpose and Objectives

4.3.1.1 Philosophy

The operations and maintenance ("O&M") philosophy for the Project will be based on the following principles:

- *Health, Safety and Environment ("HSE") First Principles* – putting the health and safety of our people and the environment at the forefront of all our operations and maintenance activities.

- *Continuous Improvement* – ensuring that we regularly review our procedures and performance, identify lessons learned and implement improvements.

- *Maximize Plant Reliability and Availability* – ensuring that we diligently design and select robust reliable wind farm components and that we implement a maintenance regime in which preventive (i.e., scheduled) maintenance is such that it reduces or eliminates the requirements for corrective (i.e., unscheduled) maintenance. In this regard, the aim is to deliver a reliable Project with high production.

- *Knowledge Transfer* – ensuring that, wherever possible, Vineyard Wind learns from other offshore projects (especially within the portfolios of the respective shareholders), wider business experience, experienced partners and contractors and the wider industry to develop our skills in order to achieve our O&M objectives.

4.3.1.2 Objectives

Vineyard Wind's primary O&M objective is to operate a safe and efficient Project. This objective shall be achieved through detailed planning, the use of well-thought-out procedures, the use of experienced and well-trained staff and contractors, and a strong focus on preventive maintenance, data analysis in order to predict/prevent corrective maintenance, and continuous review and improvement.

4.3.1.3 Development of Detailed Maintenance Plans and Processes

Vineyard Wind will develop Project-specific operations and maintenance plans and processes for the wind energy installation. These plans will reflect the installed components. The starting point for all maintenance plans and processes will be the recommendations and instructions set out in the Original Equipment Manufacturers ("OEM") manuals.

Specific maintenance schedules, which set forth the frequency with which maintenance is to be carried out, will be developed for the scheduled maintenance of each primary component (WTG, ESP, onshore substation, etc.). In addition, a scheduled maintenance checklist and or summary method statements for each scheduled task will be developed. These checklists and or summary method statements may be developed by Vineyard Wind and/or their contractors (e.g., WTG OEM).

The final strategy for execution of maintenance works will be largely dependent on the contracting strategy implemented for the maintenance works at the various stages of the Project's life cycle. However, the following principles will be central to the execution of the maintenance:

- Ensuring that experienced operations personnel and/or contractors participate in all phases of the maintenance.
- Ensuring the spare parts and consumables strategy is sufficiently robust and managed such that spares' availability is high allowing for quick repair times in the event of a failure.
- Ensuring that robust maintenance plans and procedures for maintenance are in place, and continually reviewed and updated.
- Ensuring that the organization is structured to efficiently execute the maintenance strategy and that this structure is such that knowledge transfer and continuous improvement are built in to the process.
- Planning and executing maintenance proactively to reduce or eliminate the need for corrective interventions.

4.3.2 Normal Operating Procedures

4.3.2.1 Scheduled and Preventive Maintenance

Vineyard Wind will ensure the offshore wind farm maintenance strategy aligns with best industry practice. This preventive maintenance strategy will be regularly reviewed to ensure maintenance objectives are met and continuously improved. Ultimately, the objective of preventive maintenance is to reduce or eliminate the need for corrective maintenance and contribute to the objective of maintaining good reliability and high availability.

The preventive maintenance plans will be derived from a combination of the experience of the Vineyard Wind shareholders (i.e., CIP and Avangrid) and the maintenance schedules and manuals provided by the OEM's. In addition to the physical preventive maintenance, proactive inspections will be undertaken on a routine basis to ensure the plant remains in a safe condition to enable maintenance activities to be carried out.

Scheduled Inspection and Maintenance Activities

Scheduled inspection and maintenance activities shall generally include the following tasks. A representative inspection and maintenance schedule is provided as Figure 4.3-1.

<u>WTG</u>

- Inspections of components/equipment and proactive replacement of components due to wear and tear (e.g., brake system, pitch system, bolt tightening, and blades).
- Statutory inspections of high-voltage equipment, lifting equipment, safety equipment, hook-on points, etc.

<u>Foundations</u>

- Inspection of external platform, including ladder and boat landing structure, and inspection of internal structures (corrosion measurement, etc.).
- Statutory inspections of lifting equipment, safety equipment, hook-on points, etc.
- Inspection of scour protection and monitoring of performance.

<u>ESP</u>

- Inspection and service of high-voltage equipment (e.g., main transfer, switchgears, and earthing systems) and auxiliary systems (fire protection system, communication system, heating and ventilation system, etc.)
- Statutory inspections of lifting equipment, safety equipment, hook-on points, etc.

<u>Onshore Substation</u>

- Inspection and service of high-voltage equipment (e.g., main transformer, switchgears, and earthing systems) and auxiliary systems (fire protection system, communication system, heating and ventilation system, etc.)
- Statutory inspections of lifting equipment, safety equipment, hook-on points, etc.

<u>Inter-array Cables, Inter-link Cables, Offshore Export Cables, Landfall Site(s) and Onshore Export Cables</u>

- Bathymetric and other surveys and monitoring cable exposure and/or depth of burial.

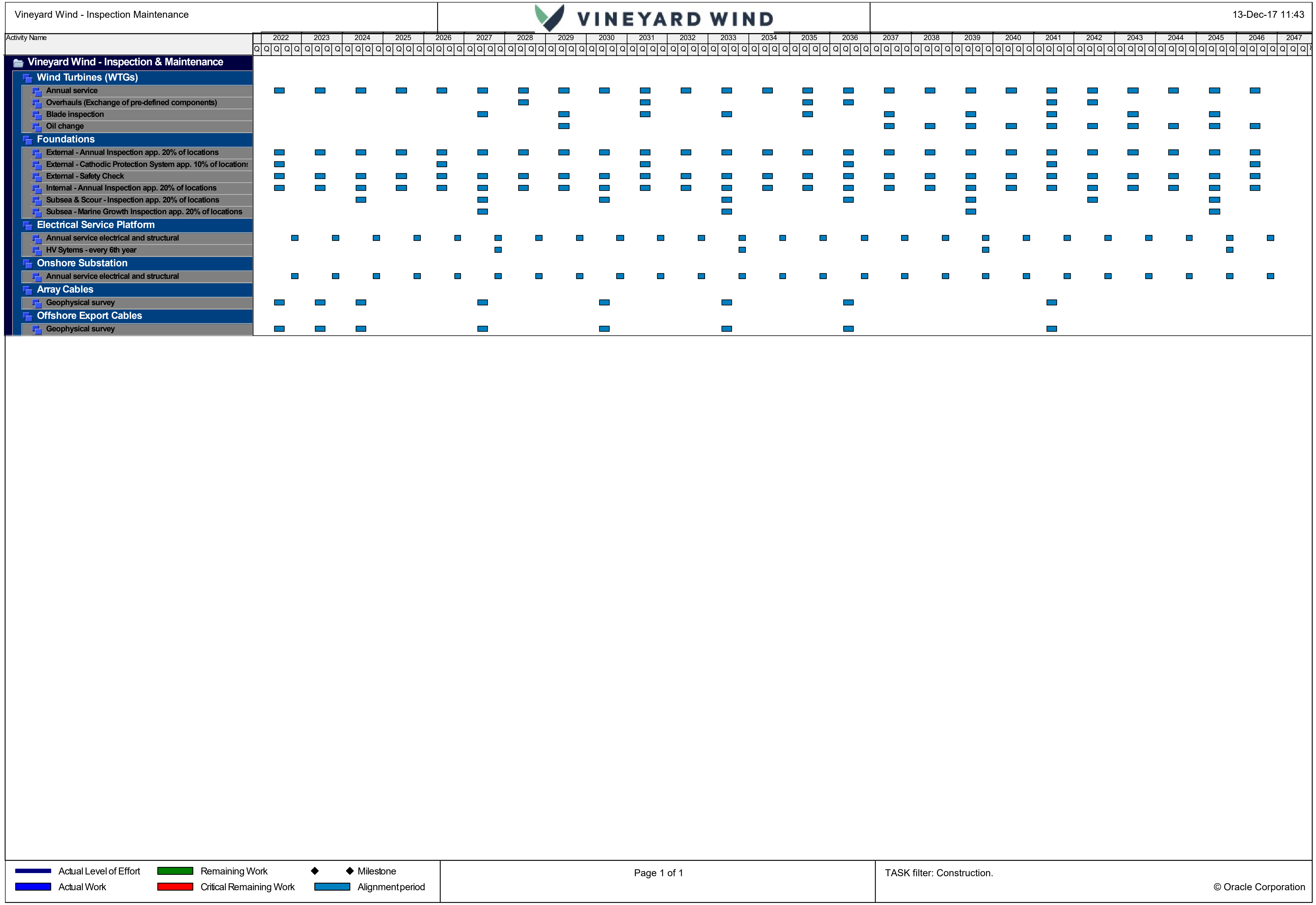

Figure 4.3-1
Representative Inspection and Maintenance Schedule

Equipment

Geophysical work will likely be conducted to ensure adequate understanding of seabed conditions, particularly in areas of seabed change, and to monitor project components such as cables and scour protection. Geophysical instruments may include, but are not limited to, side scan sonar, bathymetry, magnetometers, and sub-bottom profilers.

Equipment to be used for the inspection and O&M activities includes the following types listed in Table 4.3-1.

Table 4.3-1 O&M Activities and Equipment Types

Activity Type	Equipment
Marine inspections and surveys: • Offshore and nearshore multi-beam echosounder inspections • Offshore and nearshore side scan sonar inspections • Offshore and nearshore magnetometer inspections • Offshore and nearshore depth of burial inspections • Other geophysical surveys • Geotechnical surveys	ROV or remotely-operated towed vessel ("ROTV") deployed from a survey vessel. For geotechnical surveys, sampling instrumentation deployed from a survey vessel with geotechnical spread. Cable toner survey.
Cathodic protection inspection and repair	ROV deployed from a survey vessel or divers
Hot work (welding) and ancillary equipment (including subsea)	Crew deployed to the WTG or divers deployed from diving vessel for subsea arc welding
Removal of marine growth and guano	Using a brush to break down the marine growth (where required) followed by high-pressure jet wash (sea water only). Technicians or deck hands will be deployed from crew transport vessels ("CTVs") or similar vessel.
External surface preparation and external protective coating repair	Technicians and equipment deployed from CTVs or similar vessel. Surface preparation to break down existing surface coating and any associated rust via blaster.
Grouted connections • Intrusive core samples • Re-grouting	Intrusive core samples: ROV deployed from a survey vessel or divers Re-grouting: Injected via one of several redundant grouting injection tubes from the TP
External component replacement or repair	Varies according to component in question, could be a crew mobilized to site in CTV, diving spread, construction support vessel (CSV), or jack-up barge.

In addition to the equipment listed in Table 4.3-1, major repairs to Project components could utilize construction-type vessels, including cable-laying vessels.

4.3.2.2 Systems and Processes

Vineyard Wind will develop a number of Project-specific O&M procedures; indicatively, these will cover at least the following topics:

- General Operations
- Preventive Maintenance
- Corrective Maintenance
- Urgent Response Protocol
- Local Operations
- Back up Control Room
- Planning and Monitoring of Works
- Work Control
- Warehouse Management
- Design Modifications
- Marine Coordination
- Warranty and Insurance management and claims
- Maintenance of control room systems
- Permit to work

Vineyard Wind will have a dedicated permit-to-work process in place covering all offshore and onshore works. This permit-to-work system is primarily designed to ensure that maintenance activities are properly planned, risks assessed, and work is carried out by properly trained and qualified individuals. In addition, the permit-to-work system seeks to avoid the execution of multiple works which, if executed at the same time, could result in safety conflict.

4.3.2.3 Monitoring and Control

The WTGs are designed to operate without attendance by any operators. Continuous monitoring is conducted using a supervisory control and data acquisition (SCADA) system from a remote location. Examples of parameters that are monitored include temperature limits, vibration limits, current limits, voltage, smoke detectors, etc. The WTG also includes self-protection systems that will be activated if the WTG is operated outside its specifications or the SCADA system fails. These self-protection systems may curtail or halt production or disconnect from the grid.

While the final SCADA architecture is not finalized at this time, it is likely that that the several SCADA systems will be utilized, for example:

- WTG SCADA
- ESP SCADA
- Onshore Substation SCADA
- Other SCADA's

Monitoring of WTG

Vineyard Wind and the selected turbine manufacturer shall be responsible for the 24/7 operation and monitoring of the WTGs. This shall be executed by utilizing both the Vineyard Wind O&M Facilities and the 24/7 control center of the shareholder companies (for example, Iberdrola/Avangrid has a US-based 24/7 renewables control center capable of providing support).

Monitoring of Weather and Sea

Vineyard Wind will appoint a competent contractor to provide regular weather forecasts. This forecast shall cover key parameters, including meteorological parameters, such as wind, temperature, visibility, and warnings (e.g., lightning), and oceanographic parameters, such as wave conditions. In addition, it is likely that a small weather station, with wind and temperature sensors, will be installed on the ESPs to provide operations personnel an indication of real-time conditions offshore to support the planning and execution of work.

Communications

A dedicated communications system will be implemented for the Project; this system will primarily be designed to facilitate voice communications within the wind farm. The communications system will be designed to provide coverage within WTGs and the ESP.

In addition to this dedicated system, normal marine and aviation communications channels would be utilized for the respective logistics options (e.g., marine VHF for ships).

Standard emergency channels will also be available.

Emergency protocols will be in place for both the installation and O&M phase and will be developed as part of the SMS. The emergency protocols will include steps for external stakeholders such as the USCG and fishermen to alert Vineyard Wind of concerns related to the Project 24/7. Vineyard Wind will review draft emergency protocols with the USCG, fishermen, and other stakeholders, as relevant, prior to finalizing the SMS.

4.3.3 Non-routine Operating Procedures/Unscheduled Maintenance

Subject to sufficiently implementing preventive maintenance, corrective maintenance should be minimized. Analysis and interrogation of SCADA data and, in particular, condition monitoring systems are essential to potentially identify equipment failures in advance.

The key aims of corrective maintenance will be to:

- Minimize downtime of the Project;
- Minimize cost incurred during intervention and revenue loss; and
- Determine the root cause in order to limit potential repetition of failure event.

Corrective maintenance will, however, be required. By its nature, corrective maintenance is difficult to accurately predict. As such, being adequately prepared for corrective maintenance is key. Key preparations in order to affect corrective maintenance center on the following items:

Spare Part Availability

It is envisioned that a stock of recommended spare parts will be purchased along with the major components (e.g., WTGs, ESPs, onshore substation, cables, etc.). This stock would be based on OEM recommendations; however, it is likely that Vineyard Wind may request additional items based on its own experience.

Thereafter, Vineyard Wind, together with its contractors and service providers, will constantly monitor the use of spare parts in order to maintain recommended stock levels and, where applicable, increase stock levels and or purchase additional parts as deemed necessary.

Smaller spare parts and consumables will be stored at Vineyard Wind's O&M Facilities, while larger spare parts are likely to be stored at either the OEM facilities or other storage facilities, as required.

Workforce Availability

Given the fact that the Massachusetts economy includes significant marine industries and a strong engineering and technology component, an ample workforce is expected to be available. In addition, the rest of the US has a significant renewable energy and offshore oil and gas sector, the skills for which are readily transferable to the offshore wind industry.

While initially some Project works may have to be supported from the European or global supply chain, the local supply chain and workforce are expected to develop quickly. For addition discussion of workforce implications of the Project, see Sections 7.1.2.1.1 and 7.1.2.2.1 of Volume III.

Site Accessibility (i.e., weather conditions)

It is possible that a significant number of issues will be able to be addressed remotely (i.e., a remote reset), and it is envisioned that such remote repairs will be the most common form of corrective repair.

Corrective events which require a physical intervention offshore, will utilize the extensive metocean information described in Volume II to ensure safe and effective maintenance work.

The worst-case scenario, with respect to corrective maintenance, is to have a major component failure (i.e., gearbox, blades, transformer). In this event, a potentially significant period of downtime could be experienced for a portion of the Project.

As such, Vineyard Wind will work to maintain good in-house knowledge of component failure rates, maintenance requirements for such failures, repair periods, and spare part requirements. This allows Vineyard Wind to develop well-founded procedures which can be executed for corrective maintenance.

4.3.4 Vessels, Vehicles, and Aircraft

During operations and maintenance, many of the vessels used during construction (see Table 4.2-1) will be used for daily visits to the WDA, maintenance activities, and periodic significant repairs. Table 4.3-2 summarizes the anticipated annual vessel activity during the O&M period. On average, there will be fewer than three vessel trips per day during the Project's operational period.

Table 4.3-2 Annual Vessel Use during O&M

O&M Activity	Vessel Type	Description of Anticipated Vessel Activities	Annual Round Trips
Scour Protection Repairs			
Scour Protection Repair	Fall Pipe Vessel	One trip every 1.5 years, 2 days per trip	0.7
ESP O&M			
Refueling Operations to ESP	Crew Transfer Vessel or Multipurpose Support Vessel	One trip per year, 1 day per trip	1
WTG O&M			
WTG Transport	Heavy Cargo Vessel and/or Deck Carrier	One trip every 3 years	0.3
Main Repair Vessel	Jack-up Vessel	One trip every 1.5 years, 5 days per trip	0.7
Gearbox Oil Change	Crew Transfer Vessel or Multipurpose Support Vessel	Approximately one trip per WTG (In years 5, 13 and 21)	110
Ad Hoc Survey Work	Multi-role Survey Vessel	Up to 100 surveys over the Project's lifespan, 2 days per trip	3.3
Cable Inspection/Repairs			
Cable Inspection/Repair	Multi-role Survey Vessel	Eight surveys over the Project's lifespan, 20 days per trip (Years 1,2,3,6,9,12,15, and 20)	1
Daily and Miscellaneous O&M Scenario 1 (CTV Concept)			
Daily Crew Transfer	Crew Transfer Vessel	One trip per day for approximately 70% of the year (~256 days)	256
Daily Crew Transfer	Crew Transfer Vessel	One trip per day for approximately 70% of the year (~256 days)	256
Daily Crew Transfer	Crew Transfer Vessel	One trip per day for approximately 70% of the year (~256 days)	256
Miscellaneous Repairs	Multipurpose Support Vessel	One trip every 3 years, 10 days per trip	0.3
Marine Mammal Observations	Crew Transfer Vessel/Fishing Vessel	One trip per year, 5 days per trip	1
Guard Vessels	Crew Transfer Vessel/Fishing Vessel	One trip every 1.5 years, 7 days per trip	0.7
OR Daily and Miscellaneous O&M Scenario 2 (SOV Concept)			
Service Operation Vessel (SOV)	Multipurpose Support Vessel	One round trip every two weeks, lasting approximately two weeks each	26
Daily Crew Transfer from SOV	Crew Transfer Vessel	One trip per day for approximately 70% of the year (~256 days))	256
Marine Mammal Observations	Crew Transfer Vessel/Fishing Vessel	One trip per year, 5 days per trip	1
Guard Vessels	Crew Transfer Vessel/Fishing Vessel	One trip every 1.5 years, 7 days per trip	0.7
Total Annual Round Trips for O&M Vessels			**401 - 887**

As noted in Section 3.2.6, helicopters may be used to supplement crew transport and for Project support during the O&M period.

4.4 Decommissioning & Site Clearance Procedures

4.4.1. Decommissioning Plan Requirements

BOEM's decommissioning requirements are stated in Section 13, "Removal of Property and Restoration of the Leased Area on Termination of Lease," of the April 15, 2015 Lease for Area OCS-A 0501. Unless otherwise authorized by BOEM, pursuant to the applicable regulations in 30 C.F.R. Part 585, Vineyard Wind is required to "remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by activities on the leased area, including any project easements(s) within two years following lease termination, whether by expiration, cancellation, contraction, or relinquishment, in accordance with any approved SAP, COP or approved Decommissioning Application and applicable regulations in 30 CFR Part 585."

4.4.2. Decommissioning Time Horizon

The WTGs, ESPs, the supporting cabling, and the onshore substation infrastructure will be robustly designed and carefully maintained. As is typical of utility-grade generation and transmission infrastructure, the Project's equipment is expected to have a physical life expectancy of up to 30 years.

The first commercial-scale European offshore wind energy installation was constructed in 1991. Approximately 13,000 MW of offshore wind capacity has been installed in European waters over the past 25 years, and with a single exception,[18] all of this capacity remains in commercial operation. Accordingly, the following discussion outlines decommissioning procedures and methods that would be most appropriate given today's technology. However, it is reasonable to expect that by the end of the Lease term and beyond, experience in the European offshore wind industry and, more generally, technological advances in methods and equipment servicing the offshore industry, may result in some increased level of efficiencies as well as a reduced level of environmental impacts.

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18 In March of 2017, DONG Energy announced that it would be decommissioning the 1991 vintage Vindby (Denmark) project. The Vindby project consists of eleven 0.45 MW turbines (5 MW total) located in shallow waters a few kilometers off the southeast coast of Denmark. One of the 54 m high turbines will be displayed at the "Energimussett" (Danish Museum of Energy). The other turbines will be used for spare parts for other projects or recycled. The concrete foundations will be broken down using demolition shears.

4.4.3 General Decommissioning Concept

Before ceasing operation of individual WTGs or the entire Project and prior to decommissioning and removing Project components, Vineyard Wind will consult with BOEM and submit a decommissioning plan for review and approval. Upon receipt of the necessary BOEM approval and any other required permits, Vineyard Wind would implement the decommissioning plan to remove and recycle equipment and associated materials.

As currently envisioned, the decommissioning process is essentially the reverse of the installation process. Decommissioning of the Project is broken down into several steps:

- Retirement in place or removal of offshore cable system (e.g., 66 kV inter-array and 220 kV offshore export cables).
- Dismantling and removal of WTGs.
- Cutting and removal of monopile foundations (and/or jackets) and removal of scour protection.
- Removal of ESPs.
- Possible removal of onshore export cables.

It is anticipated that the equipment and vessels used during decommissioning will likely be similar to those used during construction and installation. For offshore work, vessels would likely include cable laying vessels, crane barges, jack-up barges, larger support vessels, tug boats, crew transfer vessels, and possibly a vessel specifically built for erecting WTG structures.

For onshore work, subject to discussions with the host town(s) on the decommissioning approach that best meets the host town's needs and has the fewest environmental impacts, the onshore cables, the concrete encased duct bank itself, and vaults would be left in place for future reuse as would elements of the onshore substation and grid connections. If onshore cable removal is determined to be the preferred approach, removal of cables from the duct bank would likely be done using truck mounted winches, cable reels and cable reel transport trucks.

4.4.4 Decommissioning Plan and Procedures

The offshore cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies on the preferred approach to minimize environmental impacts. If removal is required, the first step of the decommissioning process would involve disconnecting the inter-array 66 kV cables from the WTGs. Next, the inter-array cables would be pulled out of the J-tubes or similar connection and extracted from their embedded position in the seabed. In some places, in order to remove the cables, it may be necessary to jet plow the cable trench to fluidize the sandy sediments covering the cables. Then, the cables will be reeled up onto barges. Lastly, the cable reels will then be transported to the port area for further handling and recycling. The same general process will likely be followed for the 220 kV offshore export cables. If protective concrete mattresses or rocks were used for portions of the cable run, they will be removed prior to recovering the cable.

Prior to dismantling the WTGs, they would be properly drained of all lubricating fluids, according to the established operations and maintenance procedures and the OSRP. Removed fluids would be brought to the port area for proper disposal and / or recycling. Next, the WTGs would be deconstructed (down to the transition piece at the base of the tower) in a manner closely resembling the installation process. The blades, rotor, nacelle, and tower would be sequentially disassembled and removed to port for recycling using vessels and cranes similar to those used during construction. It is anticipated that almost all of the WTG will be recyclable, except possibly for any fiberglass components.

After removing the WTGs, the steel transition pieces and foundation components would be decommissioned. Sediments inside the monopile could be suctioned out and temporarily stored on a barge to allow access for cutting. The foundation and transition piece assembly is expected to be cut below the seabed in accordance with the BOEM's removal standards (30 C.F.R. 250.913). The portion of the foundation below the cut will likely remain in place. Depending upon the available crane's capacity, the foundation/transition piece assembly above the cut may be further cut into several more manageable sections to facilitate handling. Then, the cut piece(s) would then be lifted out of the water and placed on a barge for transport to an appropriate port area for recycling.

The steel foundations would likely be cut below the mudline using one or a combination of: underwater acetylene cutting torches, mechanical cutting, or a high pressure water jet. The sediments previously removed from the inner space of the pile would be returned to the depression left once the pile is removed. To minimize sediment disturbance and turbidity, a vacuum pump and diver or ROV-assisted hoses would likely be used.

As described in Section 3.1.3, each of the WTGs and ESPs would have stone and/or rock scour protection. Vineyard Wind would propose that the scour protection be removed. The stone and/or rock would likely be excavated with a dredging vessel, set on a barge, and transported to shore for reuse or disposal at an onshore location.

The ESPs will be disassembled in a similar manner as the WTGs, using similar vessels. Prior to dismantling, the ESP would be properly drained of all oils, lubricating fluids, and transformer oil according to the established operations and maintenance procedures and OSRP. Removed fluids would be brought to the port area for proper disposal and / or recycling. Similarly, any SF6 in gas insulated switchgear would be carefully removed for reuse. Before removing the ESPs, the 220 kV offshore export cables would be disconnected from the ESP and removed, as discussed for inter-array cables above.

The substation platform itself would then be removed from its supporting monopile or jacket foundation, and placed on a barge for transport to port. Depending on the crane capacity available and design of the substation, some of the major electrical gear could be removed first, followed by the platform itself. The ESP foundation piles will likely be removed according to the same procedures used in the removal of the WTG foundations described above.

During decommissioning activities, a careful inventory of all Project components to be removed would be made. This inventory would include the WTGs, ESPs, foundations, offshore export cables, inter-array cables, inter-link cables, cable protection system, and so forth. As they are removed from the site, Project components would be counted and noted as removed in the inventory. This careful reporting system will ensure that all Project components are removed. No additional site clearance work or surveys are anticipated to be required to confirm site clearance.

The environmental impacts from these decommissioning activities would be generally similar to the impacts experienced during construction.

As noted above, the extent of the decommissioning of onshore components, such as the onshore export cable, will be determined in consultation with the host towns, as many of the onshore components could be retired in place or retained for future use. If decommissioning of the Landfall Site, transition vault, and onshore export cable components is required, the process will consist of pulling the cables out of the duct bank, loading them onto truck-mounted reels, and transporting them offsite for recycling or possible reuse. The splice vaults, conduits, and duct banks will likely be left in place, available for reuse. This approach will avoid disruption to the streets.

In addition, decommissioning of the offshore facilities would require the involvement of an onshore recycling facility with ability to handle the large quantities of steel and other materials from the Project. Such facilities currently in operate in New England. One example is the Prolerized New England, Inc. facility on Boston Harbor in Everett Massachusetts. The Everett facility is located in a heavy industrial area and has deep water access, allowing for the foundations, WTGs, and other large components to be directly offloaded from the barges, cut into manageable sections, shredded into smaller pieces, and then shipped to end-users as scrap metal. This facility also routinely handles large volumes of scrap metal from auto recycling and a variety of demolition projects.

Currently, the fiberglass in the rotor blades has no commercial scrap value. Consequently, it is anticipated that the fiberglass from the blades would be cut into manageable pieces and then disposed of at an approved onshore solid waste facility.

Section 5.0

Regulatory Framework

5.0 REGULATORY FRAMEWORK

Table 5-1 below lists the expected federal, Massachusetts, regional (county), and local level reviews and permits for the Project. Filing dates are provided for those permit applications or review documents that have already been submitted.

Table 5-1 Required Environmental Permits for the Project

Agency/Regulatory Authority	Permit/Approval	Status
Federal		
Bureau of Ocean Energy Management	Site Assessment Plan ("SAP") approval	SAP filed March 31, 2017, deemed complete and sufficient November 21, 2017. SAP approved May 2018.
	Construction and Operations Plan ("COP") approval	COP filed with BOEM December 19, 2017.
	National Environmental Policy Act (NEPA) Environmental Review	Draft Environmental Impact Statement (DEIS) published in the Federal Register December 7, 2018.
	Consultation under Section 7 of the Endangered Species Act with National Marine Fisheries Service and US Fish and Wildlife Service, coordination with states under the Coastal Zone Management Act, government-to-government tribal consultation, consultation under Section 106 of the National Historic Preservation Act, and consultation with National Marine Fisheries Service for Essential Fish Habitat (EFH).	To be initiated by BOEM.
US Environmental Protection Agency	National Pollutant Discharge Elimination System ("NPDES") General Permit for Construction Activities	To be filed ("TBF") immediately before start of construction.
	Outer Continental Shelf Air Permit	Notice of Intent ("NOI") to apply for an air permit filed on December 11, 2017. Permit application submitted August 17, 2018. Supplemental Air Operating Permit Application filed April 18, 2019. Draft OCS Air Permit issued June 28, 2019.

Table 5-1 Required Environmental Permits for the Project (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
Federal		
US Army Corps of Engineers	Individual Clean Water Act Section 404 (Required for side-casting of dredged material and placement of foundations, scour protection, and cable protection) Rivers and Harbors Act of 1899 Section 10 Permit (Required for all offshore structures and dredging activities)	Joint permit application submitted November 27, 2018.
US National Marine Fisheries Service	Marine Mammal Protection Act (MMPA) Authorization/ Incidental Harassment Authorization (IHA)/Letter of Authorization (LOA)	NMFS concurrence that no Incidental Harassment Authorization (IHA) required for 2017 survey activities received March 9, 2017. NMFS concurrence that no IHA required for 2018 survey activities received February 28, 2018. IHA request for pile-driving activities submitted September 7, 2018 and an updated version was filed on January 16, 2019. Draft IHA issued April 30, 2019..
US Coast Guard	Private Aids to Navigation authorization	TBF
Federal Aviation Administration	No Hazard Determination	TBF
State/Massachusetts (for portions of the project within state jurisdiction)		
Massachusetts Environmental Policy Act Office	Certificate of Secretary of Energy and Environmental Affairs on Final Environmental Impact Report	Environmental notification form ("ENF") filed on December 15, 2017. Secretary's Certificate on ENF issued on February 9, 2018. Draft Environmental Impact Report ("DEIR") filed on April 30, 2018.Secretary's Certificate on DEIR issued on June 15, 2018. Supplemental Draft Environmental Impact Report (SDEIR) filed on August 31, 2018. Secretary's Certificate on SDEIR issued on October 12, 2018. Final Environmental Impact Report (FEIR) filed December 17, 2018. Secretary's Certificate on FEIR issued on February 1, 2019.

Table 5-1 Required Environmental Permits for the Project (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
State/Massachusetts (for portions of the project within state jurisdiction)		
Massachusetts Energy Facilities Siting Board	G.L. ch. 164, § 69 Approval	Petition filed December 18, 2017; evidentiary hearings completed October 26, 2018; briefs filed November and December 2018. Final decision issued May 10, 2019. Petition for a Certificate of Environmental Impact and Public Interest filed July 24, 2019. Decision is expected by Spring 2020.
Massachusetts Department of Public Utilities	G.L. ch. 164, § 72, Approval to Construct G.L. ch. 40A, § 3 Zoning Exemption (if needed)	Section 72 and Section 40A petitions were filed with the DPU on February 15, 2018, together with a request for consolidated review by EFSB, which was granted on April 5, 2018. Final decision issued May 10, 2019.
	Regulatory approval of the long-term power purchase contracts between Vineyard Wind and Massachusetts' electric distribution companies for Vineyard Wind 1	Approved April 12, 2019.
Massachusetts Department of Environmental Protection	Chapter 91 Waterways License and Dredge Permit; Water Quality Certification (Section 401 of the Clean Water Act)	Joint Chapter 91 and Water Quality Certification application filed January 18, 2019. WQC issued July 31, 2019. Draft Chapter 91 License issued August 12, 2019.
	Approval of Easement (Drinking Water Regulations)[19]	Easement not required for Covell's Beach route (TBF should the New Hampshire Avenue Route be selected).
	Superseding Order of Conditions (Barnstable)	Issued July 18, 2019.
	Superseding Order of Conditions (Edgartown)	Issued August 5, 2019.

19 Required because the onshore route may pass through a Zone I area

Table 5-1 Required Environmental Permits for the Project (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
State/Massachusetts (for portions of the project within state jurisdiction)		
	Adjudicatory Appeal of Superseding Order of Conditions issued for Barnstable Adjudicatory Appeal of Superseding Order of Conditions issued for Edgartown	Final Decision dismissing appeal issued January 15, 2020 Settlement Agreement signed September 18, 2019, and Final Decision incorporating Settlement Agreement and Final Order of Conditions issued October 1, 2019.
Massachusetts Department of Marine Fisheries (DMF)	Letter of Authorization and/or Scientific Permit (for surveys and pre-lay grapnel run)	TBF
Massachusetts Department of Transportation	Non-Vehicular Access Permits	Permit application filed July 1, 2019. Issued December 23, 2019.
	Rail Division Use and Occupancy License	Not required for Covell's Beach route (TBF should the New Hampshire Avenue route be selected).
Massachusetts Board of Underwater Archaeological Resources	Special Use Permit	Provisional permit issued May 23, 2017, final permit issued September 28, 2017 and extended on September 28, 2018
Natural Heritage and Endangered Species Program	Conservation and Management Permit (if needed)	MESA Project Review Checklist submitted December 17, 2018; TBF (if needed). Determination that the Project will not result in an adverse impact to Resource Area Habitats and will not result in a prohibited Take pursuant to MESA issued May 14, 2019.
Massachusetts Historical Commission	Field Investigation Permits (950 C.M.R. § 70.00)	Reconnaissance survey permit application filed November 14, 2017 and approved. Permit to Conduct Archaeological Field Investigation issued September 28, 2018; field investigation at substation site completed November 2, 2018; final report submitted to MHC on January 3, 2019 (no further investigations recommended). Permit amended on March 5, 2020 to conduct a supplemental field investigation at expanded substation site.

Table 5-1 Required Environmental Permits for the Project (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
State/Massachusetts (for portions of the project within state jurisdiction)		
Massachusetts Office of Coastal Zone Management Rhode Island Coastal Resources Management Council	Federal Consistency Determination (15 CFR 930.57)	Joint MA/RI consistency certification filed on April 6, 2018. RI Consistency Determination received on Feb 26, 2019. MA Consistency Determination received on May 22, 2020.
Regional (for portions of the project within regional jurisdiction)		
Cape Cod Commission (Barnstable County)	Development of Regional Impact Review	DRI filed on February 8, 2019. Full Commission voted to approve the Project May 2, 2019, and Final Decision was issued May 2, 2019.
Martha's Vineyard Commission	Development of Regional Impact Review	Referral from Edgartown Conservation Commission to MVC occurred on December 27, 2018; DRI filed January 23, 2019. Full Commission voted to approve the Project May 2, 2019. Final Decision was issued May 16, 2019.
Local (for portions of the project within local jurisdiction)		
Barnstable Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	Filed April 24, 2019. Barnstable Order of Conditions issued May 23, 2019. Superseding Order of Conditions affirming approval issued July 18, 2019. MassDEP Adjudicatory Appeal initiated by appellant August 1, 2019 and dismissed January 15, 2020.
Barnstable DPW and/or Town Council	Street Opening Permits/Grants of Location	TBF; addressed in October 3, 2018 Host Community Agreement (HCA) with Barnstable.
Barnstable Planning/Zoning	Zoning approvals as necessary	TBF; exemption from zoning requested in EFSB filing; addressed in October 3, 2018 HCA with Barnstable.
Yarmouth Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	Not required for Covell's Beach route (TBF should the New Hampshire Avenue Route be selected).
Yarmouth DPW and/or Board of Selectmen	Street Opening Permits/Grants of Location	Not required for Covell's Beach route (TBF should the New Hampshire Avenue Route be selected).
Yarmouth Planning/Zoning	Zoning approvals as necessary	Not required for Covell's Beach route (TBF should the New Hampshire Avenue Route be selected).

Table 5-1 Required Environmental Permits for the Project (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
Local (for portions of the project within local jurisdiction)		
Edgartown Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	Filed December 26, 2018, with denial issued July 18, 2019. Superseding Order of Conditions issued August 5, 2019. MassDEP Adjudicatory Appeal initiated by appellant August 19, 2019 with Settlement Agreement signed September 18, 2019 and Final Decision issued October 1, 2019.
Nantucket, Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws) (if needed as dictated by final submarine route)	Filed January 18, 2019 (applicable to eastern route through Muskeget Channel only). Nantucket Order of Conditions issued March 21, 2019.

A copy of the Coastal Zone Management Act Consistency Certification is included as Attachment III-P.

Section 6.0

Agency Contacts and Stakeholder Coordination

6.0 AGENCY CONTACTS AND STAKEHOLDER COORDINATION

Vineyard Wind has been actively consulting with BOEM, federal and state agencies, the Martha's Vineyard and Cape Cod Commission ("CCC"), and affected municipalities and federally-recognized tribes regarding Project status, planned studies, issues of concern, and related matters. In addition to regular BOEM consultations, Project representatives have met with a group of senior officials from the Massachusetts Executive Office of Energy and Environmental Affairs ("EEA") agencies, the Massachusetts Energy Facilities Siting Board ("MA EFSB") Director and senior staff, the Massachusetts "Ocean Team" agencies, the Massachusetts Department of Transportation, and the US Environmental Protection Agency ("EPA") Region 1 air quality team beginning in the spring of 2017. A list of meetings conducted to date with BOEM, other agencies, municipalities, and tribes through July 2018 is provided in Table 6-1.

Following the submittal of filings in December 2017, there have been and will continue to be a number of agency convened public hearings and informational meetings. These include BOEM/National Environmental Policy Act scoping sessions, MA EFSB public statement hearing(s), and a MEPA "on-site" consultation session.

Table 6-1 Consultations with Agencies, Tribes, and Municipalities

Date	Group	Topic
April 2015	MA Task Force Meeting: BOEM, MassCEC, MA CZM, Tribes, Municipalities, USCG	General project information and updates
October 2015	Cape Light Compact Board (municipal aggregator representing 23 towns on the Cape & Islands), including representatives from: Aquinnah, Barnstable, Barnstable County, Bourne, Brewster, Chatham, Chilmark, Dennis, Dukes County, Eastham, Edgartown, Falmouth, Harwich, Mashpee, Oak Bluffs, Orleans, Provincetown, Sandwich, Tisbury, Truro, Wellfleet, West Tisbury, Yarmouth	General project information and updates
October 2015	Martha's Vineyard All-Island Selectmen's Meeting	General project information and updates
January 2016	Public Meeting: EEA, MassCEC, BOEM	Assessment activities for future offshore wind projects in Federal wind lease areas
June 2016	BOEM	Pre-survey meeting
June 2016	Mashpee Wampanoag Tribe-Tribal Historic Preservation Officer ("THPO")	Project introduction
June 2016	Wampanoag Tribe of Gay Head-THPO	General project introduction
July 2016	BOEM	Survey coordination

Table 6-1 Consultations with Agencies, Tribes, and Municipalities (Continued)

Date	Group	Topic
July 2016	Chilmark Board of Selectmen	General project information and updates including survey planning
July 2016	Edgartown Board of Selectmen	General project information and updates including survey planning
July 2016	Narragansett Indian Tribe-THPO	Pre-survey meeting
July 2016	Oak Bluffs Board of Selectmen	General project information and updates including survey planning
July 2016	Wampanoag Tribe of Gay Head and Mashpee Wampanoag Tribe-THPOs	Pre-survey meeting
July 2016	West Tisbury Board of Selectmen	General project information and updates including survey planning
August 2016	Aquinnah Board of Selectmen	General project information and updates including survey planning
August 2016	Martha's Vineyard Commission: Executive Director	General project information and updates including survey planning
August 2016	Wampanoag Tribe of Gay Head – Tribal Council	General project information and updates including survey planning
September 2016	Tisbury Board of Selectmen	General project information and updates including survey planning
November 2016	MA CZM and Massachusetts Clean Energy Center ("MassCEC")	Update on local outreach
November 2016	Public Meeting: EEA, MassCEC, BOEM	Assessment activities for future offshore wind projects in Federal wind lease areas
December 2016	CCC	Project introduction
December 2016	Nantucket Board of Selectmen (2 meetings)	Project introduction, meeting was broadcasted on local TV
January 2017	Falmouth: Selectman, Assistant Town Manager, Town Manager, DPW	Project overview
March 2017	Barnstable: Town Manager, Assistant Town Attorney	Project overview and cable route discussion
March 2017	BOEM	Review study plans
March 2017	MA EFSB, EEA	Pre-permitting meeting
March 2017	Yarmouth: Town Manager, DPW Director	Project overview and cable route discussion
April 2017	BOEM (2 days)	COP preparation
April 2017	BOEM, National Oceanic and Atmospheric Administration, National Marine Fisheries Service ("NMFS"), Massachusetts Division of Marine Fisheries ("MA DMF")	Project overview and reviewed existing site data provided by Vineyard Wind and additional data provided by NMFS.

Table 6-1 Consultations with Agencies, Tribes, and Municipalities (Continued)

Date	Group	Topic
April 2017	Mashpee: Town Manager, DPW Director, Conservation Agent	Project overview and cable routing
April 2017	Massachusetts Ocean Team (CZM, MEPA Office, MA DMF, Massachusetts Department of Environmental Protection ["MA DEP"], Massachusetts Bureau of Underwater Archaeology)	Cable survey work
May 2017	Army Corps of Engineers (USACE)	Project update and permitting planning
May 2017	BOEM	Review Certified Verification Agent ("CVA") requirements
May 2017	BOEM	Pre-survey meeting
May 2017	MA and RI Joint Task Force Meeting: BOEM, MassCEC, MA Coastal Zone Management ("MA CZM"), Tribes, Municipalities, US Coast Guard("USCG")	Project update
May 2017	Martha's Vineyard Commission: Executive Director	Project update
May 2017	Tisbury Board of Selectmen	Project overview, update
May 2017	US Fish and Wildlife Service ("USFWS") and BOEM (Avian Study Plan)	Project update and reviewed study plans and available data
June 2017	Barnstable: Town Manager, Assistant Town Manager, Director of the Growth Management Dept., and Assistant Town Attorney	Project update and cable route discussion
June 2017	BOEM	COP preparation
June 2017	Chilmark Board of Selectmen	Project update and survey planning
June 2017	Edgartown Board of Selectmen	Project update and survey planning
June 2017	MA EFSB	Pre-permitting meeting
June 2017	Nantucket Board of Selectmen	Project update and cable route discussion
June 2017	Nantucket: DPW Director	Project update and cable route discussion
June 2017	Nantucket: Wastewater Treatment Director, Town Energy Manager	Project update and cable route discussion
June 2017	USCG	Project update and review draft project layout
June 2017	West Tisbury Board of Selectmen	Project update and survey planning
June 2017	Yarmouth: Town Manager, DPW Director	Project update and cable route discussion
July 2017	Aquinnah Board of Selectmen	General project information and updates including survey planning
July 2017	BOEM	COP preparation

Table 6-1 Consultations with Agencies, Tribes, and Municipalities (Continued)

Date	Group	Topic
July 2017	MA CZM	Survey planning
July 2017	MA DMF and MA CZM	Discussion on available data on fishing areas and gear types
July 2017	Oak Bluffs Board of Selectmen	Project update and survey planning
July 2017	Ocean Team (EEA, MA DEP, MA DMF, MA CZM)	Project update and survey planning
August 2017	BOEM	Review CVA scope
August 2017	EPA	Discuss Outer Continental Shelf Air Permit
August 2017	Mashpee Wampanoag Tribe (THPO)	Project update, survey planning, preliminary upland routing discussion
August 2017	USFWS, BOEM	Project update and avian discussion on COP needs
September 2017	BOEM	COP preparation
September 2017	MA DMF	Discussion on available data on fishing areas and gear types
September 2017	Massachusetts Department of Transportation, Highway and Rail Divisions	Project routing and construction techniques
September 2017	Nantucket Board of Selectmen	Project update, Section 106, visual impact assessment process and input request
September 2017	Nantucket: Rotary Club	Project update, visualizations, Section 106
September 2017	Rhode Island Department of Environmental Management, Division of Marine Fisheries	Discussion on available data on fishing areas and gear types and feedback on lessons learned for communication during construction.
September 2017	Nantucket	Visual impact assessment public meeting and request for input
October 2017	Barnstable Town Council	Project update and cable route discussion
October 2017	Barnstable: Town Manager, Director of Growth Management, Asst. Town Attorney, Asst. Town Manager, Leisure Service Director, Conservation Admin, Harbormaster, Department of Public Works ("DPW") Director, Dir. Of Community Services, Town Attorney, Assessing Dept. Director	Project update and cable route discussion
October 2017	BOEM (4+ meetings)	COP preparation
October 2017	Martha's Vineyard Commission: Executive Director, Regional Planner, Coastal Planner, Administrative Assistant	Project Update

Table 6-1 Consultations with Agencies, Tribes, and Municipalities (Continued)

Date	Group	Topic
October 2017	Nantucket: DPW Director	Project update
October 2017	Nantucket: Land Bank	Project introduction
October 2017	Nantucket: Planning and Economic Development Council	Project introduction
October 2017	Nantucket: Wannacomet Water Company	Project update
October 2017	NMFS - Fisheries division	Survey update and COP needs
October 2017	NMFS - Office of Protected Resources (ORP)	Incidental Harassment Authorization (IHA)
October 2017	USCG, BOEM	Navigation Risk Assessment discussion
October 2017	Yarmouth Board of Selectmen	Project update
October 2017	BOEM	Visual impact assessment preparation and alignment on key observation points
November 2017	Aquinnah Board of Selectmen	Project update
November 2017	BOEM	COP preparation
November 2017	Martha's Vineyard Commission: Full Commission	Project update
November 2017	Mashpee Wampanoag Tribe (THPO)	Discuss upland route and visual simulations
November 2017	Mashpee Wampanoag Tribe-THPO	Discuss upland route and visual simulations
November 2017	Oak Bluffs Board of Selectmen	Project update
November 2017	Ocean Team (EEA, MassDEP, DMF, CZM, MEPA)	Project update
November 2017	Tisbury Board of Selectmen	Project update – letter of support request
November 2017	US Navy	Project update, discussion for COP
November 2017	Yarmouth Board of Selectmen	Public Hearing
November 2017	Nantucket: Madaket Matters, Madaket Residents Association	Project update, visual impact assessment process, Section 106
December 2017	BOEM (3+ meetings)	COP preparation
December 2017	Chilmark Board of Selectmen	Project update
December 2017	Edgartown Board of Selectmen	Project update
December 2017	MA EFSB	Pre-permitting meeting
December 2017	Nantucket Board of Selectmen	Project update
December 2017	West Tisbury Board of Selectmen	Project update
December 2017	Yarmouth: Department Heads	Project Update
January 2018	BOEM	COP survey discussion
January 2018	EPA	OCS Air Permit
January 2018	Mashpee Wampanoag Tribe (THPO)	Project update

Table 6-1 Consultations with Agencies, Tribes, and Municipalities (Continued)

Date	Group	Topic
January 2018	MEPA	Project update
January 2018	MEPA Consultation Sessions (Boston and Hyannis)	Public Meetings
January 2018	MEPA Office & CZM	Project update, ENF comments
January 2018	Rhode Island Coastal Resource Management Council	Project overview, discuss COP
January 2018	Yarmouth: Town Agent, Natural Resources Department	Lewis Bay
January 2018	Yarmouth: Zoning and Planning Officials	Zoning
January 2018	Yarmouth Board of Selectmen (2 meetings)	Project hearing on overview and community agreement
February 2018	Barnstable: Assistant Town Attorney	Project update
February 2018	BOEM (4+ meetings)	COP review discussion, pre-survey meeting (geophysical)
February 2018	Cape Light Compact: staff	Update on project
February 2018	Mashpee Wampanoag Tribe (THPO)	Upland route window survey
February 2018	Mashpee Wampanoag Tribe (THPO)	Pre-survey meeting
February 2018	NMFS, BOEM	Marine mammal discussions and COP
February 2018	USCG, BOEM	Navigation Risk Assessment
February 2018	USFWS, BOEM	Project update and avian discussion
February 2018	Wampanoag Tribe of Gay Head (THPO)	Pre-survey meeting
February 2018	Yarmouth: DNR Officer	Commercial and recreational shell-fishing.
February 2018	Yarmouth: Conservation Commission	Shellfish survey
March 2018	BOEM	Pre-survey meeting (geotechnical)
March 2018	BOEM	Discussion on acoustics
March 2018	BOEM	CVA discussion
March 2018	BOEM (and other federal and state agencies)	Interagency Meeting
March 2018	Marine Mammal Alliance Nantucket (MMAN)	General project information and updates
March 2018	Massachusetts NHESP	ENF Comment Letter
March 2018	Massachusetts Ocean Team (CZM, MEPA, MassDEP, MBUAR, DMF)	2018 survey
March 2018	Nantucket: Energy Committee	Visual simulations presentations, requests for input
March 2018	NMFS, BOEM	Marine mammal discussions and COP
March 2018	Ocean Team (EEA, MassDEP, DMF, CZM, MEPA)	Project update and 2018 survey plan

Table 6-1 Consultations with Agencies, Tribes, and Municipalities (Continued)

Date	Group	Topic
March 2018	Yarmouth Board of Selectmen	Project regulatory update
March 2018	Yarmouth Energy Committee	Project update and discussion
March 2018	Nantucket (3 meetings)	Publicly advertised open house to present visual simulations, Section 106 process, visual impact assessment presentation, and request for input
March 2018	Nantucket Board of Selectmen	Visual simulations presentations
March 2018	Yarmouth Shellfish Dept	Project details and shellfish impacts/mitigation
April 2018	BOEM	COP comments (2 meetings)
April 2018	BOEM (4 meetings [New Bedford, Hyannis, Nantucket, Martha's Vineyard])	Public scoping meetings, visual simulations presented
April 2018	DMF	ENF comment letter
April 2018	EPA (2 meetings)	OCS Air Permit
April 2018	MA EFSB	Site Visit and Public Hearing
April 2018	Massachusetts NHESP	Avian data discussion
April 2018	MEPA	Draft EIR responsiveness to Secretary’s Scope
April 2018	NMFS, BOEM (2 meetings)	Marine mammal discussions, COP, and 2017/2018 survey review
April 2018	USACE	Buoy permit
April 2018	Yarmouth Natural Resources	Project permitting
May 2018	BOEM (2 meetings)	COP and CVA Discussion
May 2018	MA CZM (2 meetings)	Bi-weekly update call
May 2018	NMFS - ORP	IHA
June 2018	BOEM (6+ meetings)	COP discussion
June 2018	BOEM, Section 106 Consulting Groups	Section 106 update and consultation
June 2018	EPA	OCS Air Permit
June 2018	MA CZM (2 meetings)	Bi-weekly update call
June 2018	MA DEP	Project timeline and update, Permitting, considerations
June 2018	MA DMF	Discussion on MA State fishing gear loss procedures
June 2018	Rhode Island Coastal Resource Management Council	Consistency certification discussion
June 2018	Yarmouth Finance Committee	Project overview
July 2018	MA DMF	Discuss eelgrass survey procedures
July 2018	Yarmouth Shellfish Dept, DNR, Aquaculture, Commercial Shellfishermen	Project details

In addition to the consultations described in Table 6-1, extensive and ongoing consultation has been conducted by Vineyard Wind and Vineyard Wind's community partner, Vineyard Power, with key stakeholders. Vineyard Wind conducted outreach on visual impacts and visual simulations on both Martha's Vineyard and Nantucket in August and September of 2017, respectively (see Table 6-1). Notices advertising the meetings were placed in the local newspapers.

The Project also held numerous public events, including five community open houses: November 7, 2017, January 22, 2018, and February 2, 2018 in Hyannis/Barnstable, November 8, 2017 and March 7, 2018 in Yarmouth, all of which were advertised in local papers. In early 2018, Project representatives hosted six office hours sessions (also advertised in local papers, posted in community center bulletin and posted on the Vineyard Wind Website) in Yarmouth on 2/28, 3/2, 3/9, 4/27, 5/18, and 6/1. The Project hosted a community forum for abutters in Barnstable on 3/12, sending out invites to each Barnstable abutter for the event. Vineyard Wind sent a personal letter to Yarmouth abutters in early March 2018 appealing to them to reach out by phone or email, to arrange a time to discuss project details or concerns. Vineyard Wind's fisheries liaison's and representative has also been active in organizing over 100 meetings with fisheries stakeholders.

The following list includes, but is not limited to, the groups Vineyard Wind has been consulting with and continues to meet with:

- Alliance to Protect Nantucket Sound
- Anglers for Offshore Wind
- Association to Preserve Cape Cod
- Bureau of Ocean Energy Management (BOEM)
- Cape and Islands Self-Reliance
- Cape and Vineyard Electrical Cooperative
- Cape Cod Fishermen's Alliance
- Cape Cod Chamber of Commerce
- Cape Cod Climate Change Collaborative
- Cape Cod Community College
- Cape Cod Technology Council
- Cape Light Compact

- Centerville Civic Association
- Climate Action Business Association
- Coalition for Social Justice
- Commercial Fisheries Center of Rhode Island
- Conservation Law Foundation
- Coonamessett Farm Foundation
- Eastern Fisheries
- Environment Massachusetts
- Environmental Business Council of New England
- Environmental League of Massachusetts
- Fishing Partnership Support Services
- Hercules SLR
- Job Training and Employment Corporation, Cape Cod
- KSJ Seafood Inc.
- Long Island Commercial Fishing Association
- MA Fisheries Institute
- MA Fisheries Working Group
- MA Fishermen's Partnership and Support Services
- MA Habitat Working Group
- MA Lobstermen's Association
- Martha's Vineyard Fishermen Preservation Trust
- Massachusetts Audubon Society
- Massachusetts Clean Energy Center
- Nantucket Rotary Club

- National Academies of Sciences, Offshore Renewable Energy Development and Fisheries Conference
- National Wildlife Federation
- Natural Resources Defense Council
- NE Fisheries Sciences Center
- NE Fishery Management Council
- NE Fishery Sector Managers VII, VIII X, XI, XIII
- New Bedford Harbor Development Commission
- New Bedford Port Authority
- New England Aquarium
- New England Energy and Commerce Association
- Port of New Bedford
- Recreational Fishing Alliance
- Responsible Offshore Development Alliance (RODA)
- Rhode Island Fishermen's Advisory Board
- Rhode Island Habitat Advisory Board
- Scallop Industry Advisors Meeting
- Seafreeze
- Sierra Club
- Stoveboat- Saving Seafood
- The Nature Conservancy
- Town Dock
- Unitarian Church of Barnstable Green Sanctuary Committee

- University of Massachusetts (various campuses)
- Woods Hole Oceanographic Institution

Project updates and other information can be found at www.vineyardwind.com. Any interested parties can be added to the Project outreach mailing list by visiting www.vineyardpower.com.

Vineyard Wind plans to maintain an active level of consultation and outreach as the environmental review and permitting processes continue and is available to meet with any interested party (see contact information in Section 1.3.1).

Section 7.0

References and Incorporation by Reference

7.0 REFERENCES AND INCORPORATION BY REFERENCE

United States Department of the Interior, Bureau of Ocean Energy Management. (2015). Commercial lease of submerged lands for renewable energy development on the Outer Continental Shelf, Lease number OCS-A 0501. Retrieved from https://www.boem.gov/Lease-OCS-A-0501/

United States Department of the Interior, Office of Renewable Energy Programs, Bureau of Ocean Energy Management. (2016). Guidelines for information requirements for a renewable energy Construction and Operations Plan (COP), version 3.0. Retrieved from https://www.boem.gov/COP-Guidelines/

Vineyard Wind. (2017). Site Assessment Plan (SAP), Vineyard Wind Lease OCS-A 0501.

Wind Europe. (2017). The European offshore wind industry: Key trends and statistics 2016. Retrieved from https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Offshore-Statistics-2016.pdf

Appendix I-A

Draft Oil Spill Response Plan

DRAFT

OIL SPILL RESPONSE PLAN

for

VINEYARD WIND, LLC

New Bedford, Massachusetts

July 2018

(WTG oil quantities updated January 31, 2020)

A Response Plan Cover Sheet, presenting basic information regarding the Project is provided below:

Response Plan Cover Sheet

Owner/operator of facility:	**Vineyard Wind, LLC**		
Facility name:	**Vineyard Wind**		
Facility mailing address:	**700 Pleasant Street, Suite 510, New Bedford, MA 02740**		
Facility phone number:	**(508) 717-8964**	Latitude:	**N 41.171**
SIC code:	**4911**	Longitude:	**W -70.503**
Dun and Bradstreet number:			
Largest aboveground oil storage capacity (gals):	**76,994 (power transformer)**	Maximum oil storage capacity (gals):	**124,097 (per ESP)**
Number of aboveground oil storage tanks:	**(day tanks and diesel tank)**	Worst case oil discharge amount (gals):	**124,097**

Facility distance to navigable water. Mark the appropriate line:

0-1/4 mile: **X**		1/4-1/2 mile:		1/2-1 mile		> 1 mile:	

Applicability of Substantial Harm Criteria:				
Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity greater than or equal to 42,000 gallons?	**YES**	**X**	NO	
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and, within any storage area, does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation?	YES		**NO**	**X**
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments?	**YES**		**NO**	**X**
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance such that a discharge from the facility would shut down a public drinking water intake?	YES		**NO**	**X**
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil spill in an amount greater than or equal to 10,000 gallons within the last 5 years?	YES		**NO**	**X**

Management Certification

This plan has been developed for the Project to prevent and/or control the spills of oil. Vineyard Wind, LLC herein commits the necessary resources to fully prepare and implement this plan and has obtained through contract the necessary private personnel and equipment to respond, to the maximum extent practicable, to a worst-case discharge or substantial threat of such a discharge.

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and that based on my inquiry of those individuals responsible for obtaining information, I believe that the submitted information is true, accurate and complete.

Signature: ______________________________ Title: ______________________________

Name: ______________________________ Date: ______________________________

Plan Distribution

Plan Number	Plan Holder	Location
1	Qualified Individual	
2	Alternate Qualified Individual	
3	Alternate Qualified Individual	
4	Alternate Qualified Individual	
5	Operation Center	
6	BOEM Gulf of Mexico OCS and Atlantic Activities	1201 Elmwood Park Boulevard New Orleans, LA 70123-2394
7	EPA Region 1	EPA Region 1 Emergency Planning and Response Branch 5 Post Office Square Suite 100 (OSRR02-2) Boston, MA 02114-2023
8	USCG D1	USCG D1 408 Atlantic Avenue Boston, MA 02110

30 CFR 254.30(a): Biennial OSRP Review

Date	Name of Reviewer &Title	Signature

30 CFR 254.30(b): Revision Record

Revision Number	Revision Date	Pages and/or Sections Affected	Description of Revision

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Annex List

List of Acronyms

ACP	Area Contingency Plan
AQI	Alternate Qualified Individual
Bbls	Barrels
BOEM	Bureau of Ocean Energy Management
BSSE	Bureau of Safety and Environmental Enforcement
COP	Construction and Operations Plan
CFR	Code of Federal Regulations
CTV	Crew Transport Vessels
EHS	Environmental, Health, and Safety
EMS	Emergency Management Services
EPA	Environmental Protection Agency
ERT	Emergency Response Team
ESI	Environmental Sensitivity Index
ESP	Electrical service platform
FOSC	Federal On-Scene Coordinator
ICO	Incident Command Organization
ICS	Incident Command System
JIC	Joint Information Center
kV	Kilovolt
LEPC	Local Emergency Planning Committee
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
MEMA	Massachusetts Emergency Management Agency
MOU	Memorandum of Understanding
MVY	Airport code for Martha's Vineyard Airport
MW	Megawatt
NCP	National Contingency Plan
NHESP	National Heritage and Endangered Species Program
NIIMS	National Interagency Incident Management System
NOAA	National Oceanic & Atmospheric Administration
NRC	National Response Center
NWR	NOAA Weather Radio
NWS	National Weather Service
OCS	Outer Continental Shelf
OHM	Oil and Hazardous Materials

O&M	Operation and Maintenance
OPA	Oil Pollution Act of 1990 (Public Law 101-380)
OSHA	Occupational Safety & Health Administration
OSPD	Oil Spill Preparedness Division
OSRO	Oil Spill Response Organization
OSRP	Oil Spill Response Plan
PPA	Power Purchase Agreements
PPE	Personal Protective Equipment
PREP	Preparedness for Response Exercise Program
QI	Qualified Individual
RCRA	Resource Conservation & Recovery Act
REPC	Regional Emergency Planning Committee
RFP	Request for Proposal
RI	Rhode Island
RQ	Reportable Quantity
RRT	Regional Response Team
SDS	Safety Data Sheet
SERC	State Emergency Response Commission
SERO	Southeast Regional Office of Massachusetts Department of Environmental Protection
SOV	Service Operations Vessel
SPCC	Spill Prevention Countermeasures and Control
TBD	To Be Determined
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
Vol	Volume
WCD	Worst Case Discharge
WTG	Wind Turbine Generators

1. Plan Introduction Elements

1.1 Purpose and Scope of Plan Coverage

This Oil Spill Response Plan (OSRP) has been prepared for Vineyard Wind, LLC for the development of "the Project". The Project is located in the Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0501, which is located approximately 14.4 miles south of Martha's Vineyard, a Massachusetts island located approximately 4 miles from mainland Massachusetts. The Project is an 800 MW project that consists of wind turbine generators (WTGs) and associated foundations, onshore work, inter-array and inter-link cables, export cables, and either one 800 MW electrical service platform (ESP) or two 400 MW ESPs. Oil sources in the WTGs include gear boxes, transformers, yaw gears, grease for yaw rings, and the pitch system, which total approximately 4,887 gallons per WTG. Oil sources in the ESPs include lubrication oil, diesel tanks, hydraulic oil for a platform crane, power transformers, reactors, and auxiliary/earthing transformers. Oil sources presented in this document are associated with the single largest ESP, which is the 800 MW ESP. The oil sources associated with one 800 MW ESP total approximately 124,097 gallons.

The Project is located in the Outer Continental Shelf (OCS), as defined by 30 CFR 254.6 and Section 2 of the Submerged Lands Act (43 U.S.C. 1301). Therefore, this plan has been written in accordance with the requirements of 30 CFR Part 254, Subpart B, Oil Spill Response Plans for Outer Continental Shelf Facilities. In accordance with 30 CFR 254, the OSRP demonstrates that Vineyard Wind can respond effectively in the unlikely event that oil is discharged from the Project. Please note that U.S. Environmental Protection Agency's (EPA) Spill Prevention, Control, and Countermeasure (SPCC) requirements in 40 CFR §112 is only required for offshore facilities if they are classified as "oil drilling, production, or workover facilities". Therefore, an SPCC Plan is not required for the Project. In addition, the Commonwealth of Massachusetts does not require planning and response submittals for review and approval with regards to offshore oil.

The purpose of this plan is to provide a written procedure for directing a plan of action in the event of a release or discharge of oil at the Project. The release or discharge may be the result of a spill, accident, natural disaster, or civilian threat. This OSRP adopts procedures to allow for a uniform plan of action that will assist in a systematic and orderly manner of response to the incident. This plan of action will minimize confusion and indecision, prevent extensive damage to the Project or injury to personnel, and minimize exposure to personnel within or outside of the Project. Routine training and exercises regarding the content of this plan will provide the confidence needed for employees to perform their assigned duties if such an event occurs. A designated Qualified Individual (QI) and Alternate Qualified Individuals (AQI) are considered Emergency Coordinators. Personnel, through the use of this plan, will utilize all resources necessary to bring any release under control. In order to prepare for such control, all personnel will be well trained and knowledgeable as to their various roles during a release.

The OSRP has been prepared considering the National Oil and Hazardous Substances Contingency Plan (40 CFR §300) commonly called the National Contingency Plan or NCP, and the Standard Federal Region I Response Team (RRT) Regional Oil and Hazardous Substances Pollution Contingency Plan, which is the ACP. The Regional Oil and Hazardous Substances Pollution Contingency Plan is available at: https://www.nrt.org/sites/38/files/2016%20Regional%20Contingency%20Plan%20Region%201.pdf.

The OSRP is consistent with these plans in that it provides a method/process for communication, coordination, containment, removal, and mitigation of pollution and other emergencies. The preparation of this plan utilized the detailed information and support on local environmental information provided in the RRT plan. The specific guidelines presented in this plan have been carefully thought out, prepared in accordance with safe practices, and are intended to prepare personnel to respond to oil spills and other environmental emergencies. This plan has the full approval of Management at a level of authority to commit the necessary resources to implement this plan.

Specifically, this plan:

- Identifies the Qualified Individuals (QI) or Person in Charge having full authority to implement this response plan;
- Requires immediate communication with the appropriate Federal, state and local officials, and entities/persons providing personnel and equipment;
- Identifies, and ensures by contract or other means, the availability of personnel and equipment necessary to remove a worst-case discharge (WCD) and mitigate or prevent a substantial threat of such a discharge; and
- Describes training, equipment testing, periodic unannounced drills, and response actions.

1.2 Regulatory Applicability

The National Contingency Plan and the Standard Federal Region I Response Team (RRT) Regional Oil and Hazardous Substances Pollution Contingency Plan have been reviewed and this plan was written to comply with the Federal Oil Pollution Act of 1990.

1.3 General Facility Information

The Project is located on property in the Outer Continental Shelf (OCS) leased from the BOEM's WEA, which has been identified as Vineyard Wind Lease Area OCS-A-501. The Lease Area is located approximately 14.4 miles south of the island of Martha's Vineyard, which is located approximately 4 miles off of the southeastern coast of mainland Massachusetts. The Project is depicted in Figure A1-1 through A1-4 (Annex 1). The mailing address of the Project is 700 Pleasant Street, Suite 510, New Bedford, Massachusetts.

The Project consists of wind turbine generators (WTGs) and associated foundations, onshore work, inter-array and inter-link cables, export cables, wind turbines, and electrical service platforms (ESPs). Oil sources in the WTGs include gear boxes, transformers, yaw gears, grease for yaw rings, and the pitch system and total approximately 4,887 gallons per WTG. Oil sources in the ESPs include lubrication oil, diesel tanks, hydraulic oil for a platform crane, power transformers, reactors, and auxiliary/earthing transformers. Oil sources associated with one 800 MW ESP total approximately 124,097 gallons.

Table 1-1 provides general information for the Project as it pertains to planning for potential spills. Annexes 1, 3, and 7 provide discussion of facility operations in greater detail regarding equipment description, drainage, secondary containment and emergency planning scenarios.

1.4 Plan Review and Revision

The July 2018 version of the OSRP is a draft working copy. Additional details will be provided for the OSRP as the size and buildout schedule of the Project are finalized.

In accordance with 30 CFR §254.30, the OSRP must be reviewed at least every two years. Documentation of this review will be provided in the Review Table presented at the front of this OSRP. If the review does not result in modifications to the OSRP, the Chief of the Bureau of Safety and Environmental Enforcement (BSEE), and agency of the US Department of the Interior, should be notified that there are no changes. The BSEE Oil Spill Preparedness Division (Chief, OSPD) or designee must be notified in writing.

The OSRP must be modified and submitted to the Chief, OSPD for approval within 15 days when the following occurs:

- A change occurs which significantly reduces response capabilities;
- A significant change occurs in the worst-case discharge scenario or in the type of oil being handled, stored, or transported at the facility;
- There is a change in the name(s) or capabilities of the oil spill removal organizations cited in the OSRP;
- There is a significant change to the Area Contingency Plan(s) for the region; or
- The Chief, OSPD, requires that you resubmit your OSRP if it has become outdated, numerous revisions have made its use difficult, or if the OSRP has significant inadequacies.

Table 1-1 Facility Summary Information

Facility Owner	Vineyard Wind, LLC
Facility Name	Vineyard Wind
Facility Mailing Address	700 Pleasant Street Suite 510 New Bedford, MA 02740
Facility Qualified Individual	Person X
Facility Phone Number	(508) 717-8964 (New Bedford office)
E-mail Address	info@vineyardwind.com
Latitude	N 41.171
Longitude	W -70.503
SIC Code	4911
Wind Turbine Generators (WTGs)	• WTGs will range from 8 to ~14 MW. • Largest oil source in the WTGs is the gearbox/main bearings: 2,113 gallons • Total oil storage is 4,887 gallons • WTGs are equipped with secondary containment which is sized according with the largest container.
Electrical Service Platforms (ESPs): Emergency Generators	• Emergency Generators contain diesel day tanks and lubrication oil totaling 1,018 gallons • Largest oil source in the generator is the diesel day tank: 1,004 gallons.
ESP: Diesel Tank	• Diesel storage tank: 4,463 gallons
ESP: Transformers	• ESP will have power transformers and auxiliary/earthing transformers • Total oil storage is 79,226 gallons • Largest oil source is power transformers: 76,994 gallons
ESP: Reactors	• Reactors: 39,055 gallons
ESP: Other	• Hydraulic oil for platform crane: 174 gallons
Operation and Maintenance Center	• Vineyard Haven and/or New Bedford
Materials Stored / Oil Storage Start-Up Date	Petroleum Oil / Proposed 2022
Worst-Case Discharge Volume[1]	124,097 gallons
Maximum Most Probable Discharge Volume (USCG) [2]	12,410 gallons
Average Most Probable Discharge Volume (USCG) [2]	1,241 gallons
Oil Spill Response Organization (OSRO)	TBD

***Notes:**

1. Criteria established in 30 CFR 254.26 is for oil production platform facilities and pipeline facilities only. RPS has contacted BSEE for guidance regarding determining the worst-case discharge volume.

2. Definitions in 33 CFR 155.1020 are based percentage of cargo from a vessel during oil transfer operation

2. Core Plan Elements

2.1 Discovery and Initial Response

Detection of a spill or emergency is the first step in a response. There are several methods by which an emergency situation at the Project may be discovered including the following:

- Reported by company personnel;
- Abnormal operating conditions observed by operator; or
- Reported by private citizens or by public officials.

In every case it is important to collect accurate information and immediately notify the On-Duty Supervisor and any affected area personnel.

Initial response will take place as indicated in Table 2-1 Initial Response Actions Checklist. The Initial Notification Data Sheet Form (Annex 4**)** will be completed by the On-Duty Supervisor while discussing the incident when it is initially reported by the person detecting the spill/release. Information not immediately known may be added to the form as it becomes available.

The On-Duty Supervisor will notify the Qualified Individual (QI) or Alternate immediately upon receiving notification of an emergency event. The QI or his designee will make notifications as discussed in Section 2.2 to Federal, state and local agencies (Figure 2-1 and Table 2-3) immediately and shall assure that all required documentation is kept.

When making the initial notifications to the On-Duty Supervisor and affected personnel, one should attempt to provide the following information:

- Name of caller and callback number;
- Exact location and nature of the incident (e.g., fire, release);
- Time of incident;
- Name and quantity of material(s) involved, or to the extent known;
- The extent of personal injuries, damage and/or fire, if any;
- The possible hazards to human health, or the environment, outside the facility;
- Body of water or area affected;
- Quantity in water (size and color of slick or sheen) or amount released to the land or atmosphere;
- Present weather conditions–wind speed and direction, movement of slick or sheen, current/tide;
- Potential for fire; and
- Action being taken to control the release.

A log should be maintained which documents the history of the events and communications that occur during the response. See Annex 4 for form. It is important to remember that the log may become instrumental in legal proceedings, therefore:

- Record only facts, do not speculate.
- Do not criticize the efforts and/or methods of other people/operations.
- Do not speculate on the cause of the spill.
- If an error is made in an entry, do not erase; draw a line through it, add the correct entry above or below it and initial the change.

- Always evaluate safety throughout the response actions.

Table 2-1 Initial Response Checklist

Action	Comments
First Person on Scene	
Take personal protective measures (PPE) and/or distance.	
Identify and control source if possible (close valve, turn off pump, blind the flange). Eliminate ignition sources.	
Notify the On-Duty Supervisor.	
Notify the affected personnel of the incident.	
Warn personnel in the area and enforce safety and security measures.	
If possible, implement countermeasures to control the emergency. If personal health and safety is not assured, do not attempt to reenter the emergency site.	
Designate a staging area where the Emergency Response personnel and equipment can safely report to without becoming directly exposed to the emergency release (until QI arrives).	
On-Duty Supervisor	
Activate local alarms and evacuate non-essential personnel.	
Notify QI.	
Initiate defensive countermeasures and safety systems to control the emergency (booms, sorbent material, loose dirt, sandbags, or other available materials). Eliminate ignition sources.	
Initiate Emergency Response notification system.	
Dispatch response resources as needed.	
Monitor and or facilitate emergency communications until QI arrives.	
Keep the public a safe distance from the release.	
Qualified Individual (QI) or Designee	
Notify Federal, state and local agencies.	
Establish On-Scene Command and respond to the Command Post.	
Assess situation and classify incident.	
Perform air monitoring surveys prior to entering a release area.	
Determine extent and movement of the release.	
Identify sensitive areas and determine protection priorities.	
Request additional or specialized response resources.	
Establish Isolation Zones (Hot, Warm, Cold) and Direct On-Scene Response Operations.	
Coordinate initial regulatory notifications and external contacts.	
Keep the public a safe distance from the release.	

2.2 Notifications

2.2.1 Internal Notifications

The individual discovering the spill will call the On-Duty Supervisor immediately and report initial facts about the incident. The On-Duty Supervisor will record the facts (see forms in Annex 4) and immediately (within 15 minutes) notify the Qualified Individual (QI). Table 2-2 lists the QIs and their 24-hour contact information.

Table 2-2 Qualified Individuals

Name	Position	Cell	Email
Person A	Qualified Individual, Title	(XXX) XXX-XXXXX	XXX@XXX.com
Person B	Alternate Qualified Individual, Title	(XXX) XXX-XXXX	XXX@XXX.com
Person C	Alternate Qualified Individual, Title	(XXX) XXX-XXXX	XXX@XXX.com
Person D	Alternate Qualified Individual, Title	(XXX) XXX-XXXX	XXX@XXX.com
The Qualified Individual or designated alternate on duty will be available 24-hours per day and capable of arriving to the Project in a reasonable amount of time after contacting (typically within 1 hour).			

2.2.2 External Notifications

External notifications to agencies are required for:

- Spills of 10 gallons or greater on land; and
- Any size oil spill on water or on land with a threat to impact water (i.e., Atlantic Ocean, wetlands).

For initial determination of external notifications follow the steps in Figure 2-1. **Please note that the initial calls to USCG must be made within the first hour of discovering a reportable spill.** **Initial calls to MassDEP must be made within two hours of discovery of a release.** Follow-up calls to agencies can be provided as more information is obtained.

The QI or designee will make all initial and follow-up federal, state, and local agency notifications. Use forms provided in Annex 4 to document details of notifications and ensure accurate information is being passed along. For follow-up purposes, agency specific phone numbers are provided in Table 2-3 as well as the requirements for notifications, additional phone numbers are provided in Annex 2. It is recommended that a courtesy call be placed to the appropriate agency in order to establish proper lines of communication if warranted by the situation.

There are a number of other contacts that must be made if the incident is of a magnitude that requires them, and they may include:

- Massachusetts Department of Environmental Protection (MassDEP);
- Emergency Medical Personnel;
- Oil Spill Response Organizations (OSROs) available 24/7;
- OSHA (if death or 3 personnel injuries result in hospitalization); and

- Wildlife rehabilitation personnel if wildlife affected.

Contact information for these entities and others are included in Annex 2**.**

In the event that public notification of a spill is required, as deemed necessary by the Federal On-Scene Coordinator (FOSC), be prepared to discuss the following:

- The nature and extent of the economic losses that have occurred or are likely to occur;
- The persons who are likely to incur economic losses;
- The geographical area that is affected or is likely to be affected;
- The most effective method of reasonably notifying potential claimants of the designated source; and
- Any relevant information or recommendations.

Figure 2-1 External Notification Flowchart

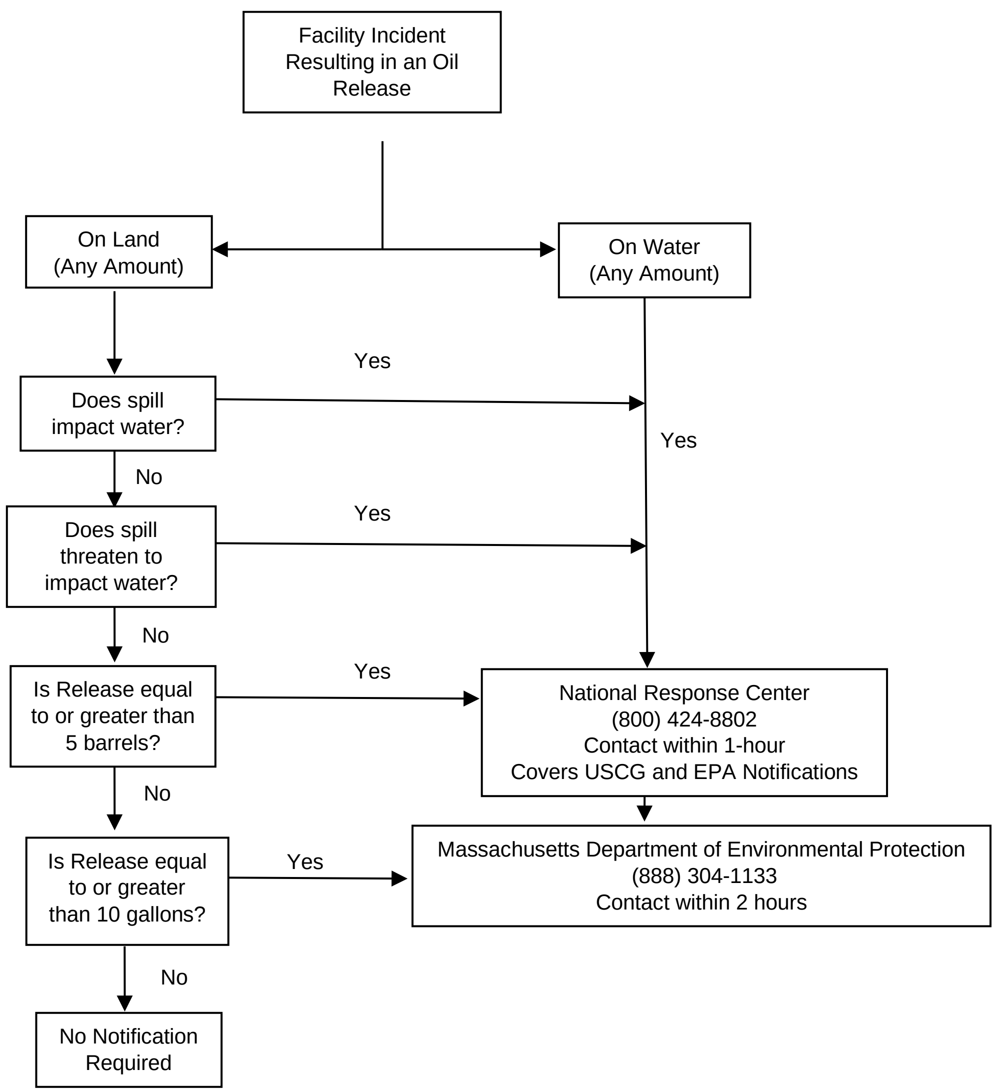

Table 2-3 Initial Agency Notifications

Agency	Phone	Requirements for Notifications
Federal Agencies		
National Response Center (NRC)	(800) 424-8802 (serves to notify EPA and USCG)	Immediate notification (less than one hour) is required for all discharges of oil sufficient to produce a sheen on navigable waters of the United States.
EPA Region 1	(888) 372-7341 or (617) 918-1251	The EPA must be notified through the NRC for all oil discharges into inland navigable waters of the U.S. sufficient to create a sheen. A written report is not required. If the facility has discharged more than 1,000 gallons of oil in a single discharge or more than 42,000 gallons of oil in each of two discharges occurring within any twelve month period, the following must be submitted to EPA within 60 days: name of facility; name of reporting party; location of facility; maximum storage or handling of the facility and normal daily throughput; corrective action and countermeasures that have been taken, including a description of equipment repairs and replacements; adequate description of the facility, including maps, flow diagrams, and topographical maps; the cause of such discharge as including a failure analysis of the system or subsystem in which the failure occurred, additional preventive measures that have been taken or contemplated to minimize the possibility of recurrence and such other information as the EPA may reasonably require pertinent to the Plan or discharge.
USCG	(617) 223-4812 or (617) 406-9011	The USCG must be notified via the NRC for all oil discharges into coastal navigable waters of the U.S. sufficient to create a sheen. A written report is not required.
OSHA	(617) 565-9860	OSHA must be notified by telephone if an accident occurred which caused a death, or three personnel injuries which required hospitalization.
Bureau of Safety and Environmental Enforcement (BSEE)	(504) 736-2595 or (504) 400-7836	Documentation of the biennial review must be submitted to the BSEE Oil Spill Preparedness Division (Chief, OSPD) or designee in writing. If the OSRP must be modified, it must be submitted to the Chief, OSPD for approval within 15 days.
State Agencies		
Massachusetts Department of Environmental Protection (MassDEP)	(888) 304-1133	Immediate notification (less than two hours) is required for all discharges of oil to water and any spill equal to or greater than 10 gallons on land. In addition, the local fire department should be notified, if applicable.
Local Authorities		
Barnstable County REPC	(508) 375-6908	Contact for any release, fire, or explosion which could threaten human health, or the environment for Nantucket island.
Dukes County REPC	(508) 696-4240	Contact for any release, fire, or explosion which could threaten human health, or the environment for Martha's Vineyard.
Contact information for additional agencies or services that may become involved in an incident is provided in Annex 2.		

2.3 Establishment of a Response Management System

The Qualified Individual (QI) at the facility will initially be the incident commander during any spill. As the incident escalates, more personnel will be called in to form the Incident Command System (ICS). The National Interagency Incident Management System (NIIMS) will be used by the facility, in concert with OSROs and federal, state, and local agencies. An outline of the ICS can be found in Annex 3.

The designated QI or AQI for the Project is English-speaking, located in the United States, available on a 24-hour basis, familiar with implementation of this response plan, and trained in their responsibilities under the plan. The QI or designated AQI has full written authority to implement this response plan, including:

(1) Activating and engaging in contracting with identified oil spill removal organization(s);
(2) Acting as a liaison with the pre-designated Federal On-Scene Coordinator; and
(3) Obligating, either directly or through prearranged contracts, funds required to carry out all necessary or directed response activities.

2.3.1 Preliminary Assessment

After initial response has been taken to stop further spillage and notifications made to the required agencies further spill containment, recovery and disposal operations can begin. It is important to first identify the magnitude of the problem and resources threatened. The QI or designee will:

1. Classify the type and size of spill (see Figure 2-2).
2. Determine chemical and physical properties of spilled material for potential hazards (see Annex 10, Safety Data Sheets - SDS).
3. Obtain on-scene weather forecast such as wind speed, wind direction and tide schedules (12, 24, 48 and 72-hour).
4. Track oil movement or projected movement. Consider need for over flights.
5. Continuously assess human health and environmental concerns.
6. Determine extent of contamination and resources threatened (i.e., waterways, wildlife areas, economic areas).
7. Start chronological log of the incident.

Incident classifications, or levels, are used to quickly categorize the appropriate level of response, notifications, and resources which may be necessary to mitigate the emergency. The incident will be categorized based upon the nature of the incident, degree of containment and isolation, materials involved or size of the release, and any other additional information provided by the person reporting the release. Incident levels may be upgraded or downgraded from the initial determination if the call-in classification was inaccurate or the situation changes. The Incident Classification levels are presented in Figure 2-2.

Based on the preliminary assessment, additional clean-up personnel and equipment will be dispatched to the site and deployed to control and contain the spill.

Figure 2-2 Guidelines for Determining Incident Classification

Level 1 – Minimal danger to life and property and the environment. Project personnel are capable of responding to the incident. The problem is limited to the immediate work area or release site and spills are generally less than 55 gallons.

Level 2 – Serious situation or moderate danger to life, property, and the environment. The problem is currently limited to the Project Area, but does have the potential for either involving additional exposures or migrating offsite. The incident could involve a large spill of oil, a fire, and loss of electrical power.

Level 3 – Crisis situation or extreme danger to life, property, and the environment. The problem cannot be brought under control, goes beyond the Project Area, and/or can impact public health and safety, and the environment, or a large geographic area for an indefinite period of time. Such incidents include a vessel fire or release of oil in a volume that can impact surrounding areas.

2.3.2 Establishment of Objectives and Priorities

Emergency conditions will be managed in a controlled manner, and oil release response operations will be conducted with the following objectives:

1. Continuously assess personnel safety.
2. Secure or isolate the source.
3. Contain the release.
4. Protect sensitive areas.
5. Coordinate response actions and customize response organization to situation.
6. Think ahead and anticipate needs.
7. Recover product.
8. Document incident.

During a major oil spill, resource, time, and various response constraints may limit the amount of areas that can be immediately protected. Every attempt should be made to prevent impacts to areas surrounding a spill site.

The Project is located in the OCS. The island of Martha's Vineyard, which is the closest land mass, is located approximately 14.4 miles north of the Project. Martha's Vineyard is comprised of six towns and a sovereign tribal nation. The towns of Chilmark, West Tisbury, and Edgartown are located on the southern portion of the island. Resources of special economic or environmental importance located on the southern portion of Martha's Vineyard include:

- Public drinking water well and distribution systems;
- Primary schools located in Chilmark, West Tisbury, and Edgartown;
- Squibnocket Beach, Lucy Vincent Beach, Long Point Beach, Katama Beach, and East Beach;

- Sovereign tribal nation of the Wampanoag Tribe of Gay Head (Aquinnah); and
- Marinas of Edgartown, West Tisbury, and Chilmark.

Environmental Sensitivity Index (ESI) maps, available from NOAA, provide a summary of coastal resources that are at risk if an oil spill occurs in the area. Maps with coverage of Martha's Vineyard would be contained in: Massachusetts and Rhode Island: Volume 3 Buzzards Bay. The maps are available in pdf format at: https://response.restoration.noaa.gov/maps-and-spatial-data/download-esi-maps-and-gis-data.html.

2.3.3 Implementation of Tactical Plan

The Construction and Operations Plan (COP) for the Project is to be submitted to BOEM WEA by the end of 2017. Initial award selection(s) for long term PPA(s) are expected in the spring of 2018. Construction is scheduled to commence in 2020. Vineyard Wind will establish contractual agreements with an oil spill response organization (OSRO).

The general procedures for implementation of a tactical plan are:

- Maximize protection of response personnel.
- Deploy containment resources and if appropriate divert spill to a suitable collection point that is accessible and has the least impact to surrounding areas.
- Boom off sensitive areas.
- Maximize on-water containment and recovery operations.
- Handle wastes to minimize secondary environmental impacts.

Vineyard Wind will establish contractual agreements with an OSRO to contain a spill on the waterway or land, and clean up the area after a spill. The Response Team will use containment equipment available at the site to surround or divert the spill until the contractor arrives on scene. Vineyard Wind personnel and equipment will assist in any way possible to expedite the cleanup operations.

2.3.4 Containment and Recovery Methods

The objective of the initial phase of the containment procedure prevents the spread of the spill, especially on water, and confines it to as small an area as possible. The containment goals are to prevent liquid or vapors from reaching a possible ignition source (i.e., boat engines, electrical equipment) and any environmentally sensitive area (i.e., water, wetland, wildlife management area). The primary methods to be used in containing a release would be absorbents, if on the rig, or containment booms, if it reaches water. It may be necessary to use many different methods in one release.

Containment and recovery refer to techniques that can be employed to contain and recover onshore and aquatic petroleum spills. Responses on water should therefore emphasize stopping the spill, containing the oil near its source, and protecting sensitive areas before they are impacted.

Sorbents can be used to remove minor on-water spills on the WTGs and ESPs. For larger spills, or spills reaching water, booming is used to protect sensitive areas and to position oil so it can be removed with skimmers or vacuum trucks. Due to entrainment, booming is not effective when the water moves faster than one knot, or waves exceed 1.5 feet in height. Angling a boom will minimize entrainment. Using multiple parallel booms will also improve recovery in adverse conditions. A summary of booming techniques for both aquatic and onshore scenarios is provided in Table 2-4.

Table 2-4 Containment and Diversion Booming Techniques

Type of Boom	Use of Boom
Containment/Diversion Berming	Berms are constructed ahead of advancing surface spills to contain spill or divert spill to a containment area. May cause disturbance of soils and some increased soil penetration.
Containment Booming	Boom is deployed around free oil. Boom may be anchored or left to move with the oil.
Diversion Booming	Boom is deployed at an angle to the approaching oil. Oil is diverted to a less sensitive area. Diverted oil may cause heavy oil contamination to the shoreline downwind and down current. Anchor points may cause minor disturbances to the environment.

2.4 Response Strategies for Containment and Recovery

The WTGs and ESPs will be located in the OCS. Offshore cable systems will move power from the offshore substations to landfall on the south-central shore of Cape Cod (i.e., Landfall Site). Vineyard Wind has been engaged in route selection work for the necessary sea cable Landfall Site, the landside transmission cabling, the onshore substation and utility interconnection point. At this juncture, the Project is considering potential landfall sites in the Towns of Yarmouth and Barnstable; a single Landfall Site may be used for all cables for the 800 MW project. If oil storage on the landside of the Project exceeds 1,320 gallons in capacity in aggregate for containers or oil-filled equipment with a capacity of 55 gallons or greater, an SPCC Plan or an Integrated Contingency Plan (ICP) will be developed to address spill response procedures. While onshore releases are not the primary focus of this plan, they are still addressed for completeness.

2.4.1 Atlantic Ocean

The Project is located in the OCS. Water depths in the area of the Project range from 115 feet to 161 feet. However, oils stored in the WTGs and ESPs have a specific gravity less than 1.0 and would float on the surface of the water. Feasible protection methods include skimming, booming, and improvised barriers.

2.4.2 Banks

The nearest land mass to the WTGs and ESPs is Martha's Vineyard, which is located approximately 14.4 miles north of the Project. Therefore, it is not anticipated that a release of oil would impact the terrain alongside the bed of a river, creek, or stream. However, the following response discussion is made available for planning of such an event.

Vegetated Banks

Oil may penetrate the area and coat plants and ground surfaces. Oil can persist for months. Minimize cutting plants. A no-action alternative may be appropriate to minimize environmental impacts. Cleanup is usually unnecessary for light coatings, but heavier accumulations may require sediment surface removal to allow new growth. Low-pressure spraying and neutralization solutions may aid removal.

Sand Beaches

Heavy accumulations of wastes can cover an entire beach surface and subsurface. Oil can penetrate the sand from 6 to 24 inches deep. Organisms living along the beach may be smothered or dangerously contaminated. Fine sand beaches are generally easier to clean. Clean by removing oil above the swash zone after all oil has come ashore. Minimize sand removal to prevent erosion. Soil treatment may be possible as well.

Muddy Beaches

Mud habitats are characterized by a substrate composed predominantly of silt and clay sediments, although they may be mixed with varying amounts of sand or gravel. The sediments are mostly water saturated and have low bearing strength. In general, mud shorelines have a low gradient. These fine-grained habitats often are associated with wetlands. Mud habitats are highly sensitive to oil spills and subsequent response activities. Shoreline sediments are likely to be rich in organic matter and support an abundance of fauna. Muddy habitats are important feeding grounds for birds and rearing areas for fish. Oil will not penetrate muddy sediments because of their low permeability and high-water content, except through decaying root and stem holes, or animal burrows. There can be high concentrations and pools of oil on the surface. Natural removal rates can be very slow, chronically exposing sensitive resources to the oil. The low bearing capacity of these shorelines means that response actions can easily leave long-lasting imprints, cause significant erosion, and mix the oil deeper into the sediments. When subsurface sediments are contaminated, oil will weather slowly and may persist for years. Response methods may be hampered by limited access, wide areas of shallow water, fringing vegetation and soft substrate. Natural recovery is typically the best response action for light crude. Vacuum trucks may be used to remove pooled oil on the surface if accessible. Avoid digging trenches to collect oil because that can introduce oil deeper into the sediment.

Riprap Structures

Oil contamination may penetrate deeply between the rocks. If left, oil can asphaltize and fauna and flora may be killed. If possible remove all contaminated debris. Use sorbents to remove oil in crevices. Best response may be to remove and replace heavily contaminated riprap to prevent chronic sheening and release.

Walls/Pier/Barriers and Docks

Mussels, shellfish, and algae are often found attached to these structures, which may be constructed of concrete, stone, wood, or metal. Contamination may percolate between joints and coat surfaces. Heavy accumulations will damage or kill the biota. High-pressure spraying may remove oil and prepare the substrate for recolonization of fauna/flora. Consider concentration of oil and continual release concentration to make a determination as to whether an action is required to remove contamination from these structures.

2.4.3 Wetlands

MassDEP’s Priority Resource Map does not identify any wetland areas along the southern shoreline of Martha’s Vineyard. Wetlands are located in the vicinity of Allen Point, Cobbs Point, Swan Neck Point, King Point, and Butler Neck. It is anticipated that a release of oil would impact the shoreline prior to impacting the wetlands areas. However, the following response discussion is made available for planning of such an event.

Wetlands are characterized by water, unique soils, and vegetation adapted to wet conditions. Wetlands include a range of habitats such as marshes, bogs, and swamps. The surfaces of wetlands usually have a low gradient, and vegetated areas are typically at, or under, the water level. Wetlands are highly sensitive to oil spills. The biological diversity in these habitats is significant and they provide critical habitat for many types of animals and plants. Oil spills affect both the habitat and the organisms that directly and indirectly rely on the habitat. Wetlands support populations of fish, amphibians, reptiles, birds, and mammals, with many species reliant upon wetlands for their reproduction and early life stages when they are most sensitive to oil. Migratory water birds depend heavily on wetlands as summer breeding locations, migration stopovers, and winter habitats.

For small to moderate spills and lighter oils, natural recovery avoids damage often associated with cleanup activities. However, the threat of direct oiling of animals using the wetland often drives efforts to remove the oil. Sorbents may be used, but overuse generates excess waste materials. Flooding can be used selectively to remove localized heavy oiling, but it can be difficult to direct water and oil flow towards recovery devices. Pooled oil can be removed by vacuum truck, if accessible, and trampling of vegetation can be avoided. The removal of heavily oiled vegetation may reduce the contamination of wildlife. Time of year is an important consideration for any clean-up method used in a wetland area.

2.4.4 Onshore Spills

The WTGs and ESPs are located in the OCS. It is unlikely that a release of oil from the WTGs or ESPs would result in an onshore spill. However, the following response discussion is made available for planning of such an event.

Onshore spills typically result from pipeline or equipment (i.e., pumps, valves) leaks. Secondary containment systems will be provided at operating areas more prone to spillage. The WTGs and ESPs are equipped with a secondary containment structure that will be sized according to the largest container. The ESP containment will drain to a sump tank. Spills occurring outside these areas should be contained at or near the source to minimize the size of the cleanup area and quality of soil affected.

Containment is most effected when conducted near the source of the spill, where the oil has not spread over a large area, and contained oil is of sufficient thickness to allow effective recovery and/or cleanup. The feasibility of effectively implementing containment and recovery techniques is generally dependent upon the size of the spill, available logistical resources, implementation time, and environmental conditions or nature of the terrain in the spill area.

For onshore spills, trenches, earthen berms, or other dams are the most effective response to contain oil migration on the ground surface. Recovery of free oil is best achieved by using pumps, vacuum trucks, and/or sorbents. Forming collection ponds for containing free product may be considered when attempting to recover free oil. Absorbents such as hay, straw, dry dirt or sand, and other commercial products may be considered as alternative methods of containment.

2.4.5 Small Lakes

Edgartown Great Pond and Tisbury Great Pond are located along the southern portion of Martha's Vineyard and have navigational channels connecting the pond to the Atlantic Ocean. It is anticipated that a release of oil from the WTGs and ESPs could be contained prior to reaching the navigational channels for the ponds. However, should this occur, the following response discussion is made available for planning of such an event.

Lakes and ponds are standing bodies of water of variable size and water depth. Water levels can fluctuate over time. The bottom sediments close to shore can be soft and muddy, and the surrounding land can include wetlands and marshes. Floating vegetation can be common. Lakes provide valuable habitat for migrating and nesting birds and mammals, and support important fisheries. Wind will control the distribution of oil slicks, holding the oil against a shore, or spreading it along the shore and into catchment areas. Wind shifts can completely change the location of oil slicks, contaminating previously clean areas. Thus, early protection of sensitive areas is important. Oil impacts on floating vegetation depend to a large degree on dose, with possible elimination of plants at high doses. The best possible response method is to deploy booms to prevent oil from entering the lakes. If oil does enter any lakes, containing the oil to a small area with booms is the next best response.

2.4.6 Offshore Environments

The Project is located approximately 14.4 miles south of the southern shore of Martha's Vineyard. Therefore, it is anticipated that a release of oil from the WTGs and ESPs could be contained prior to reaching the coastline. However, should this occur, the following response information is included in this plan to assist in planning of such an incident.

The initial response to mitigate/contain a spill in a coastal environment is to review the ACP response plans for locating applicable sensitive areas. Oil that is deposited on an open water surface is generally distributed by wind direction and velocity. In addition, wave action causes emulsification of the oil, decreasing the recoverable amount, and increasing the area of contamination. These elements will be used as an advantage for containment/cleanup response. Deploy the containment boom in a V-shape, allowing the wind/wave action to move the oil, trapping, and funneling the oil towards recovery equipment near shore. Plan the recovery sites near roads, if possible, to allow tanker trucks and vacuum trucks to pick up the recovered material and transport it to disposal, recovery, or temporary storage. Clean up any accumulated amounts of contaminated shoreline debris. Store the debris on impervious material and cover it in the same manner.

2.5 Waste Disposal and Oil Recovery

Oil spill cleanup from recovery operations will involve the further handling of recovered oil and oiled materials. These will be directed to a state-approved reclamation/disposal site. Normally, the waste generated from a recovery operation will be classified as a non-RCRA state regulated waste. Waste Code MA01 is appropriate for used or unused waste oil that is not otherwise RCRA hazardous waste. Waste Code MA97 is appropriate for Class A regulated recyclable material (including, but not limited to, specification used oil fuel) that is shipped using a hazardous waste manifest. Waste Code MA98 is appropriate for off-specification used oil fuel that is shipped using a hazardous waste manifest. In rare instances, where it is suspected that extraneous substances have been introduced into a spill, it is appropriate to test the recovered oil for hazardous waste characteristics (ignitability, reactivity, corrosivity, and toxicity).

The different types of wastes generated during response operations require different disposal methods. Waste will be separated by material type for temporary storage prior to transport to an approved recovery or treatment/storage/disposal facility.

Skimmer tanks allow for gravity separation of the oil from the water. The separated water is transferred through a hose and discharged forward of the recovery pump. This method is called "decanting". This process is vital to the efficient mechanical recovery of spilled oil because it allows maximum use of limited storage capacity, thereby increasing recovery operations. Approval must be obtained from federal and state agencies prior to decanting.

Recovered oil may be transferred to portable tanks. It is important to ensure temporary storage devices are of sufficient size to allow continued operations.

Oily debris collected requires specific handling. Contaminated materials will be placed in leak proof, sealable containers, such as drums or roll-off boxes, and transported to appropriate facilities for processing, recycling, or disposal.

Clean sand and shoreline materials can be separated from oiled materials and returned to the shoreline. Not only is this cost effective from an operations perspective, it also provides an efficient means of returning clean, excavated material back to the shoreline as a restorative measure.

2.6 Potential Failure Scenarios

Specific mitigation actions and responses to be taken (exact pumps to shut down, valves to close, etc.) depend on the way the transfer is performed and the nature of the situation; however, certain failure scenarios share common characteristics for mitigation. Mitigation procedures will be performed with consideration for health and safety as the top priority.

The Project is being developed and permitted using an “Envelope” concept. The Envelope concept allows Vineyard Wind to properly define and bracket Project characteristics for purposes of environmental review and permitting, while maintaining a reasonable degree of flexibility with respect to selection and purchase of key Project components. Potential failure scenarios will be developed as key Project components are selected. General mitigation procedures are included in Annex 3.

2.7 Procedures for Mobilization of Resources

A major consideration during a spill is the organization and direction of the transportation of manpower, equipment, and materials used in response operations. The QI will work with local authorities (state police) to establish land routes which will expedite the movement of personnel, equipment, materials, and supplies to the Staging Area, and waste products from the Staging Area. The facility will utilize status boards to coordinate all equipment, personnel, and materials mobilized to the spill site. Equipment will first be mobilized from the OSRO warehouse to the Staging Area. A Staging Area Manager will be designated to direct which equipment will be delivered to which Division/Task Force.

Once the first increment of the Project is installed, tested, and commissioned, the Project will enter a 20 to 30 year operating phase. In support of Project operations and the necessary maintenance activities, Vineyard Wind will have management and administrative team offices, a control room, and an Operation and Maintenance Facility (O&M facility). These functions will be co-located, if feasible. Details regarding spill response materials, services, equipment, and response vessels has not been finalized at this time. Vineyard Wind will retain a third-party OSRO that is licensed as hazardous waste transporters, and can provide emergency response services and cleanups of oil and/or hazardous material (OHM) spills. MassDEP emergency response contractors located in close proximity to the Project include Frank Corporation (New Bedford), Global Remediation Services, Inc. (Sandwich), Clean Harbors, Incorporated (Braintree), and Cyn Oil Corporation (Stoughton). Response times for mobilization of OSRO resources will be dependent on the location of the OSRO.

2.8 Sustained Actions

The WTGs and ESPs are equipped with secondary containment, which would reduce the potential for the need for a sustained action. Most incidents are able to be handled by a few individuals without implementing an extensive response management system. However, an incident could occur where clean-up is not possible within seven days, transition from the initial emergency stage. A sustained action stage may be required where more prolonged mitigation and recovery actions may be warranted.

Response operations will need to be managed 24-hours a day, seven days a week, until the operation is complete. The facility’s Incident Command Organization (ICO) team members are available to be cascaded in to support response operations. Once the initial emergency stage of the spill situation has transformed to the sustained action stage, the response management structure will develop more prolonged mitigation and recovery action strategies.

2.9 Termination and Follow-Up Actions

Cleanup will be conducted as thoroughly as possible, but will be terminated when, in the opinion of the FOSC and the QI;

- There is no detectable oil in the water;
- Further removal actions would cause more environmental harm than the remaining oil;
- Cleanup measures would be excessive in view of their insignificant contribution to minimizing a threat to the public health, welfare, or the environment; and
- Actions required to repair unavoidable damage resulting from removal activities have been completed.

Once the determination has been made that the response can be terminated, certain regulations may become effective once the “emergency” is declared over. Orderly demobilization of response resources will need to occur. Follow-up actions such as accident investigation, response critique, plan review, and written follow-up reports are needed.

The QI will develop a plan of demobilization and assist to ensure that an orderly, safe, and cost-effective demobilization of personnel and equipment is accomplished.

General demobilization considerations for all personnel are the following:

- Complete all work assignments;
- Brief subordinates regarding demobilization;
- Complete and file required forms and reports;
- Follow check out procedures provided by the QI;
- Evaluate performance of subordinates prior to release;
- Return communications equipment or other non-expendable supplies; and
- Report to assigned departure points on time, or slightly ahead of schedule.

The QI will convene a meeting to summarize the incident, and a complete report will be developed within 180 days. This report will record the incident as it developed and will identify, in detail, the actions taken, resources committed, and any problems encountered. The QI will include a recommendation outlining any suggested changes of policies or procedures.

Annex 1 – Facility Diagrams

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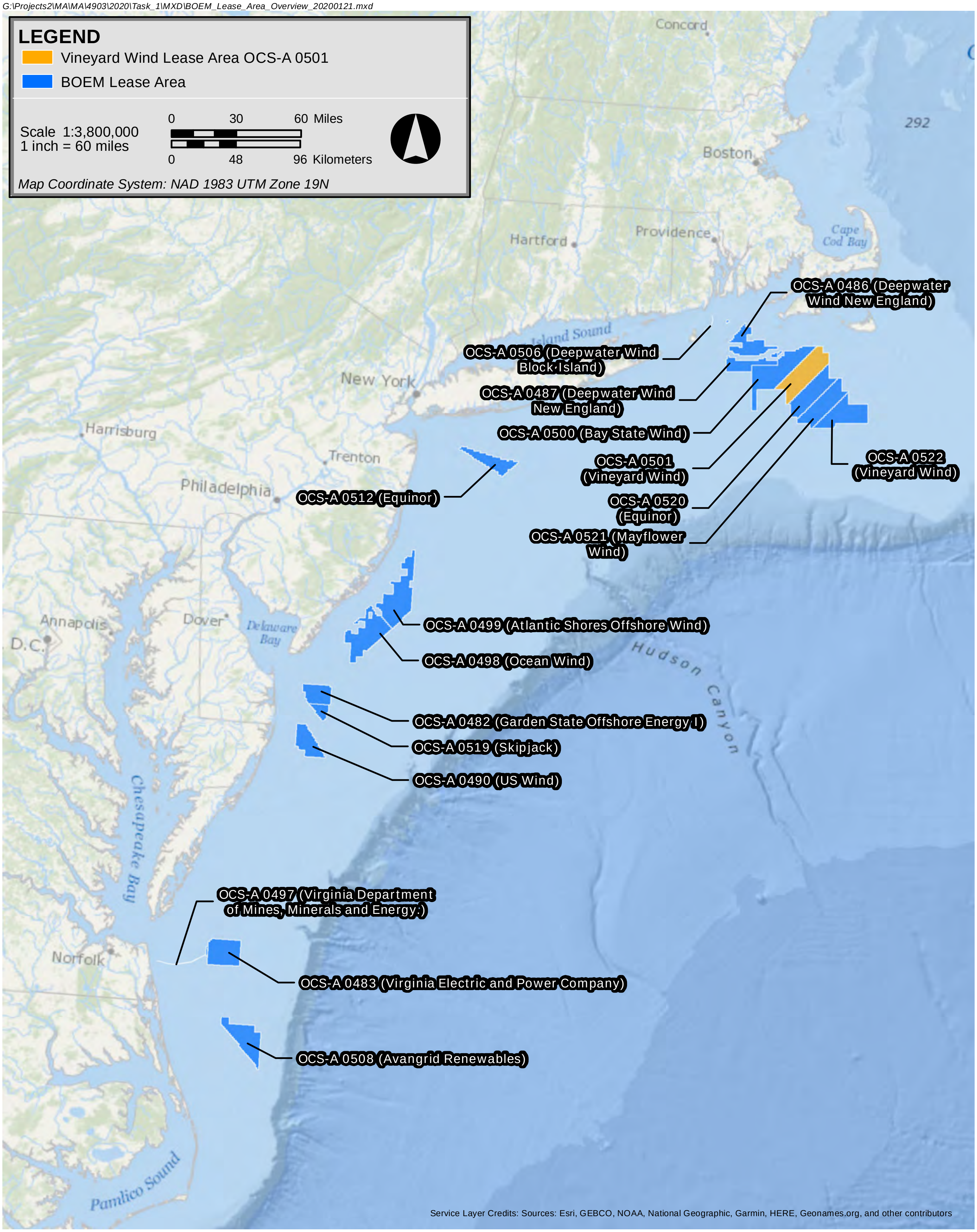

Vineyard Wind Project

VINEYARD WIND

Figure A1-1

Overview, BOEM Offshore Wind Lease Areas - Atlantic Coast

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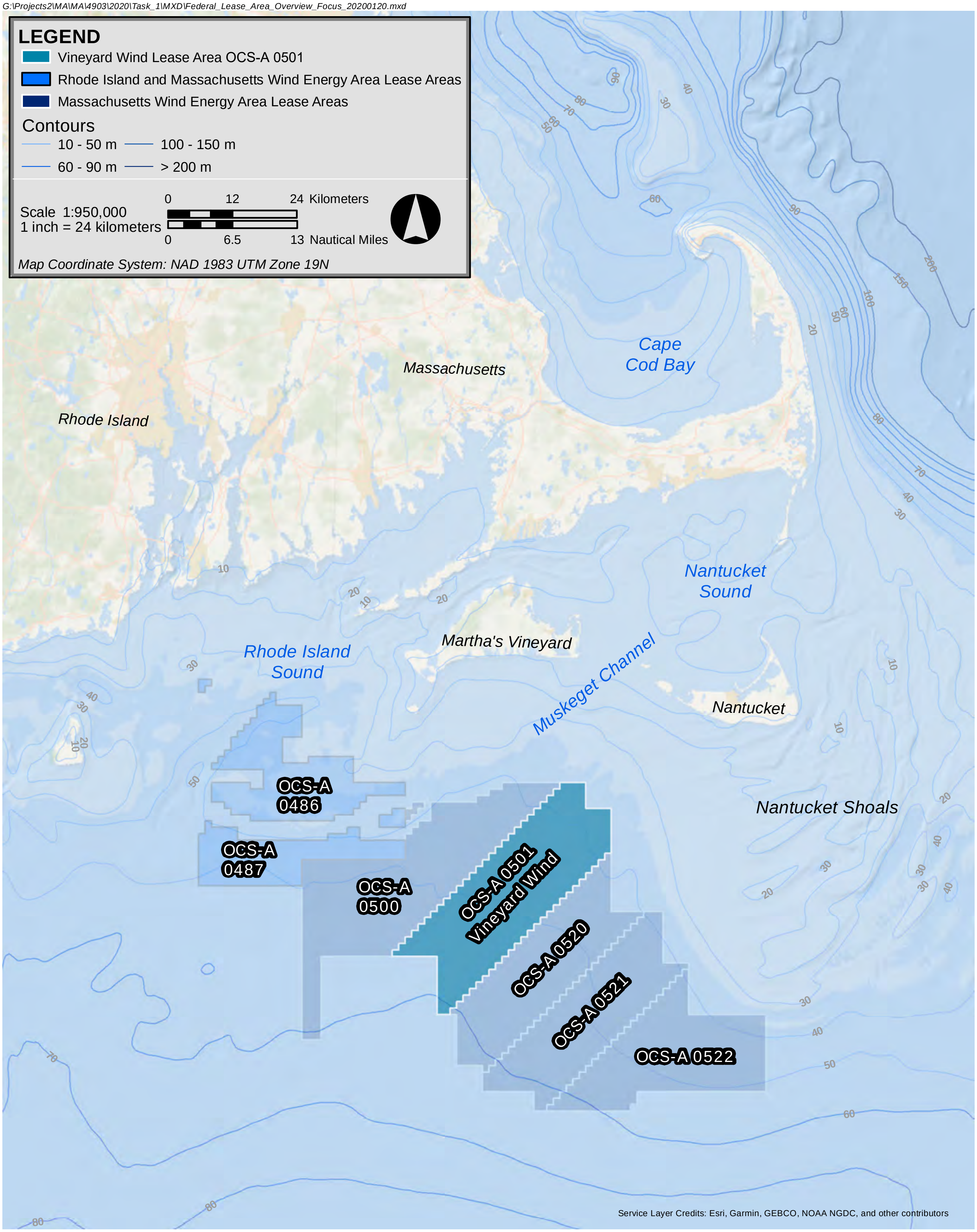
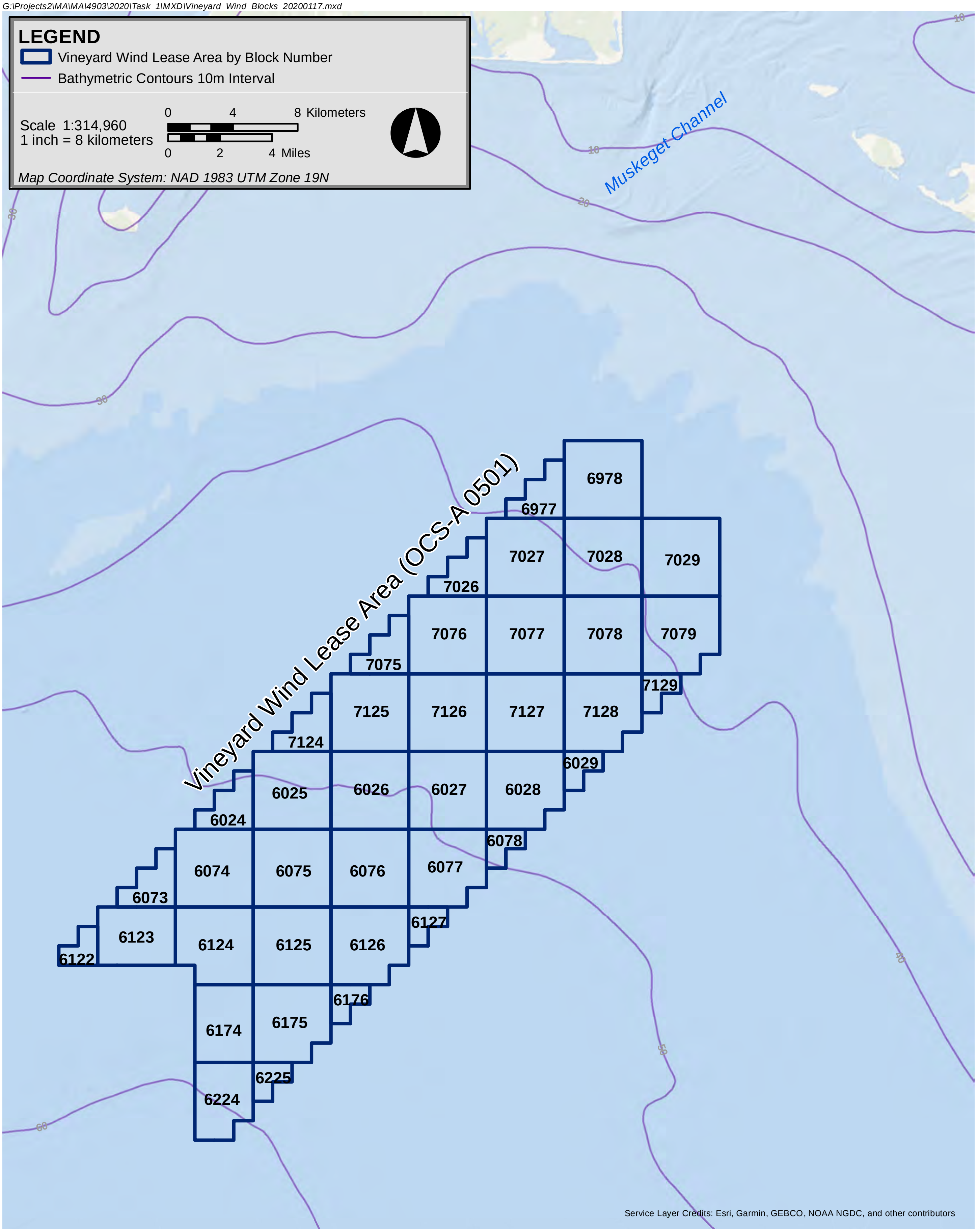


Vineyard Wind Project

VINEYARD WIND

Figure A1-2

RI and MA Lease Areas Overview



Vineyard Wind Project

VINEYARD WIND

Figure A1-3

Vineyard Wind Lease Area with BOEM Block Designation

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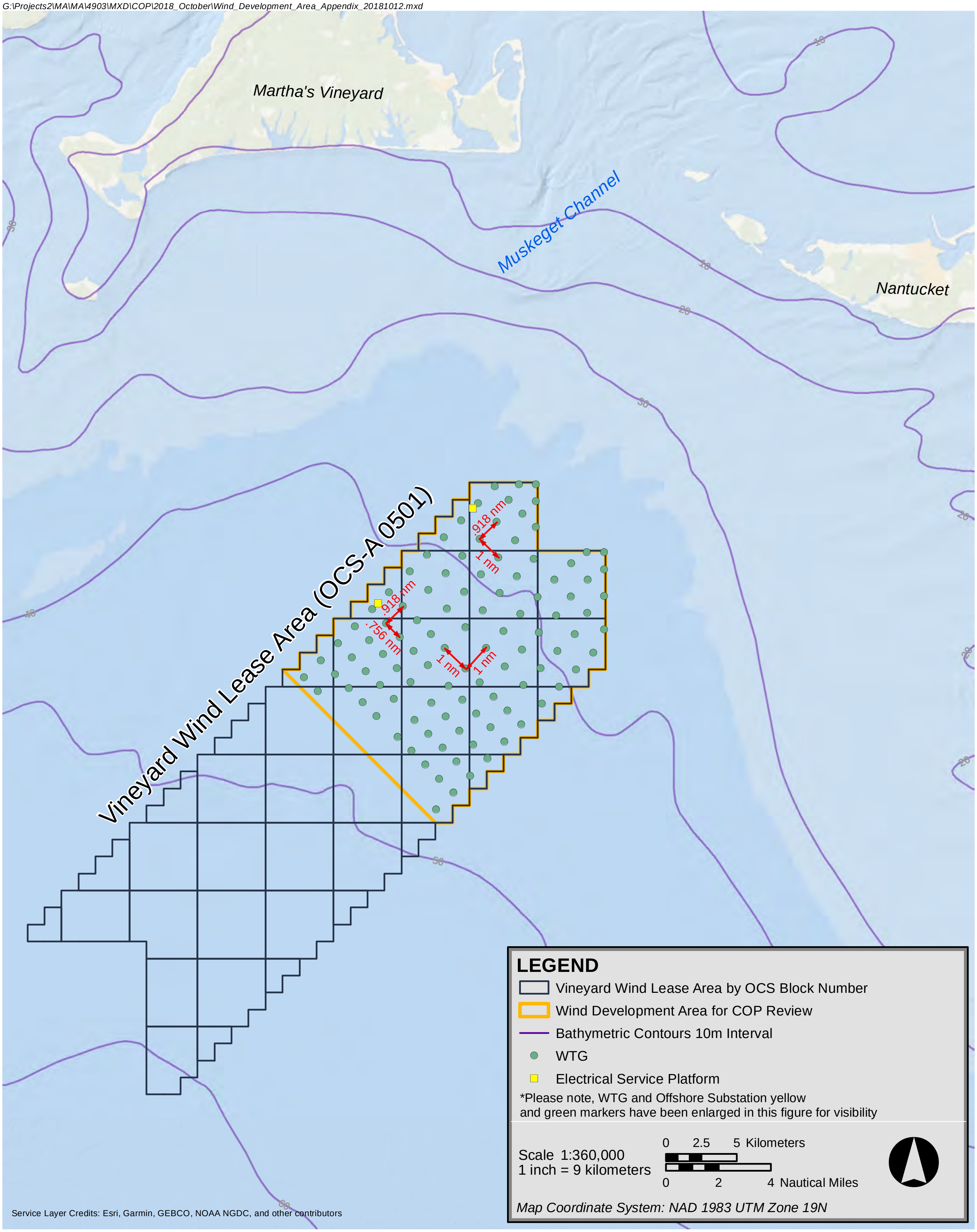

Vineyard Wind Project

VINEYARD WIND

Figure A1-4

Wind Development Area and Site Layout

Annex 2 – Notification Contact List

Table A2-1 Internal Notification List

The Project has not yet been approved. Construction of the Project is scheduled to commence in 2020. Details regarding QI personnel have not been finalized at this time.

Name	Title	Phone Number
Person A	Qualified Individual, Title	(XXX) XXX-XXXX
Person B	Alternate QI, Title	(XXX) XXX-XXXX
Person C	Alternate QI, Title	(XXX) XXX-XXXX
Person D	Alternate QI, Title	(XXX) XXX-XXXX
Person E	Manager EHS	(XXX) XXX-XXXX
Person F	Director of Communications	(XXX) XXX-XXXX
Person G	Chief Financial Officer	(XXX) XXX-XXXX
Person H	Director of Administration	(XXX) XXX-XXXX

Table A2-2 External Notification and Call Lists

Agency	Location	Telephone
Initial Required Notifications		
National Response Center	c/o USCG (CG-3RPF-2) 2100 2nd Street Southwest Room 2111-B Washington, D.C. 20593-0001	800-424-8802 (24 hr) 202-267-2675 (24 hr) 202-267-1322 (fax)
Massachusetts State Emergency Response Commission (SERC)	MEMA 400 Worcester Road Framingham, MA 01702	508-820-2010
U.S. Coast Guard (any discharge on navigable water)	408 Atlantic Avenue Boston, MA 02110	617-223-4812 or 617-406-9011
Massachusetts Department of Environmental Protection (10 gallons or more)	1 Winter Street Boston, MA 02108	888-304-1133
EPA Region 1 (>5 barrels on land or any amount on water)	5 Post Office Square Boston, MA 02109	888-372-7341 or 617-918-1251
Bureau of Safety and Environmental Enforcement (BSSE)	1201 Elmwood Park Boulevard New Orleans, LA 70123-2394	504-736-2595 or 504-400-7836
Dukes County REPC (Threat to Martha's Vineyard)	32 Water Street Tisbury, MA 02568	508-696-4240
Wampanoag Tribe of Gay Head (Threat to tribal lands on MV)	20 Black Brook Road Aquinnah, MA 02535	508-645-9265
Barnstable County REPC (Threat to Nantucket)	3195 Main Street Barnstable, MA 02630	508-375-6908
OSHA (fatality or 3 or more employees sent to hospital)	200 Constitution Avenue Washington, D.C. 20210	800-321-6742
USCG Classified Oil Spill Response Organizations (OSRO)		
Vineyard Wind has not selected a OSRO at this time. MassDEP maintains a list of licensed hazardous waste transporters who provide Emergency Response Services in MassDEP's Southeast Region. The list is available here: http://www.mass.gov/eea/docs/dep/cleanup/serohwtr.pdf		
Weather		
National Oceanic & Atmospheric Administration National Weather Service National Weather Service	445 Myles Standish Boulevard Taunton, MA 02870	508-822-0634 (forecasts) 508-828.2672 (general info) http://www.weather.gov/box/
NOAA Weather Radio (NWR) Hyannis, MA	Camp Edwards Hyannis, MA	Call sign: KEX73 VHF: 162.550
NOAA National Data Buoy Center	http://www.ndbc.noaa.gov/maps/Northeast.shtml	
MVY: Martha's Vineyard Airport	http://mvyairport.com/	
Aviation Resources		
Vineyard Wind has not selected aviation resources at this time. A list of Massachusetts charter operators is available at: http://www.aircharterguide.com/US_Operators/MA/Massachusetts		
Marine Resources		
Steamship Authority	1 Cowdry Road Woods Hole, MA 02543	508-548-5011

Agency	Location	Telephone
Regulatory Agencies for Wildlife		
U.S. Fish and Wildlife Service North East Regional Office	300 Westgate Center Drive Hadley, MA 01035	413-253-8200
U.S. Fish and Wildlife Service New England Field Office	70 Commercial Street Suite 300 Concord, NH 03301	603-223-2541
Massachusetts Environmental Police (fish kills)	251 Causeway Street Boston, MA 02114	800-632-8075
MassWildlife	1 Rabbit Hill Road Westborough, MA 01581	508-389-6300
MA Department of Fish and Game	251 Causeway Street Boston, MA 02114	617-626-1500
Other Wildlife Resources		
Mass Audubon	208 South Great Road Lincoln, MA 01773	781-259-9500 or 800-823-8266
Felix Neck Wildlife Sanctuary	100 Felix Neck Drive Edgartown, MA 02539	508-627-4850
International Fund for Animal Welfare	290 Summer Street Yarmouth Port, MA 02675	508-743-9548
New England Aquarium	1 Central Warf Boston, MA 02110	617-973-5247
NOAA Greater Atlantic Fisheries Office	55 Great Republic Drive Gloucester, MA 01930	866-755-6622
National Audubon Society	New York, NY	212-979-3196
Licensed Wildlife Rehabilitation Providers		
The Commonwealth of Massachusetts maintains a list of licensed wildlife rehabilitators at: https://www.mass.gov/service-details/wildlife-rehabilitators-southeast-district		
Medical Facilities		
Martha's Vineyard Hospital	1 Hospital Road Oak Bluffs, MA 02557	508-693-0410
Vineyard Medical Care (Walk-in Clinic)	364 State Road Vineyard Haven, MA 02568	508-693-4400
Ambulances		
Tri-Town Ambulance	West Tisbury, MA	508-693-4922
Oak Bluffs Ambulance Department	Oak Bluffs, MA	508-693-5380
Tisbury Ambulance	Vineyard Haven, MA	508-696-4112
Boston MedFlight (Air lift)	Bedford, MA	781-863-2213
Coast Guard Air Station Cape Cod (Medevac)	Buzzards Bay, MA	508-968-6673
Fire Aid (911)		
Edgartown Fire Department	Edgartown, MA	508-627-5167
Oak Bluffs Fire Department	Oak Bluffs, MA	508-693-0077
West Tisbury Fire Department	West Tisbury, MA	508-693-2749
Chilmark Fire Department	Chilmark, MA	508-645-2207
Vineyard Haven Fire Department	Vineyard Haven, MA	508-696-6726

Police Aid (911)		
Massachusetts State Police	Oak Bluffs, MA	508-693-0545
Dukes County Sherriff	Edgartown, MA	508-627-5328
Massachusetts Environmental Police	Boston, MA	800-632-8075
Massachusetts Department of Public Safety	Boston, MA	617-727-3200
US Marshals Services	Boston, MA	617-748-2500
Federal Bureau of Investigation	Chelsea, MA	857-386-2000
Local Government and Agencies		
Wampanoag Tribe of Gay Head (Aquinnah)	Aquinnah, MA	508-645-9265
Dukes County Health Department	Vineyard Haven, MA	508-696-3844
Martha's Vineyard Chamber of Commerce	Vineyard Haven, MA	508-693-0085
Edgartown Town Hall	Edgartown, MA	508-627-6100
Oak Bluffs Town Hall	Oak Bluffs, MA	508-693-3554
Town of Tisbury	Vineyard Haven, MA	508-696-4200
West Tisbury Town Hall	West Tisbury, MA	508-696-4700
Chilmark Town Hall	Chilmark, MA	508-645-2100
Aquinnah Town Selectman	Aquinnah, MA	508-645-2310
Other Industrial Facilities in Local Area		
Not Applicable		

Annex 3 – Response Management System

Figure A3-1 Initial Response Flowchart

Annex 4 – Incident and Other Documentation Forms

The Qualified Individual (QI) will coordinate the documentation during the incident, and for post-incident review, in conjunction with federal, state, and local officials, as well as with others familiar with the incident. Forms to assist in documentation and presentation of consistent notification information are presented at the end of this Annex for use during an incident. These include:

- Initial Notification;
- Agency Call Back for Information;
- Chronological Log of Incident; and
- Incident Report.

As an alternative, or in addition to, the National Incident Management Systems (NIMS) Incident Command Forms noted below may also be used. These can be accessed on-line at: http://www.fema.gov/emergency/nims/JobAids.shtm

Table A4-1 ICS Forms National Incident Management System (NIMS) Alternative

ICS Form No.	Description
IAP	Cover Sheet Incident Action Plan
201	Incident Briefing
202	Incident Objectives
203	Organization Assignment List
204	Assignment List
204a	Assignment List Attachment
205	Incident Radio Communications Plan
206	Medical Plan CG
207	Organizational Chart
208	Site Safety Plan
209	Status Summary (SITREP/Opsum)
210	Status Change
211	Check-In List
213	General Message
213-RR	Resource Request
214	Unit Log
215	Operational Planning Worksheet
216	Radio Requirements Worksheet
217	Radio Frequency Assignment Worksheet
218	Support Vehicle Inventory
219	Resource Status Card (T-Cards)
220	Air Operations Summary
221	Demobilization Checkout
224	Crew Performance Rating
225	Personnel Performance Rating
226	Individual Personnel Rating
230	Daily Meeting Schedule
232	Resources at Risk Summary
232a	ACP Site Index

233	Open Action Tracker
234	Work Analysis Matrix
235	Facility Needs Assessment

The post-incident investigation will begin after the source of the incident has been corrected, eliminated, or repaired, and the facility has been declared safe by the QI. The QI will take the following steps during a post-accident investigation:

- Obtain all data, information, and reports pertaining to the incident.
- Interview in person, or by telephone, each person knowledgeable of the incident.
- Review the response of operations personnel to see if procedures and training were adequate or if changes are warranted.
- Evaluate other potentially dangerous situations which could have occurred, and if the response of personnel and safety systems would have accommodated those situations had they occurred.
- Prepare recommendations as appropriate for changes to:
    - o Design of facility;
    - o Operating procedures;
    - o Training;
    - o Communications; and
    - o Emergency response plans and procedures.
- The QI will prepare and issue a written report to all supervisors with any changes deemed appropriate.

The QI will prepare a Post-Incident report. This annex will contain an accounting of incidents that occur including proof that the Project met its legal notification requirements for any given incident (i.e., signed record of initial notifications and certified copies of written follow-up reports submitted after a response).

Examples of routine equipment and maintenance checklists/ logs are also provided. These include:

- Response Equipment Inspection Log;
- Secondary Containment Checklist and Inspection Form;
- Tank Inspection Form; and
- Maintenance Log.

Form A4-10 Initial Notification Data Sheet

Date:	Time:
INCIDENT DESCRIPTION	
Reporters Name:	Position:
Reporters Phone Number:	Address:
Company:	
Latitude:	Longitude:
Date of Incident:	Time of Incident:
Spill/Incident Location:	Source and/or Cause of spill/incident:
Material spilled and total volume:	Vessel Name and Number (if applicable):
Is the material spilled in water?	Is the source secured?
Weather conditions:	Precipitation?
Incident Description:	
Name of Incident Commander:	Where is the Incident Command Post (directions)?
RESPONSE ACTIONS	
Actions taken to correct, control or mitigate incident:	
Number of injuries:	Number of deaths:
Were there evacuations?	Number of evacuated:
Areas affected:	Damage estimate:
Any other information about impacted medium:	
CALLER NOTIFICATIONS	
National Response Center (NRC): 800-424-8802	Texas State Emergency Response Commission: 800-832-8224
NRC Incident Assigned Number:	Other Agencies Notified: □ USCG □ EPA □ OSHA □ USFWS □ MassDEP
Other Information Not Recorded Elsewhere:	

Note: Do Not Delay Notifications Pending Collection of All Information. Notify within 1 hour of discovery.

Form A4-11 Agency Call Back Information

Incident Number: ____________

Document all information that agencies request.

Date:	**Time:**
Agency:	**Person Contacted:**
Reason for Call Back:	
Document all dialogue with agency below:	

Form A4-12 Chronological Log of Events

Incident No.___________

Document all events chronologically.

Date/Time	Record of Event

Form A4-13 Incident Report

Incident No. ___________

Reviewed by:	**Final Date:**
□ Attach Initial Notification Form for basic data, update as incident progresses.	
Incident Duration (dates and time):	Type and Location of Incident:
Categorical Level of Incident and what portions of response team were assembled? Identify all leader positions and names.	Does the incident create a potential compliance issue? If yes, describe.
Material released:	Final released volume:
Were there any abnormal operating conditions immediately before the emergency? If yes, describe.	Were there any equipment problems or changes immediately before the emergency? If yes, describe.
Description of media impacted:	Was all media cleaned up to satisfaction of regulatory agencies?
Type and volume of waste generated: (attach waste tracking log if applicable)	How and where was waste disposed or recovered?
Were all spilled materials recovered? If not, describe what was not recovered and why.	

Provide description of clean-up methods utilized:	
Describe decontamination procedures and include pieces of equipment decontaminated.	
Has stock of emergency equipment been replenished to pre-incident conditions?	Date demobilization was completed.
Describe what worked and did not work during incident:	
Recommendations for improvement:	

Form A4-14 Response Equipment Inspection Log

Incident No. ___________

Inspector	Date	Equipment	Comments

The Project is being developed and permitted using an "Envelope" concept. The Envelope concept allows Vineyard Wind to properly define and bracket Project characteristics for purposes of environmental review and permitting while maintaining a reasonable degree of flexibility with respect to selection and purchase of key Project components. Specific details will be identified in the final version of the OSRP.

Form A4-15 Secondary Containment Checklist and Inspection Form

Incident No. ___________

Area(s) Inspected:	**Date/Time:**	**Inspected By:**
Inspection Item	**Acceptable (Y/N)**	**Comments/Corrective Action**
Level of precipitation in containment		
Presence of spilled or leaked material		
Operational status of drainage valves		
Debris		
Location/status of pipes, inlets, drainage		
Cracks		
Discoloration		
Corrosion		
Valve conditions		

The Project is being developed and permitted using an "Envelope" concept. The Envelope concept allows Vineyard Wind to properly define and bracket Project characteristics for purposes of environmental review and permitting while maintaining a reasonable degree of flexibility with respect to selection and purchase of key Project components. Specific details will be identified in the final version of the OSRP.

Form A4-16 Monthly Checklist and Inspection Form

Incident No. ___________

Tank(s) Inspected:	**Date/Time:**	**Inspected By:**
Inspection Item	**Acceptable (Y/N)**	**Comments/Corrective Action**
Emergency Generator (Day Tank and Lubrication Oils)		
Diesel Tank		
Platform Crane		
Power Transformers		
Reactors		
Auxiliary/Earthing Transformers		
Wind Turbine Generators		

Inspect for the following:

- **Support structure is in good condition (no corrosion or damage)**
- **External shell structure is in good condition (no corrosion or damage)**
- **Drip pans are in place (if applicable)**
- **Foundation is in good condition (stable and level)**
- **Liquid level gauge is in place and in good working condition (if applicable)**

Remarks:

Form A4-17 Response Equipment Maintenance Log

This may be maintained on computer log or paper but kept on-site. Include description of maintenance activities performed (i.e., repaired boat motor, gate valves lubricated, booms cleaned, etc.).

Date	Equipment	Maintenance Performed

Annex 5 – Training Exercises/Drills and Logs

Facility response training, drills/exercises, personnel response training, and spill prevention meetings in this section comply with the requirements of 30 CFR 254.41. Per 30 CFR 254.41(d), training certificates and training attendance records must be maintained in a designated location for at least two years. Vineyard Wind will maintain documentation of training in the New Bedford, Massachusetts office. Training records must be made available to any authorized BSEE representative upon request. The Emergency Response Critique forms used to document inspections, drills and training are included in Appendix A5-1.

A5.1 Drills and Exercises

Per 30 CFR 254.42(a), the entire OSRP must be exercised at least once every three years. However, to satisfy this requirement, separate exercises may be conducted over a 3-year period. Exercises must simulate conditions in the area of operations, including seasonal weather variations, to the extent practicable. In addition, exercises must cover a range of scenarios, such spills of a short duration and limited volume, large continuous spills, and the worst-case scenario discharge.

A schedule of exercises will be determined by management in accordance with 30 CFR §254.42(b). The Chief, OSPD may require a change in the frequency of required exercises. Actual training exercises will be coordinated with the OSRO. Response training programs will comply with the Preparedness for Response Exercise Program (PREP) and the USCG/EPA training guidelines for oil spill response. Table A5-1 includes a list of regular personnel training exercises. Appendix A5-1 presents Drill/Exercise Documentation Forms associated with the training exercises.

The Chief, OSPD and BOEM must be notified at least 30 days prior to the following exercises: annual spill management team tabletop exercise; annual deployment exercise of response equipment identified in the OSRP that is staged at onshore locations; and semi-annual deployment exercise of any response equipment which the BSEE Regional Supervisor requires an owner or operator to maintain at the facility or on dedicated vessels. The annual Incident Command Organization (ICO) tabletop exercise will include the actual notification to the NRC, BSEE Regional Supervisor, BOEM, and the OSRO, to determine availability and response times. Each call that is made will begin with the statement “This is a drill”.

As detailed in this annex, several types of drills are conducted as part of the drill program as follows:

- Notification drills to test communications procedures are conducted monthly.
- Qualified Individual (QI) notification drills are conducted at least quarterly to verify that the QI can be reached in an emergency situation to perform required duties.
- The Spill Management Team participates in a table-top drill annually and is included in other drills as often as possible.
- Unannounced annual notification drills are performed. These drills are conducted with BOEM and OSRO participation. These annual drills will simulate a response action and conveyance of key information between the QI, BOEM, and the OSPD.
- Every effort is made to cooperate in local drills requested by regulatory agencies and neighbors.
- Spill removal organizations under contract are drilled at least annually.

The annual notification drill will be an opportunity for the QI, BOEM, and OSPD to simulate an incident command post setting that is capable of supporting response efforts (e.g., deployment of personnel and equipment, tracking containment efforts, taking samples, shoreline cleanup, etc.) for a variety of spill scenarios. Prior to the drill, the size and scope of the drill will be defined and will be structured of various levels of complexity to test events ranging from implementation of specific components of the OSRP to full implementation of the plan.

Facility spill response drills are comprehensive and designed to improve response actions at the level of the first responder. A tabletop planning session is held prior to the drill, with a limited number of supervisory personnel informed of the drill.

Drills are conducted to enable personnel who will act as initial responders during an actual spill to become familiar with response equipment. During spill drills, the techniques of pulling and placing boom such as for diversion, deflection, and containment are practiced. Drills are also conducted to allow personnel to become familiar with climatic conditions, such as the interactions of wind, tide, and wave actions and their effect on oil movement. In spill drills, consideration is given to sensitive areas which may be affected and need protection.

As part of the drill process, a critique is held following the drill. All personnel who participate in the drill, including observers, also participate in the critique. The purpose of this is to review the drill for procedures which worked well and procedures which did not work well. Each individual has an opportunity to provide for input. Recommendations are submitted to management.

Annually, at least one of the exercises listed in Table A5-1 must be unannounced. Unannounced means the personnel participating in the exercise must not be advised in advance, of the exact date, time, and scenario of the exercise. The staff from the Project will also participate in unannounced exercises as directed by the lead federal agency. The objectives of the unannounced exercises will be to test notifications and equipment deployment for response to the average most probable discharge. After participating in an unannounced exercise directed by the lead federal agency, Project personnel will not be required to participate in another unannounced exercise for at least 3 years from the date of the exercise.

Project personnel will also participate in Area exercises as directed by the applicable On-Scene Coordinator. The Area exercises will involve equipment deployment to respond to the spill scenario developed by the Exercise Design Team, of which Project will be a member. After participating in an Area exercise, Vineyard Wind will not be required to participate in another Area exercise for at least six years.

All drills and exercises will be documented on the Exercise Drill Logs and maintained by the Training Department. An example training log form is presented in Appendix A5-2. Records of these activities will be maintained for a period of three years, as per 30 CFR 254.42(e).

A5.2 Planned Training

Planned training sessions are held for staff and operations personnel on an annual basis to gain an understanding of the OSRP process. The intent of these sessions is to keep personnel informed of their obligation to respond to all emergencies, prevent pollution incidents, and to improve spill control and response techniques. These briefings highlight and describe known spill events or failures, malfunctioning components, and recently developed precautionary measures to prevent spills.

All field personnel will be indoctrinated in the proper procedures for the reporting of spills. Included in this training are procedures for contacting the Qualified Individual (QI) on a 24-hour basis. They will also review procedures on how and where to place facility containment/recovery materials depending on where the spill occurs and various seasonal conditions. Personnel will be informed that detergents or other surfactants are prohibited from being used on an oil spill in the water, and that dispersants may only be used with the approval of the Regional Response Team.

Records of all training activities are maintained for at least five years following completion of training. The facility will maintain records for each individual as long as these individuals are assigned duties in this plan. Individuals will sign documentation when participating in training classes or exercises as provided in Appendix A5-2.

Credit for any of the above drills and exercises may be taken by Vineyard Wind if an actual incident occurs and records of the incident are maintained to show evidence of complying with any of the above drill or exercise requirements.

Table A5-1 Response Training Exercises

Exercise	Purpose/Scope	Objectives	Frequency	Participants
QI Notification Exercise	Ensure the QI can be contacted in a spill response emergency in order to carry out required duties.	• Contact QI by telephone, radio, fax, pager, or email. • Confirmation received from QI of notification.	Monthly	Qualified Individuals
Incident Command Organization Team (table top) *	Ensure the Incident Command Organization's emergency management team is familiar with the procedures.	• ICO Team is familiar with emergency response procedures. • Employs proper procedures during a simulated emergency response.	Annually	ICO Management Team, OSPD, BOEM
On-Site Equipment Deployment Exercise	Verify that required response equipment is operable and personnel are capable of deploying the equipment.	• Verify that designated equipment is available. • Deploy at least minimum required equipment during exercise. • Verify that personnel tasked with deployment have received required training.	Annually	Project Response Team, OSPD, BOEM, OSRO
OSRO Equipment Deployment Exercise	Same as above, but performed by OSRO	• Same as above	Annually	OSRO
Discharge Prevention Briefings	Conduct Discharge Prevention Briefings	• Personnel have adequate understanding of the OSRP. • Describe known discharges or failures. • Discuss any recently developed precautionary measures.	Annually (optional)	Oil-handling Personnel
Simulated Spill Drill**	Test the resources and response capabilities of the OSRO.	• Demonstrate OSRO's ability to deploy resources to include: o On water containment and recovery o Sensitive habitat protection • Storage	Every three years	Oil-handling Personnel

* *In a 3-year period, at least one of these exercises must include a worst-case discharge scenario.*
** *In a 3-year period, all components of the response plan must be exercised.*
Annually at least one of the first three exercises listed must be unannounced to participants.

A5.2 Training Documentation and Record Maintenance

Spill response personnel training records will be maintained at the Vineyard Wind office in New Bedford, example training record is provided in Appendix A5-2. Records will be maintained at this location for five years and will include:

- Documentation of yearly training associated with the OSRP as provided to ICO and facility personnel;
- Records of personnel training in accordance with OSHA at 29 CFR §1910.120 regulations; and
- Records of training provided for response contractor personnel will be maintained at the respective contractor's office and will be verified by facility personnel on-site.
- Logs of volunteer workers (if applicable) and activities performed.

Table A5-2 Spill Response Drill Form Notification Exercise

VINEYARD WIND LLC
SPILL RESPONSE DRILL/EXERCISE DOCUMENTATION FORM

NOTIFICATION EXERCISE

1. Date performed: ____
2. Exercise or actual response: ______________________________________
3. Facility initiating exercise:____
4. Name of person notified:____

   Is this person identified in your response plan as qualified individual or designee?____
5. Time initiated:____

   Time in which qualified individual or designee responded:_____________________
6. Method used to contact:

   ____Telephone

   ____Pager

   ____Radio

   ____Other______________________________
7. Description of notification procedure:

   ____

   ____

   ____
8. Evaluation of Drill:

   ____

   ____

   ____
9. Changes to be implemented (if any):

   ____

   ____

   ____

Certifying Signature____

Table A5-3 Spill Response Drill Form Team Tabletop Exercise

VINEYARD WIND LLC
SPILL RESPONSE DRILL/EXERCISE DOCUMENTATION FORM

SPILL MANAGEMENT TEAM TABLETOP EXERCISE

1. Date performed:____
2. Exercise or actual response:____

   If an exercise, announced or unannounced:_________________________________
3. Location of tabletop:____
4. Time started:____

   Time completed:____
5. Response plan scenario used (check one):

   ____Average most probable discharge ____Worst case discharge

   ____Maximum most probable discharge ____Size of (simulated) spill-bbls/gals
6. Describe how the following objectives were exercised:

a) Spill management team's knowledge of oil-spill response plan:

____

____

____

b) Proper notifications:

____

____

____

c) Communications system:

____

____

____

d) Spill management team's ability to access contracted oil spill removal organizations:

____

____

____

e) Spill management team's ability to coordinate spill response with On-Scene Coordinator, State and applicable agencies:

____

____

____

f) Spill management team's ability to access sensitive site and resource information in the Area Contingency Plan:

____

____

____

SPILL MANAGEMENT TEAM TABLETOP EXERCISE (Continued)

7. Evaluation of Exercise:

8. Changes to be implemented (if any):

Certifying Signature:____

Table A5-4 Spill Response Drill Form Equipment Deployment Exercise

VINEYARD WIND LLC
SPILL RESPONSE DRILL/EXERCISE DOCUMENTATION FORM

EQUIPMENT DEPLOYMENT EXERCISE

1. Date performed:____
2. Exercise or actual response:____

   If an exercise, announced or unannounced:__________________________________
3. Deployment location(s):

   ____
   ____
   ____
4. Time started:____

   _______Time OSRO called (if applicable)

   _______Time on-scene

   _______Time boom deployed

   _______Time recovery equipment arrives on-scene

   _______Time completed
5. Equipment deployed was:

   _______Facility-owned

   _______OSRO-owned; if so, which OSRO:__________________________________

   _______Both
6. List type and amount of all equipment (e.g., boom and skimmers) deployed and number of support personnel employed:

   ____
   ____
   ____
   ____
   ____
7. Describe goals of the equipment deployment and list any Area Contingency Plan strategies tested. Attach a sketch of equipment deployments and booming strategies:

   ____
   ____
   ____
   ____
   ____
8. For deployment of facility-owned equipment, was the amount of equipment deployed at least the amount necessary to respond to your facility's average most probable spill?

   ____
   ____
   ____

EQUIPMENT DEPLOYMENT EXERCISE (Continued)

9. Was the equipment deployed in its intended operating environment?

____
____
____

10. For deployment of OSRO-owned equipment, was a representative sample (at least 1000 feet of each boom type and at least one of each skimmer type) deployed?

____
____
____

11. Was the equipment deployed in its intended operating environment?

____
____
____

12. Are all facility personnel that are responsible for response operations involved in a comprehensive training program, and all pollution response equipment involved in a comprehensive maintenance program?

____
____
____

13. Date of last equipment inspection:______________________________
14. Was the equipment deployed by personnel responsible for its deployment in the event of an actual spill?______________________________
15. Was all deployed equipment operational? If not, why not?

____
____
____

16. Evaluation of Exercise:

____
____
____

17. Changes to be implemented (if any):

____
____
____
____
____
____

Certifying Signature:______________________________

Table A5-5 Vineyard Wind Training Log

VINEYARD WIND LLC
TRAINING LOG

EMPLOYEE TRAINING

Employee Name	Date	Hours of Training	Training Topic

Annex 6 – Regulatory Compliance and Cross-Reference Matrix

Table A6-1 Oil Spill Response Plans for Outer Continental Shelf Facilities

Oil Spill Response Plans for Outer Continental Shelf Facilities 30 CFR254, Subpart B		Plan Reference
254.21(b)(1)	Table of Contents	Table of Contents
254.21(b)(2)	Emergency response action plan	Annex 3
254.21(b)(3)(i)	Equipment response inventory	Annex 9
254.21(b)(3)(ii)	Contractual agreements	Annex 8
254.21(b)(3)(iii)	Worst case discharge scenario	Annex 7
254.21(b)(3)(iv)	Dispersant use plan	Annex 7: Response
254.21(b)(3)(vi)	In situ burning plan	Annex 7: Response
254.21(b)(3)(vi)	Training and drills	Annex 5
254.22(a)	Facility location and type	OSRP Section 1.3
254.22(b)	Table of Contents	Table of Contents
254.22(c)	Record of changes	OSRP Page iv
254.22(d)	Cross reference table	Annex 6
254.23(a)	Designation of QI	OSRP: Section 2.2, Table 2-2, Section 2.3
254.23(b)	Designation of spill management team	TBD[1]
254.23(c)	Spill response operating team	TBD[1]
254.23(d)	Spill response operation center	TBD[1]
254.23(e)	Oil stored, handled, or transported	Annex 7
254.23(f)	Procedures for early detection of a spill	OSRP Section 2.1
254.23(g)(1)	Spill notification procedures	OSRP Section 2.2 Annex 4
254.23(g)(2)	Methods to detect/predict spill movement	Annex 7
254.23(g)(3)	Methods to prioritize areas of importance	OSRP Section 2.5, Annex 7
254.23(g)(4)	Methods to protect areas of importance	OSRP Section 2.6
254.23(g)(5)	Containment and recovery equipment deployment	Table 2-4
254.23(g)(6)	Storage of recovered oil	OSRP Section 2.6.3
254.23(g)(7)	Procedures to remove oil and oil debris from shallow waters	OSRP Section 2.6.2
254.23(g)(8)	Procedure to store, transfer, and dispose of recovered oil and oil-contaminated materials	OSRP Section 2.6.3
254.23(g)(9)	Methods to implement dispersant use plan and in situ burning plan	Annex 7: Response
254.24(a)	Inventory of spill response resources	Annex 9

Oil Spill Response Plans for Outer Continental Shelf Facilities 30 CFR254, Subpart B		Plan Reference
254.24(b)	Procedures for inspecting and maintaining spill response equipment	Annex 9
254.25	Contractual agreements	Annex 8
254.26(a)	Volume of worst case discharge	Annex 7
254.26(b)	Trajectory analysis	Annex 7
254.26(c)	List of special economic and environmentally important resources	Table 2-4
254.26(d)(1)	Response equipment	Annex 9
254.26(d)(2)	Personnel, materials, and support vessels	TBD[1]
254.26(d)(3)	Oil storage, transfer, and disposal equipment	Annex 9
254.26(d)(4)	Estimation of time to mobilize	TBD[1]
254.26(e)	Suitability of response	TBD[1]
254.27	Dispersant use plan	Annex 7: Response
254.28	In situ burning plan	Annex 7: Response
254.29(a)	Training	Annex 5
254.29(b)	Drills	Annex 5
254.30	Revision of OSRP	OSPR Page iv

Note: The Construction and Operations Plan (COP) for the Project is to be submitted to BOEM WEA by the end of 2017. Initial award selection(s) for long term PPA(s) are expected in the spring of 2018. Construction is scheduled to commence in 2020.

Annex 7 – Planning Calculations for Discharge Volumes and Response Equipment

Per 30 CFR 254.26, the volume of the worst-case discharge scenario must be determined using the criteria in 30 CFR 254.47. The criteria in 30 CFR 254.47 applies to oil production platform facilities and pipeline facilities. The Project does not fall into either one of these categories. Per BOEM WEA, each region is responsible for Worst Case Discharge Determination (WCD) verifications and decision documentation for plans in their regional jurisdiction. The Atlantic Region does not have guidance available for wind farms. For calculating the worst-case scenario, information on what fluids will be present and associated quantities was provided.

A7.1 Facility Information

Vineyard Wind is developing an 800 MW offshore wind project for the northern half of BOEM WEA Lease Area OCS-A-0501 (the Project). The Project is being developed and permitted using an “Envelope” concept. The Envelope concept allows Vineyard Wind to properly define and bracket Project characteristics for purposes of environmental review and permitting while maintaining a reasonable degree of flexibility with respect to selection and purchase of key Project components (the wind turbine generators, the foundations, the offshore cable system, the offshore substations, etc.). This flexible approach is particularly important in this situation because the RFP process is designed to reward the most economic projects.

The Project will include Wind Turbine Generators (WTGs) ranging from 8 to ~14 MW. Up to 106 turbine locations are being permitted to allow for spare positions (in the event of environmental or engineering challenges). Although the Project is including 106 WTG positions in the Project Envelope, only up to 100 positions will be occupied by a WTG. The offshore substations or electrical service platforms (ESPs) will include step-up transformers (66 kV to 220 kV) and other electrical gear. The Project will include either one 800 MW ESP or two 400 MW ESPs. The ESPs are expected to be located along the northwest edge of the Lease Area.

Table A7-1 WTG Oil Storage

Oil Source	Volume (Liters)	Kilograms	Approximate Gallons
Gearbox, yaw, and hydraulics	8,000		2,113
Transformer	6,500		1,717
Grease for Yaw Ring	1,000		264.2
Diesel	3,000		792.5
TOTAL			**4,887**

Table A7-2 ESP Oil Storage

Oil Source	Volume (Liters)	Gallons
Emergency Generator – Diesel Day Tank	3,802	1,004
Emergency Generator – Lubrication Oil	53	14
Diesel Tank	16,896	4,463
Platform Crane – Hydraulic Oil	1,267	335
Power Transformers (2 units)	291,454	76,994
Reactors (2 units)	147,839	39,055
Auxiliary/Earthing Transformer	8,448	2,232
TOTAL		**124,097**

A7.2 Oil Volume and Spill Containment

If all the oils associated with the ESPs were released, the worst-case scenario would be 124,097 gallons per ESP. However, control measures (e.g. containment structures) would be in place to contain a release of oil. Where possible, biodegradable oils will be used. In addition, monitoring equipment will be used to detect a release of oil. Monitoring equipment being considered include closed circuit televisions (CCTVs), supervisory control and data acquisition (SCADA), alarm systems (e.g. tank level, containment liquids, etc.), and oil detection equipment for the sump tank. The equipment will be monitored remotely from a "control room". Specific details will be identified in the final version of the OSRP.

The ESP platform is designed to be equipped with a drain system consisting of containment structures, piping, an oil water separator, and a sump tank. The containment structures are sized according to the largest container and are connected via a piping system, draining liquids under gravity to an oil water separator and a sump tank. The sump tank can store the largest oil volume on one transformer and its cooler. The sump tank may be emptied by a service vessel for proper disposal of the oily substances onshore.

In general, all equipment that contains an environmentally harmful substance is placed above drip trays. The central area of the platform where the transformers are placed is a plated area with drains, acting as drip trays. Drip trays that have the potential to collect rain water, such as the central area, are connected via the oil water separator to the sump tank. Other drip trays (e.g. indoor) which collect only harmful substances may be connected directly to the sump tank.

Rain water and oily substances are separated in the oil water separator before water is led overboard. Water being led overboard is monitored for oil contamination. The overboard line will be closed and the drained liquids are fed to the sump tank and stored, in the event of a release.

Any temporary piping connections transporting oily substances (e.g. between diesel storage container and emergency generator) will be made using off-shore certified dry-break connectors and placed above a drip tray. A simple oil spillage kit, allowing to mitigate small, local spillage during maintenance, will be part of the delivery. The WTGs contain approximately 4,887 gallons of oil per WTG. The WTGs are designed to have a fiberglass secondary containment system, which would be sized according to the largest container.

A7.3 Oil Spill Trajectory

An oil spill modeling study was performed to assess the trajectory and weathering of oil following a catastrophic release of all oil contents from the topple of an electrical service platform (ESP; the only project component containing 250 barrels or more of oil) located closest to shore within the Wind Development Area (WDA). This would be the worst-case discharge scenario, involving the unlikely release of a relatively small and finite amount of oil (on the order of 1,500-3,000 barrels (bbl) in comparison to a larger multi-million bbl catastrophic release such as the Deepwater Horizon oil spill). It is important to note that the modeling conducted includes the conservative assumption that no oil spill response or mitigation would occur. In fact, Vineyard Wind would employ containment and recovery methods, including response equipment employed on water that would be used to prevent the spread of the spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted. A full description of the oil spill modeling and results are provided in Annex 11 of this OSRP.

A7.4 Resources of Special Economic or Environmental Importance

According to the Regional Oil and Hazardous Substances Pollution Contingency Plan, MassDEP is the designated representative of Region I RRT for the Commonwealth of Massachusetts. In addition, MassDEP is the Trustee for Natural Resources under OPA. MassDEP has established a Priority Resource Map, which includes data such as sole source aquifers, wellhead protection areas, protected open space areas, areas of critical environmental concern, and estimated habitats of rare wildlife. The mapping does not include the Project area, since it is in the OCS.

The nearest land mass to the Project is the island of Martha's Vineyard, which is located approximately 14.4 miles north of the Project. The island of Martha's Vineyard is an EPA designated sole source aquifer. The central and eastern portions of Martha's Vineyard have been identified as potentially productive aquifers. An area that has been designated as a NHESP Estimated Habitat of Rare Wildlife is located south of Martha's Vineyard in the Atlantic Ocean. This area extends approximately 1 mile offshore in the western and central portions of Martha's Vineyard to approximately 4.5 miles offshore in the eastern portion of Martha's Vineyard. Open spaces on Martha's Vineyard include Manuel F. Correllus State Forest in the central portion of the island and several beaches located along the perimeter of the island.

Environmental Sensitivity Index (ESI) maps, available from NOAA, provide a summary of coastal resources that are at risk if an oil spill occurs in the area. Maps with coverage of Martha's Vineyard are contained in: Massachusetts and Rhode Island: Volume 3 Buzzards Bay. The maps are available in pdf format at: https://response.restoration.noaa.gov/maps-and-spatial-data/download-esi-maps-and-gis-data.html.

The oil spill modeling results (provided in Annex 11 of this OSRP) conservatively assume that no oil spill response or mitigation would occur. This is a very conservative assumption as the ESP will be designed with containment and Vineyard Wind would employ containment and recovery methods to contain and recover onshore and aquatic petroleum spills. Under these very conservative assumptions, the modeling results indicate there is a <30-40%% probability that oil above a threshold of concern for ecological impacts would reach the shorelines of Martha's Vineyard and Nantucket within 1-3 days of the release during all seasons. There is a lower probability (<10%) of oil above the threshold reaching the shorelines of Rhode Island and Massachusetts >3 days following the release. There is the relatively small (<10%) potential for shoreline contamination to occur above the threshold on parts of Long Island and

Connecticut; however, the timing for this to happen is much longer (>10 days) in most cases, and would likely be largely mitigated with response measures. When comparing the oil spill modeling results with the ESI data for Massachusetts and Rhode Island, the southern shores of Martha's Vineyard and Nantucket, which would likely be the first shorelines to be impacted by a spill (prior to response equipment being deployed), are primarily dominated by tidal flats. The shorelines of Rhode Island and Massachusetts on which there would be a lower probability of oiling above the threshold for ecological effects are predominately comprised of sand and gravel beaches and riprap. Some of the specific areas of environmental concern along the southern shores of Martha's Vineyard and Nantucket that would be taken into special consideration in the event of an oil spill include the Long Point Wildlife Refuge, Katama Plains Nature Preserve, Head of Plains Wildlife Management Area, Smooth Hummock Coastal Preserve and Miacoment Heath Wildlife Management Area.

A7.5 Response

The Project has not yet been approved. Details regarding spill response materials, services, equipment, and response vessels have not been finalized at this time.

The WTGs and ESPs have been designed to utilize secondary containment systems to prevent a release of oil to the environment. Containment will be provided considering the size of the largest container. The secondary containment for the ESPs are connected to a sump tank. In addition, an oil/water separator will be in use. It is unlikely that a release of oil would not be contained by the containment systems.

Oils used by the Project have a specific gravity of less than 1.0. Therefore, any releases of oil to water would float on the surface of the water and on-water techniques could be used to recover the released oil.

Vineyard Wind will retain a third-party Oil Spill Response Contractor to assist in the unlikely event of a release of oil to the environment. In addition, Vineyard Wind will maintain pier space for Crew Transport Vessels (CTV) and other support vessels. CTVs are purpose built to support offshore wind energy projects; they are typically 75 feet in length and set up to safely and quickly transport personnel, parts and equipment. In addition to vessels, Vineyard Wind will maintain spill response equipment such as a spill overpack drum, containment bladders, absorbent booms, pigs, socks, and other sorbent materials. In addition, Vineyard Wind will have on-hand personal protective equipment (PPE) such as goggles or safety glasses, face shields, gloves, and disposable chemical and oil resistant suits (e.g. Tyvek suits).

Massachusetts Department of Environmental Protection (MassDEP) maintains a list of companies licensed as hazardous waste transporters who provide emergency response services and cleanups of oil and/or hazardous material (OHM) spills. MassDEP SERO emergency response contractors located in close proximity to the Project include Frank Corporation (New Bedford), Global Remediation Services, Inc. (Sandwich), Clean Harbors, Incorporated (Braintree), and Cyn Oil Corporation (Stoughton). Both companies maintain boats and other equipment to respond to releases of oil on the in a marine environment. Once a spill response contractor has been selected, additional details will be provided regarding spill response resources and the time needed for procurement of the spill response resources. In addition, a discussion of response to worst case scenario in adverse weather conditions will be addressed once a spill response contractor has been selected. Per 33 CFR 115.1020, factors to consider when evaluating adverse weather include, but are not limited to, significant wave height, ice, temperature, weather-related visibility, and currents.

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) restricts dispersant use to only areas where agreements have been established. In addition, the NCP limits restricts dispersant use to only those approved by EPA. Per Appendix 4 of the RRT Regional Oil and Hazardous Substances Pollution Contingency Plan, pre-authorization for the use of chemical dispersants has been established.

The Massachusetts/Rhode Island Dispersant Pre-Authorization Policy establishes conditional approval zone for areas in Massachusetts and Rhode Island within two nautical miles of the mainland or designated islands, or areas that have a mean low water depth of less than 40 feet. The Project is located in the OCS and is beyond two nautical miles of the mainland or designated islands. In addition, water depths in the area of the Project are approximately 115 to 161 feet. Therefore, the Project is not located in an area that has pre-authorization for the use of dispersants. Vineyard Wind does not propose to use dispersants, and a dispersant use plan is not warranted.

In-situ burning is regulated by Subpart J of the NCP. In addition, the NCP restricts in-situ burning to areas where agreements have been made between state and federal regulatory authorities. Per Appendix 2 of the RRT Regional Oil and Hazardous Substances Pollution Contingency Plan, Region 1 has established an In-Situ Burning Memorandum of Understanding (MOU). The MOU establishes three zones and designates decision of authority for use of in-situ burning in these zones. Zone A is defined as all waters subject to the jurisdiction of the United States located seaward of a line measured six miles from the mean waterline along the coasts and islands of Maine, Massachusetts, New Hampshire, and Rhode Island. Zone B is defined as all waters subject to the jurisdiction of the United States located seaward of a line measured one mile and terminating six miles from the mean low waterline along the coasts and islands of Maine, Massachusetts, New Hampshire, and Rhode Island. Zone C is defined as waters that are shoreward of a line measured 1 mile seaward of the mean low water mark along the coasts and islands of Maine, Massachusetts, New Hampshire, and Rhode Island. The nearest land to the Project is the island of Martha’s Vineyard, which is located approximately 14.4 miles north of the Project. Therefore, the Project is not located in an area that has pre-authorization for the use of in-situ burning. Vineyard Wind does not propose to use in-situ burning, and an in-situ burning plan is not warranted.

Annex 8 – Agreement with Oil Spill Response Organization

The Project has not yet been approved. Construction of the Project is scheduled to begin in 2020. Details regarding contractual agreements have not been finalized at this time.

Per 30 CFR 254.25, the contractual agreements appendix must furnish proof of any contracts or membership agreements with OSROs, cooperatives, spill-response service providers, or spill management team members who are not Vineyard Wind employees that are cited in the OSRP. Documentation should include copies of the contracts, or membership agreements, or certification that contracts or membership agreements are in effect. The contract or membership agreement must include provisions for ensuring the availability of the personnel and/or equipment on a 24-hour-per-day basis.

Vineyard Wind will retain a third-party OSRO. MassDEP SERO emergency response contractors located in close proximity to the Project include Frank Corporation (New Bedford), Global Remediation Services, Inc., (Sandwich), Clean Harbors, Incorporated (Braintree), and Cyn Oil Corporation (Stoughton).

Appendix 9 of the Regional Oil and Hazardous Substances Pollution Contingency Plan contains the Coast Guard/Environmental Protection Agency Response Jurisdiction Boundary. This document demarcates the boundary between inland and coastal zones for the purpose of pre-designation of on-scene coordinators for pollution response. Martha’s Vineyard, Nantucket, and all other islands lying off the coast of Massachusetts are the responsibility of the US Coast Guard for providing the predesignated Federal On-Scene Coordinator. USCG will be responsible for general agency and incident specific responsibilities under the NCP and Area Contingency Plan.

Annex 9 – Equipment Inventory

The Project has not yet been approved. Details regarding spill response materials, services, equipment, and response vessels has not been finalized.

A9.1 Maintenance Facilities

In support of Project operations and the necessary maintenance activities, Vineyard Wind will have a management and administrative team, a "control room" operation, and maintenance facilities. These functions will be co-located, if feasible. Vineyard Wind is in the early stages of evaluating possible locations for the O&M facilities; possible locations include Martha's Vineyard, New Bedford, and other locations.

The technicians and engineers responsible for long term Project maintenance will operate from the maintenance facilities. The maintenance operation will include office and training space, shop space, warehouse space for parts and tools, and pier space for Crew Transport Vessels (CTV), and other support vessels. CTVs are purpose-built to support offshore wind energy projects; they are typically 75 to 85 feet in length and set up to safely and quickly transport personnel, parts, and equipment. The CTVs are typically used in conjunction with helicopters. Helicopters can be used for fast response visual inspections and repair activities, as needed. The maintenance operation may also make use of larger Service Operations Vessels (SOVs). SOVs are typically 260 to 300 feet in length with a deadweight of approximately 4,000 tons at maximum draft. SOVs are usually diesel electric powered with dynamic positioning.

In addition to the vessels above, it is anticipated that Vineyard Wind will maintain spill response equipment such as a spill overpack drum, containment bladders, absorbent booms, pigs, socks, and other sorbent materials. In addition, Vineyard Wind will have on-hand personal protective equipment (PPE) such as goggles or safety glasses, face shields, gloves, and disposable chemical and oil resistant suits (e.g. Tyvek suits).

A9.2 Electrical Service Platform (ESP)

The offshore substations or electrical service platforms (ESPs) will include step-up transformers (66 kV to 220 kV) and other electrical gear. The Project will include either one 800 MW ESP or two 400 MW ESPs. The ESPs are expected to be located along the northwest edge of the Lease Area.

Vineyard Wind will maintain spill response equipment at the ESPs. Brooms, shovels, sorbents, pigs, socks, and a spill overpack drum will be maintained at the ESP for response to minor leaks and spills. In addition, Vineyard Wind will have on-hand personal protective equipment (PPE) such as goggles or safety glasses, face shields, gloves, and disposable chemical and oil resistant suits (e.g. Tyvek suits).

A9.3 Oil Spill Response Contractor

Vineyard Wind will retain a third-party OSRO. Massachusetts Department of Environmental Protection (MassDEP) maintains a list of companies licensed as hazardous waste transporters who provide emergency response services and cleanups of oil and/or hazardous material (OHM) spills. The list is updated annually by MassDEP and is organized by MassDEP Regions. The Southeast Regional Office (SERO) is affiliated with Martha's Vineyard and New Bedford. The list of contractors for the SERO Region is available at: http://www.mass.gov/eea/docs/dep/cleanup/serohwtr.pdf. MassDEP emergency response contractors located in close proximity to the Project include Frank Corporation (New Bedford), Global Remediation Services, Inc. (Sandwich), Clean Harbors, Incorporated (Braintree), and Cyn Oil Corporation (Stoughton).

The selected spill contractor will be responsible for the inspection and maintenance of their equipment. The equipment should be inspected on at least a monthly basis.

A9.4 Inspections (30 CFR 254.43)

Response equipment will be inspected when the WTG is otherwise visited or at least quarterly and maintained to ensure optimal performance. Records of inspections of response equipment must be maintained for at least two years and made available to authorized BSEE representatives upon request. Inspections of contractor equipment is addressed in A9.8.

The program of maintenance and testing of emergency response equipment involves four activities: Operability Check, Inventory, Inspection, and Maintenance. The Emergency Response Team (ERT) Coordinator or designee is required to sign the inspection form, and will be responsible for any follow-up actions that may be required as a result of the inspection, inventory or test of emergency response equipment. For any items that cannot be replaced or repaired during the inspection, test or inventory, the inspector will indicate need of further action on the inspection form. It will then become the responsibility of the ERT Coordinator to take further actions(s) as required.

A9.5 Operability Check (Semi-annual)

This activity is intended to periodically insure the operability of certain items of equipment in the Project's emergency equipment inventory so that it is in a constant state of readiness for deployment. The designated inspector will check the operability of equipment including safety monitoring equipment and outboard motors. Any equipment that is electronic, electrical, or mechanical will be tested under actual load or use conditions.

During the operability check, the inspector will also perform routine maintenance on the equipment, as needed, such as battery replacements, oil and filter changes, and cleaning of boom. The inspector will indicate on the inspection form any problems encountered with the equipment and corrective measures taken or needed.

A9.6 Inventory (Monthly)

The inspector will verify the availability and condition of the variety of supplies, materials, and tools that are maintained in storage. The inspector will work from a list of items that are required to be maintained at all times. Any discrepancies in the list, or item replacement needs, will be noted on the inventory form. Inspection for condition of emergency resources will be checked semi-annually.

A9.7 Inspections

The semi-annual inspection of the sorbent booms will involve complete removal of booms from storage and the laying-out of the booms in an area that would not cause damage to the fabric of the booms. The inspector will examine each length of boom closely, making note of any fabric damages or wear, broken or frayed cable, missing weights and damaged connectors. The inspector will also verify the quantity of boom that is in storage to ensure there is sufficient supply. Any damages will be repaired, if possible. If the length of boom cannot be economically repaired, the inspector will request replacement.

A9.8 Contractor Equipment

The ERT will ensure that the contractor has a maintenance program established for its equipment. A copy of the program would be requested and kept on file.

Annex 10 – Safety Data Sheets

Include SDSs for oils to be located at the Project.

Annex 11 – Vineyard Wind Offshore Wind Project Oil Spill Modeling Study

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Final Report

Vineyard Wind Offshore Wind Project
Oil Spill Modeling Study

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PROJECT NUMBER: 17-000678

VERSION: d4

DATE: 9 July 2018

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Document Control Form

Title:

"Vineyard Wind Offshore Wind Project Oil Spill Modeling Study"

Location & Operator:

Offshore Rhode Island & Massachusetts, Vineyard Wind

RPS Project Number:

17-000678 Vineyard Winds, Oil Spill Modeling

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Release	File Name	Date Submitted	Notes
D4	VineyardWind_OilSpillModeling_2018July9.docx	July 9, 2018 (WTG oil quantities updated January 31, 2020)	Final Report

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Executive Summary

Vineyard Wind, LLC ("Vineyard Wind") is proposing an 800 megawatt ("MW") wind energy project within BOEM Lease Area OCS-A 0501, consisting of offshore wind turbine generators ("WTGs") each placed on a foundation support structure; electrical service platforms ("ESPs"); an Onshore Substation; offshore and onshore cabling; and onshore Operations & Maintenance Facilities (these facilities will hereafter be referred to as the "Project"). Pursuant to 30 CFR 585.627(c), as part of the requirement to submit an Oil Spill Response Plan (OSRP), BOEM states that if any component of the proposed offshore facility contains 250 barrels or more of oil, the OSRP should include a stochastic spill trajectory analysis that addresses the following:

a. The worst-case discharge (WCD) from each component containing 250 barrels or more of oil.

b. The longest period of time that the oil discharged from each component containing 250 barrels or more of oil would reasonably be expected to persist on the water's surface, or 14 days, whichever is shorter.

c. The probabilities for oiling on the water's surface and on shorelines, and minimum travel times for the transport of the oil, over the duration of the model simulation. Oiling probabilities and minimum travel times calculated for exposure threshold concentrations reaching 10 g/m^2. Stochastic analysis incorporating a minimum of 100 different trajectory simulations using random start dates selected over a multi-year period.

Therefore, as an Annex to the Vineyard Wind OSRP (COP Appendix I-A), an oil spill modeling study was performed to assess the trajectory and weathering of oil following a catastrophic release of all oil contents from the topple of an electrical service platform (ESP; the only project component containing 250 barrels or more of oil) located closest to shore within the Wind Development Area (WDA). This would be the worst case discharge scenario, involving a relatively small and finite release of oil (on the order of 1,500-3,000 barrel [bbl] in comparison to a larger multi-million bbl catastrophic release such as the Deepwater Horizon oil spill). Based on the results of a previous BOEM study (Bejarano et al. 2013) assessing potential catastrophic oil spills from offshore wind structures, the probability of occurrence of this type of catastrophic release, such as the topple of an ESP, is extremely small. In addition to the low probability of such an event, the oil spill scenarios modeled in this study assume that no oil spill response or mitigation would occur. This is also a very conservative assumption as the ESP will be designed with containment and Vineyard Wind would employ containment and recovery methods to contain and recover onshore and aquatic petroleum spills. As discussed in further detail in Section 2.3.4 of the OSRP (COP Appendix I-A), response equipment employed on water would be used to prevent the spread of the spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted.

The oil spill model, OILMAP/SIMAP, was used to conduct this assessment. Model inputs included winds, currents, chemical composition and properties of oils of interest and specifications of the release (amount, location, etc.). Environmental conditions (i.e., wind and current forcing, water temperature and salinity) play a critical role in the assessment of the trajectory and weathering of oil in a marine spill. Therefore, a data analysis of these conditions as input to the model was also performed. The data analysis also helped to identify the site-specific seasons in which the modeling scenarios should be performed. As a result of this analysis, a total of eight stochastic modeling scenarios (one per season for two spill volumes) were assessed.

Based on the environmental datasets analyzed as input for the oil spill modeling, the following conclusions can be drawn:

- Winds in the region are moderate, generally blowing from the northwest (winter) or southwest sector (summer) with monthly average wind speeds ranging from 6 to 10 m/s. The strongest winds are found in December and January with the weakest in August.
- Currents at the spill site are up to approximately 30 cm/s speed on average, and their direction changes in the representative seasons.
- In the area of interest, winds are usually more influential than the associated currents in regards to surface transport; however the winds in this region are often much more variable. During the month of July when wind intensity decreases, surface current may control the movement of floating slicks.
- Though there are strong seasonal trends in winds, it is important to note that the direction and magnitude of winds can change from day to day, and the wind roses presented below show monthly averages.

Based on the results of the stochastic oil spill trajectory analysis, the following conclusions can be made:

- The sea surface area exposed to oil exceeding the 10 g/m^2 threshold is contained within approximately 20-25 miles of the 400 MW ESP spill location and 30-50 miles of the 800 MW ESP spill location for all four seasons, with the area for the winter simulation being relatively smaller than the other three seasons.
- In all seasons, there is a 1-40% probability of oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) reaching the shorelines of Martha's Vineyard and Nantucket within 1-3 days of the release. There is an even lower probability (<10%) of oil above the threshold reaching the shorelines of Rhode Island and Massachusetts >3 days following the release. There is the relatively small (<10%) potential for shoreline contamination to occur above 100g/m^2 on parts of Long Island and Connecticut; however, the timing for this to happen is much longer (>10 days) in most cases, and would likely be largely mitigated with response measures.

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1. Introduction

1.1. Project Background

Pursuant to 30 CFR 585.627(c), in which a stochastic spill trajectory analysis is required as part of the Oil Spill Response Plan (OSRP) for any component of the proposed offshore facility containing 250 barrels or more of oil, this Annex documents the oil spill modeling study performed in support of the Vineyard Wind Offshore Wind Project Construction and Operations Plan (COP).

As described in the Vineyard Wind OSRP (COP Appendix I-A), the project components containing oil include the offshore wind turbine generators ("WTGs") placed on a foundation support structure and the electrical service platforms ("ESPs"). The Project will include either one 800 MW conventional ESP or two 400 MW conventional ESPs. The oil sources in the WTGs include gear boxes, transformers, yaw gears, grease for yaw rings, diesel, and the pitch system, which total approximately 4,887 gallons (116 bbl) per WTG. Oil sources in the ESPs include lubrication oil, diesel tanks, hydraulic oil for a platform crane, power transformers, reactors, and auxiliary/earthing transformers. Oil sources associated with one ESP, which is the only project component containing 250 barrels or more of oil, totals approximately 64,634 gallons (1,539 bbl) for a 400 MW ESP and 124,097 gallons (2,954 bbl) for an 800 MW ESP. Therefore, this oil spill modeling study assesses the trajectory and weathering of a catastrophic release of all oil contents from two different scenarios in four seasons (8 total scenarios), including

1. the topple of a 400 MW ESP located closest to shore within the Wind Development Area (WDA). This would be the lower volume worst case discharge scenario involving a relatively small and finite release of oil from one ESP station (1,539 bbl or 245 m^3), in comparison to a larger multi-million bbl catastrophic release (such as the Deepwater Horizon oil spill); and
2. the topple of an 800 MW ESP located closest to shore within the WDA[1], releasing a conservative volume of 2,954 bbl (460 m^3) of oil for a higher end worst case discharge.

Based on the results of a previous BOEM study (Bejarano et al. 2013) assessing potential catastrophic oil spills from offshore wind structures, the probability of occurrence of this type of catastrophic release, such as the topple of an ESP, is extremely small. In addition to the low probability of such an event, the oil spill scenarios modeled in this study assume that no oil spill response or mitigation would occur. This is also a very conservative assumption as the ESPs will be designed with containment and Vineyard Wind would employ containment and recovery

[1] The Project includes two ESP locations: one closer to shore (ESP 1) and one farther from shore (ESP 2). The model scenarios both use the ESP position that is located closest to shore (ESP 1); however, in the time interval between the first and second drafts of this report, a review of ongoing survey data led to the relocation of the ESP closest to shore to a new position that is slightly farther offshore (referred to as ESP 1 – revised). Therefore, the model scenario for the 800 MW ESP incorporates the revised ESP position (ESP 1 – revised) that is slightly farther offshore than the original ESP position (ESP 1) modeled for the 400 MW ESP scenario. The ESP 2 position was not modeled since it is located farthest from shore.

methods to contain and recover onshore and aquatic petroleum spills. As discussed in further detail in Section 2.3.4 of the OSRP (COP Appendix I-A), response equipment employed on water would be used to prevent the spread of the spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted.

1.2. Objectives, Tasks and Study Output

The goals of spill modeling include projecting the probable behavior of accidentally spilled oil using a state-of-the-art 3-dimensional transport model, and producing modeled trajectory and fate output such as visual representations (e.g., probability of oiling and minimum travel time maps) for various scenarios. RPS's proprietary oil spill modeling framework, OILMAP/SIMAP, was used for the simulations performed in this study. Model inputs included winds, currents, chemical composition and properties of oils of interest and specifications of the release (amount, location, etc.). The model was run in stochastic mode, as described further in Section 3, providing two types of information: 1) the footprint of sea surface and shoreline areas exposed to oil above a certain threshold of concern and the associated probability of oil contamination, and 2) the shortest time required for oil to reach any point within the areas predicted to be oiled.

Environmental conditions (i.e., wind and current forcing, water temperature and salinity) play a critical role in the assessment of the trajectory and weathering of oil in a marine spill. Therefore, a data analysis of these conditions as input to the model was performed. The data analysis also helped to identify the site-specific seasons in which the modeling scenarios should be performed. As a result of this analysis, a total of eight stochastic modeling scenarios (one per season for two oil volumes) were assessed.

This report describes the models, modeling approach, model inputs and outputs used in this study. A description of environmental data sources is provided in Section 2. The oil spill modeling approach and scenario specifications are provided in Section 3. Section 4 provides a summary of the stochastic modeling results and conclusions. References are provided in Section 5.

2. Environmental Conditions and Data Analysis

In order to understand the behavior of a marine oil spill, it is necessary to evaluate the predominant environmental conditions in the area. Winds and currents are the key forcing agents that control the transport and weathering of oil. To reproduce the natural variability of the environment, the OILMAP/SIMAP model requires wind and current datasets that vary both spatially and temporally. Optimally, the minimum time window for stochastic simulations is 5 to 10 years; therefore, long-term records of wind and current data were obtained from the outputs of global numerical atmospheric and circulation models. The following section describes the key environmental conditions that dominate in the region of interest and more specifically in the model domain (Figure 1) for which the environmental datasets have been subset.

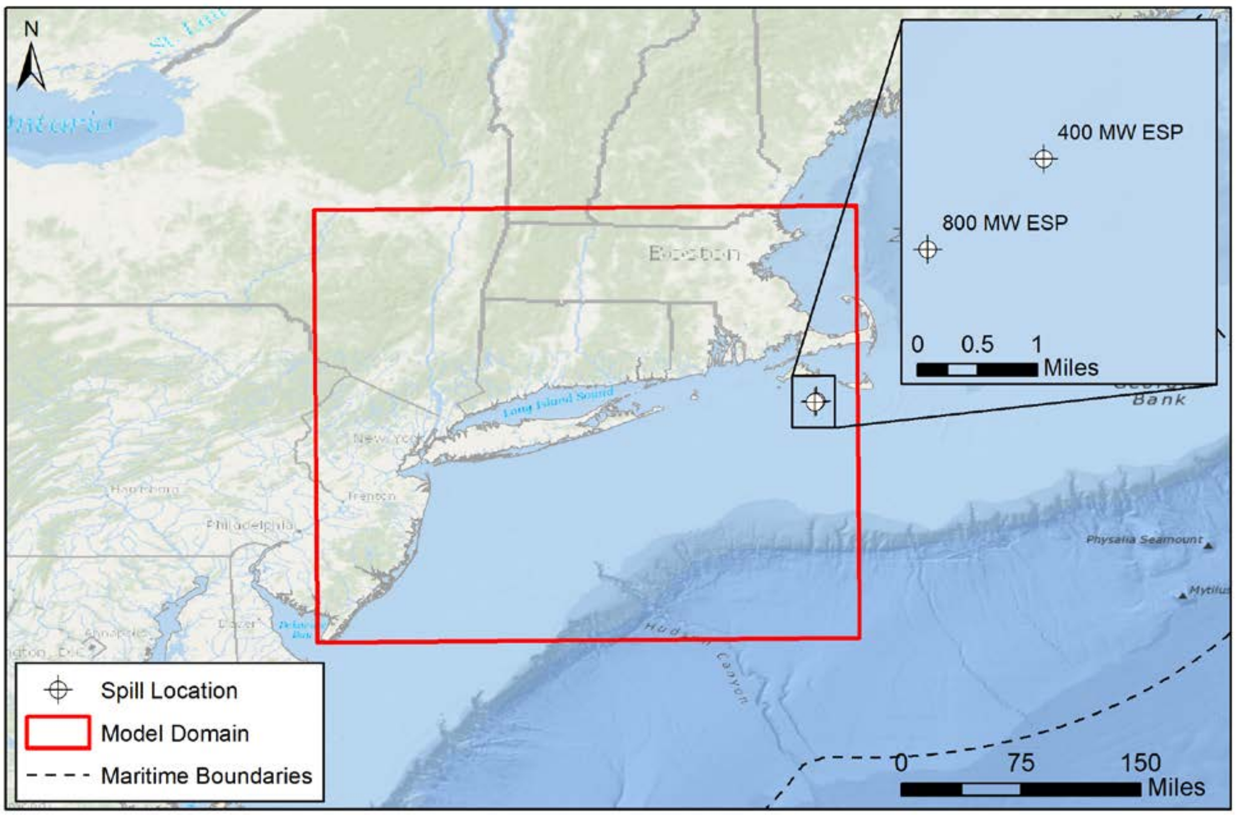


Figure 1. Oil Spill Model domain defined for this study, south of Martha's Vineyard.

2.1. General Dynamics and Climatology

The site of interest is located in the inner shelf of Martha's Vineyard, Massachusetts. Based on the types of spills and the predominant environmental conditions in the region, the modeling domain was defined to encompass the region located south of Martha's Vineyard (Figure 1).
This is an area which has been heavily investigated in terms of the dynamics of depth-dependent across-shelf circulation caused by wind and wave forcing. Fewings et al. (2008) and Lentz et al.

(2008) found significant across-shelf circulation driven by across-shelf winds, as well as evidence of a circulation resulting from waves in the inner shelf. The seasonal (both summer and winter) mean circulations found in the moored observations of Lentz et al. (2008) and Fewings et al. (2008) were generally attributed to the effects of pressure gradients (Lentz 2008; Fewings and Lentz 2010) or surface gravity waves (Lentz et al. 2008). However, modeling studies by He and Wilkin (2006) and Wilkin (2006) indicated that large tidal velocities in the gap between the islands of Martha's Vineyard and Nantucket play a critical role in the formation of upwelling centers near Martha's Vineyard, despite uniform winds.

Data obtained from the World Ocean Atlas (WOA) 2013 climatology dataset (Levitus et al. 2014) for the potential spill site shows the monthly sea surface water temperature typically varies from 4°C to 19°C. The temperature starts to increase from April and reaches the peak during August. After this period, the temperature decreases and reaches the minimum of 4°C in March. The salinity at the spill site stays relatively stable throughout the year, around 32 ppt. The monthly average values of sea surface temperature and salinity at the spill site location are presented in Figure 2.

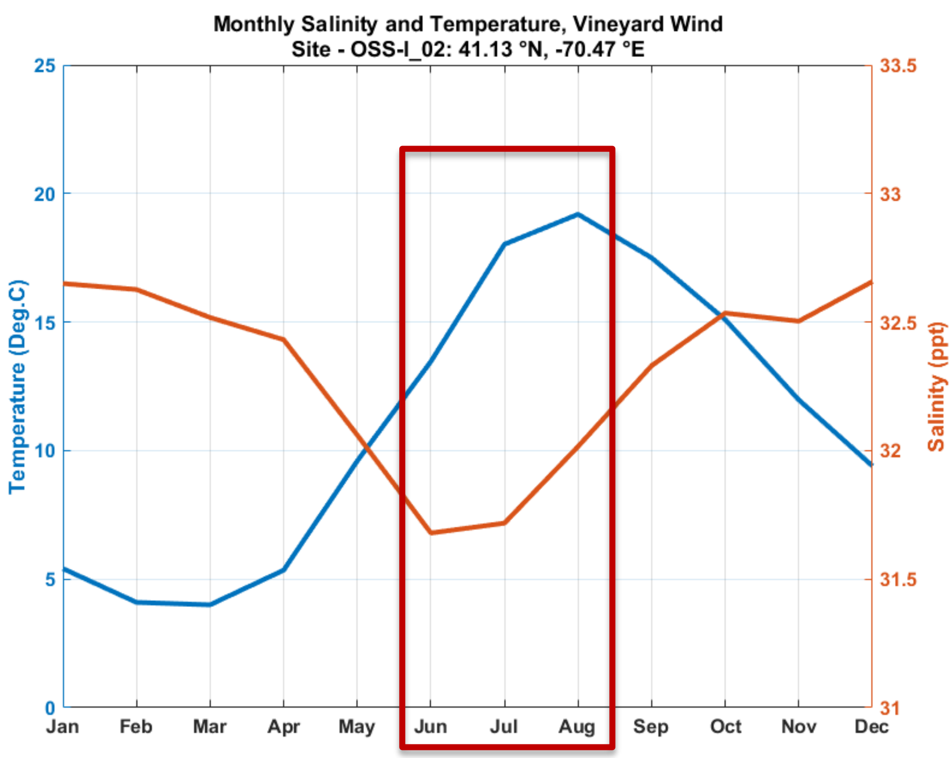


Figure 2. Monthly sea surface temperature (°C) in blue and salinity (ppt) in red at the spill location (data source: WOA 2013). Summer season highlighted with a red box.

From a modeling perspective, the year was split into four representative periods which correspond to the meteorological seasons (winter, spring, summer and fall).
Table 1 lists the months and predominant environmental conditions for each representative period.

Table 1. Summary of season breakdown used for the oil spill modeling.

Season	Representative Months	Season Description
Winter	December-February	Higher Wind, predominately from NW
Spring	March-May	Transition of wind direction from NW to SW with relatively lower wind speed than Winter
Summer	June-August	Lower wind speed, predominantly from SW
Fall	September-November	Transition of wind direction from SW to NW with relatively higher wind speed than Summer

2.2. Wind Dataset – NCEP CFSR

For this study, wind data were obtained from the U.S. National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) for a 10-year period (2001 to 2010). The CFSR was designed and executed as a global, high-resolution, coupled atmosphere-ocean-land surface-sea ice system to provide the best estimate of the state of these coupled domains (Saha et al. 2010). This atmospheric model has a horizontal resolution of 38 km, with 64 vertical levels extending from the surface to the height at which air pressure reaches 0.26 hPa. CFSR winds were also one of the main driving forces used in the HYCOM Reanalysis, the global hydrodynamic currents dataset used in this study. To validate the CFSR product for the purposes of it being included as the wind forcing for oil spill modeling, wind measurements were obtained from a meteorological station located in Buzzards Bay, MA. The name of the station is BUZM3 and it is a Coastal-Marine Automated Network (C-MAN) station, established and operated by National Data Buoy Center (NDBC). Annual wind roses along with monthly statistics were compared between BUZM3 wind data and CFSR wind output (at a grid point close to the location of BUZM3) for a 5-year period (2006-2010). The observation was recorded at an elevation of 24.8m and for comparison with 10m wind from CFSR[2].

The following figures provide qualitative and statistical description of the CFSR winds in this region in order to understand their variability, both spatially and temporally:

- Annual wind roses (in m/s) from BUZM3 observation and CFSR model (Figure 3) in the direction from which the wind is blowing;
- Monthly wind roses (in m/s) from BUZM3 observations (Figure 4) and CFSR model (Figure 5) (near the BUZM3 location) in the direction from which the wind is blowing;
- Wind speed statistics (Figure 6): Monthly average and 95th percentile wind speed statistics (in m/s) from BUZM3 station and CFSR model output (near the BUZM3 location);

[2] The altitude factor has been applied by using the wind shear formula, $u=(uref)*((z/zref)^{\alpha})$ where the shear exponent is typically assumed to be equal to 0.2.
(Source: https://www.esrl.noaa.gov/csd/projects/lamar/windshearformula.html)

- Comparison between BUZM3 observation and CFSR model (Figure 7): Wind speed (in m/s) and direction (degrees) time-series compared between BUZM3 observation and CFSR output.
- Windrose map (Figure 8): Spatial distribution of CFSR annual windroses (in m/s) off the southern coast of New England in the direction from which the wind is blowing;
- Annual windrose (Figure 9): Annual CFSR windrose (in m/s) near the spill site in the direction from which the wind is blowing;
- Wind speed statistics (Figure 10): Monthly average and 95th percentile CFSR wind speed (in m/s) statistics near the spill site, and
- Monthly windroses (Figure 11): Monthly CFSR windroses (in m/s) near the spill site, in the direction from which the wind is blowing.

Based on this analysis of the BUZM3 station observations and the CFSR global wind dataset for a 5-year period (2006-2010), the following conclusions can be drawn:

- CFSR was able to reproduce the wind speed magnitude and direction close to what are seen from observational data (BUZM3), and captured the seasonal variation of wind intensity and directionality. Monthly statistics and time-series (speed and direction) comparison between BUZM3 and CFSR wind indicates the CFSR slightly underestimates the BUZM3 observation in terms of speed, though the seasonal trend of wind direction and magnitude is clearly similar to the observation.
- Winds are mostly consistent during winter and summer, in terms of direction and speed. During winter (December-February), it is predominantly northwesterly with higher speed while throughout summer (June-August), it is mostly southwesterly with lower speed. Spring (March-May) and fall (September-November) are the transition seasons. In spring, predominant wind direction changes from northwest to southwest and average wind speed decreases. Fall marks the period when wind direction changes from southwest to northwest and the speed starts to rise.
- Wind speed and direction are mostly consistent throughout the domain of interest. The spatial distribution of wind (Figure 8) shows that winds are predominantly blowing from the northwest and southwest sectors.
- Monthly average wind speeds range from 6 to 10 m/s, with the weakest winds in August.

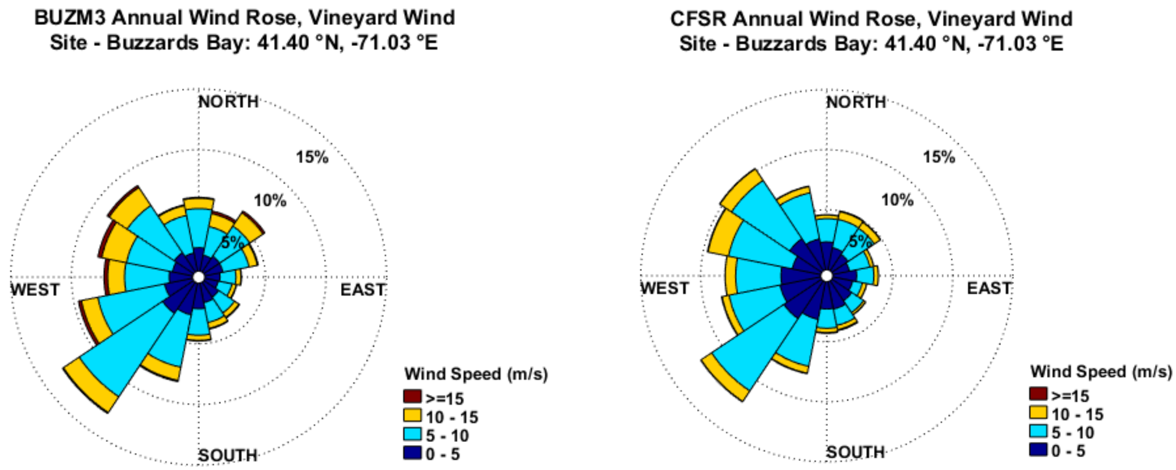


Figure 3. Annual BUZM3 wind rose (left panel) and CFSR wind rose (right panel) near BUZM3 station located in Buzzards Bay for 5 year period (2006-2010). Wind speeds in m/s, using meteorological convention (i.e., direction from which wind is blowing).

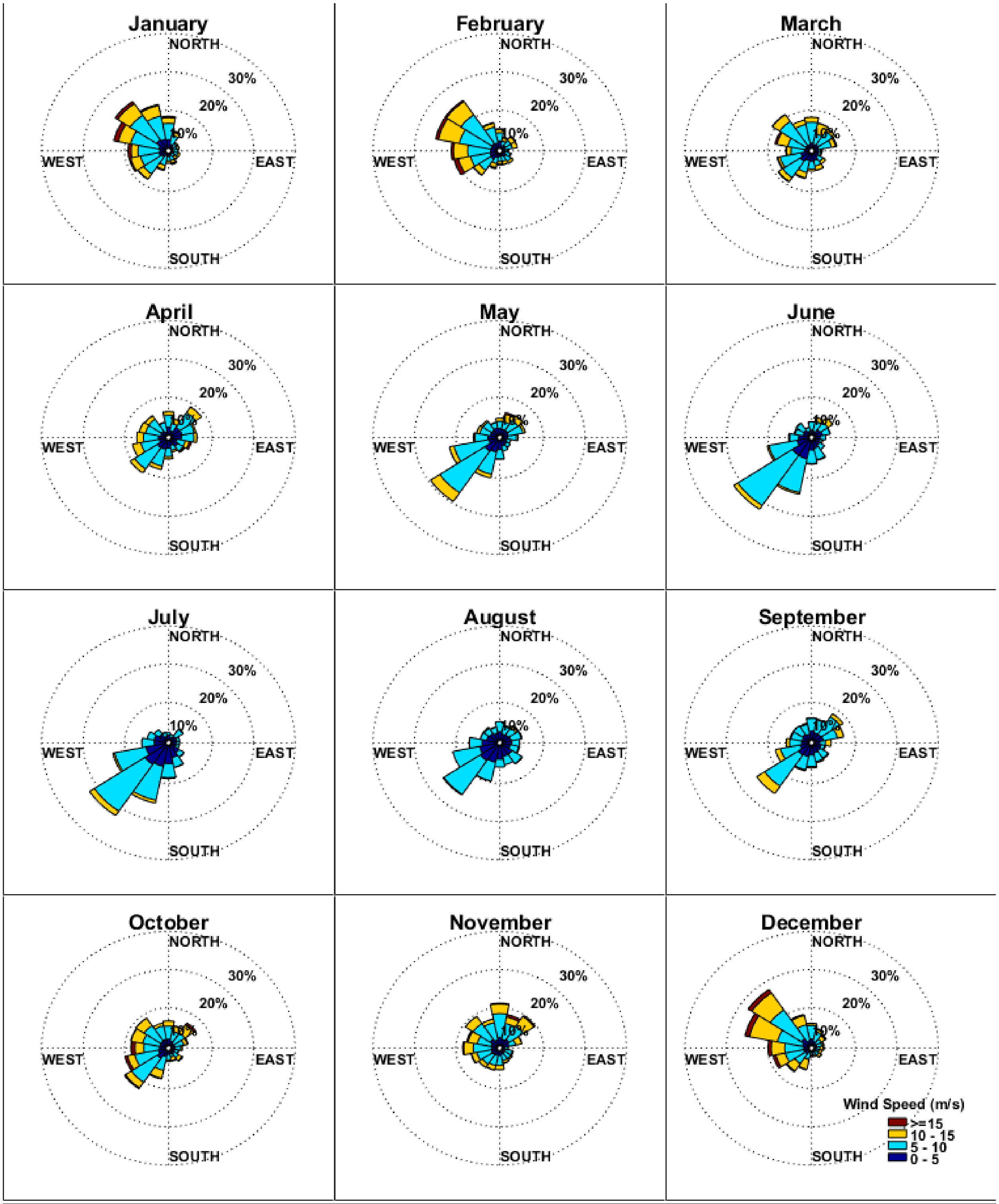


Figure 4. Monthly BUZM3 windroses for 5 year period (2006-2010). Wind speeds in m/s, using meteorological convention (i.e., direction from which wind is blowing).

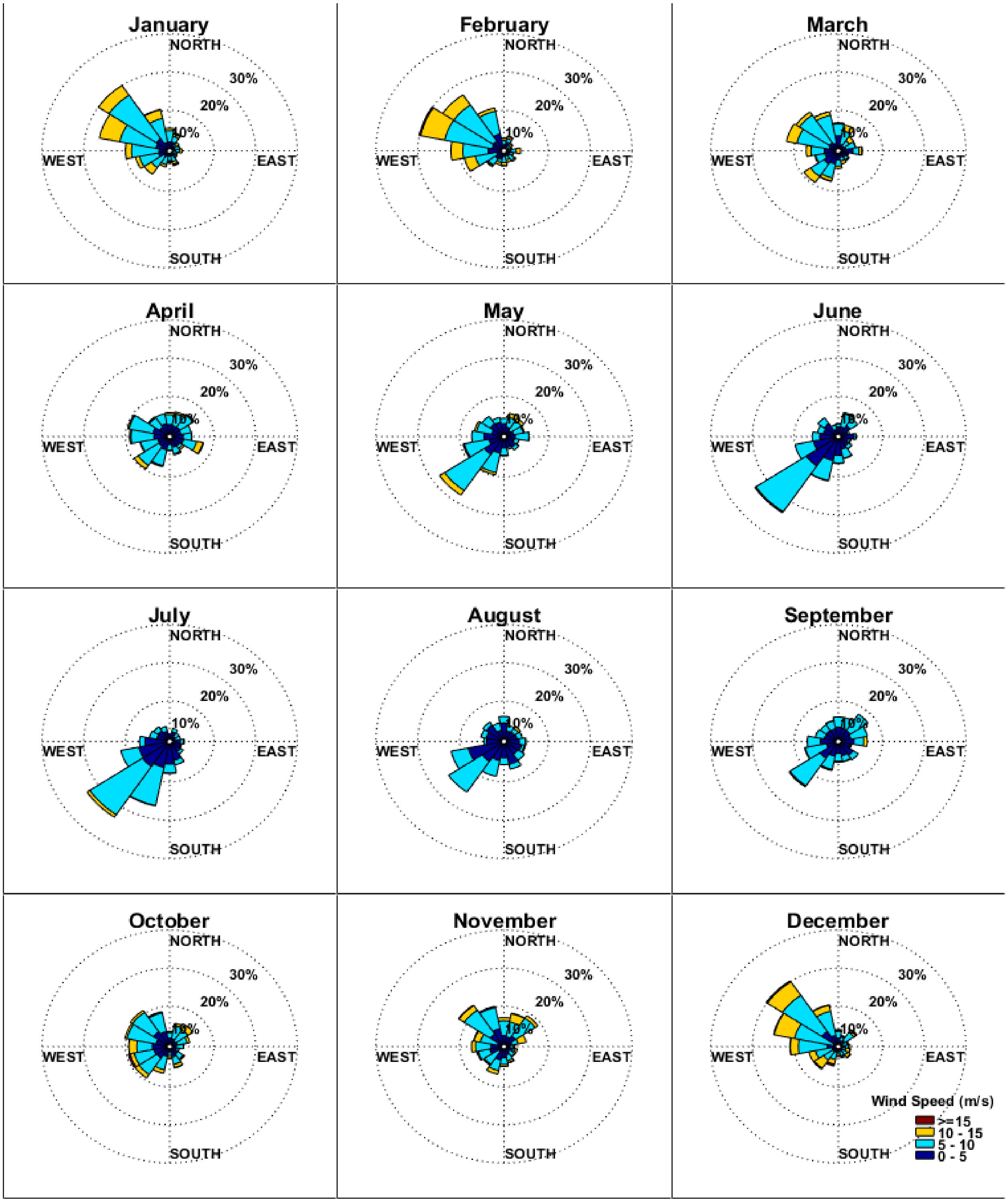
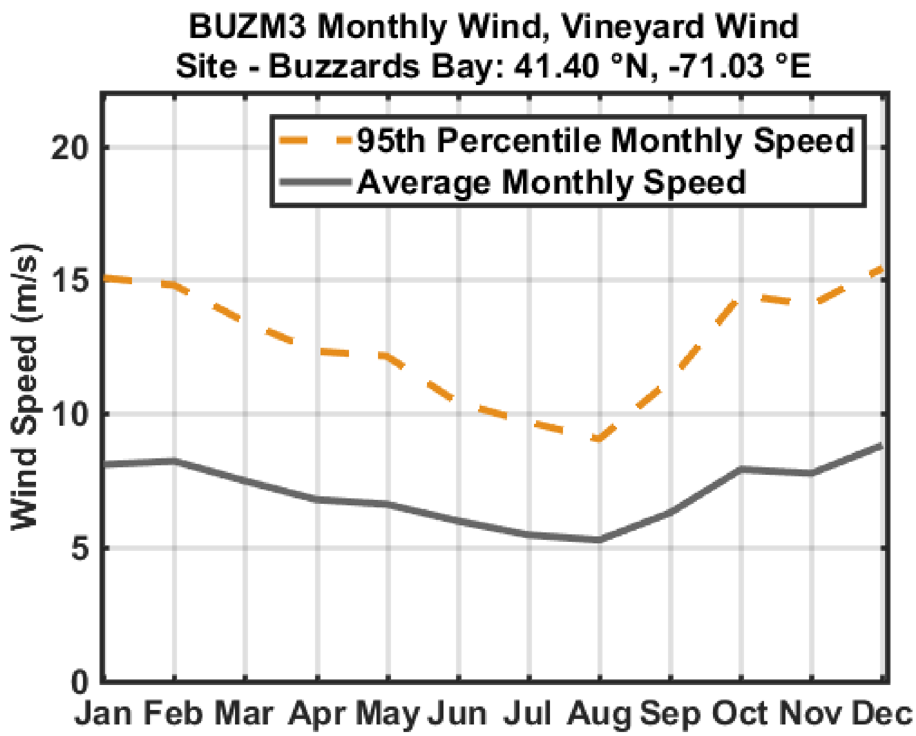


Figure 5. Monthly CFSR wind roses for 5 year period (2006-2010) near BUZM3 station located in Buzzards Bay. Wind speeds in m/s, using meteorological convention (i.e., direction from which wind is blowing).



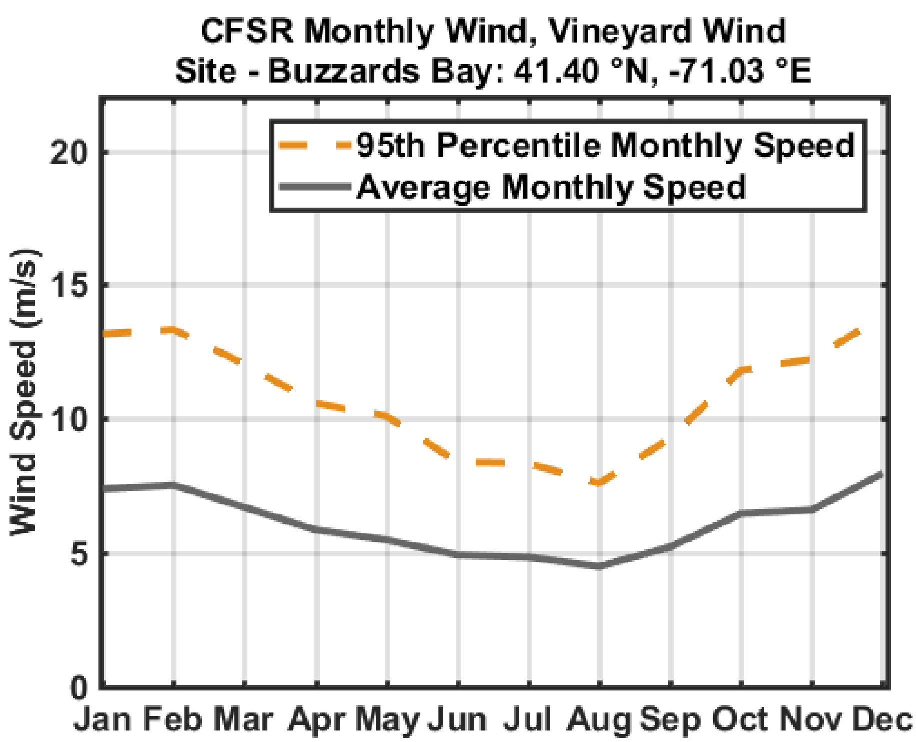


Figure 6. Monthly average and 95th percentile wind speed statistics for BUZM3 station (upper panel) and CFSR (lower panel) for 5 year period (2006-2010): monthly average (grey solid) and 95th percentile (orange dashed).

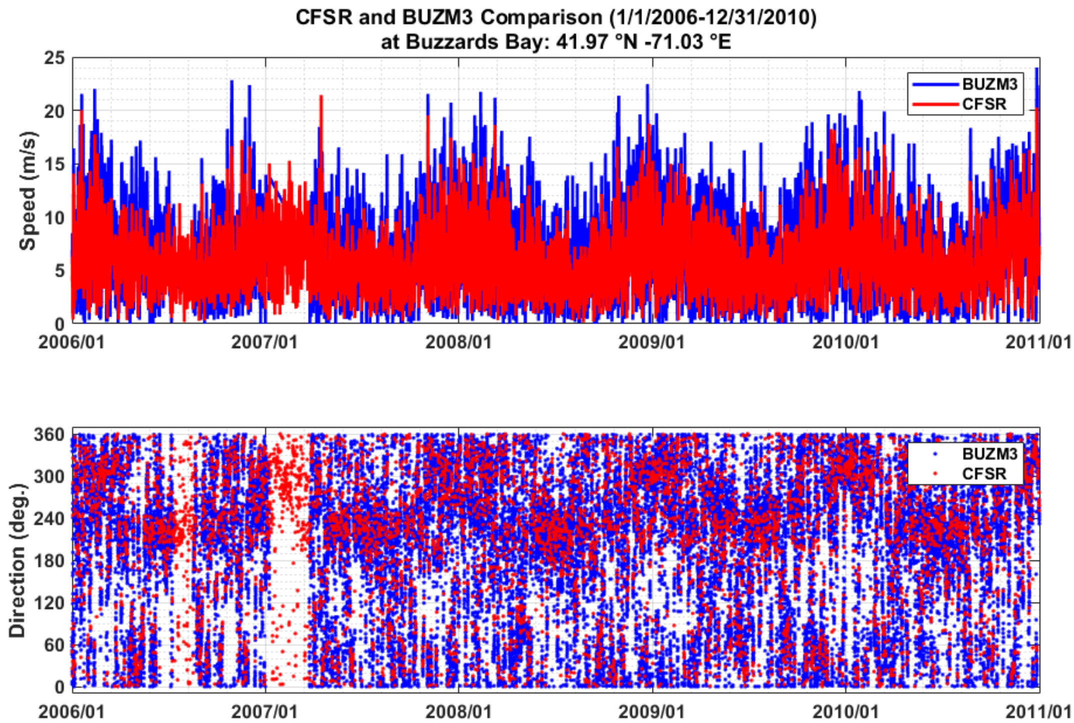


Figure 7. Comparison of speed (upper panel) and direction (lower panel) from BUZM3 and CFSR wind.

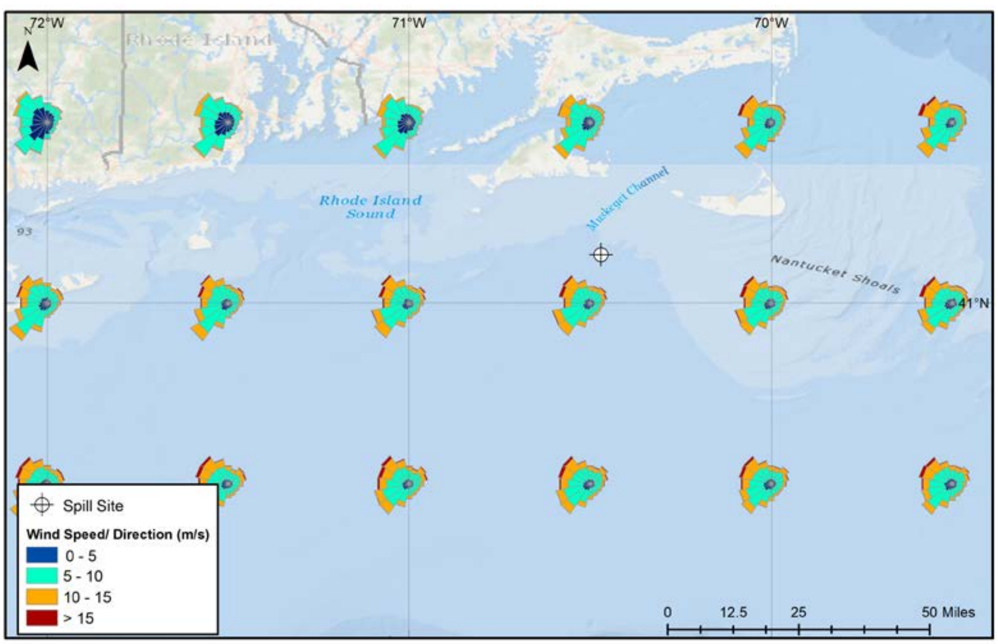


Figure 8. Spatial distribution of CFSR wind speed (in m/s) and direction off the coast of southern New England. The white crosshairs symbol indicates the modeled spill location.

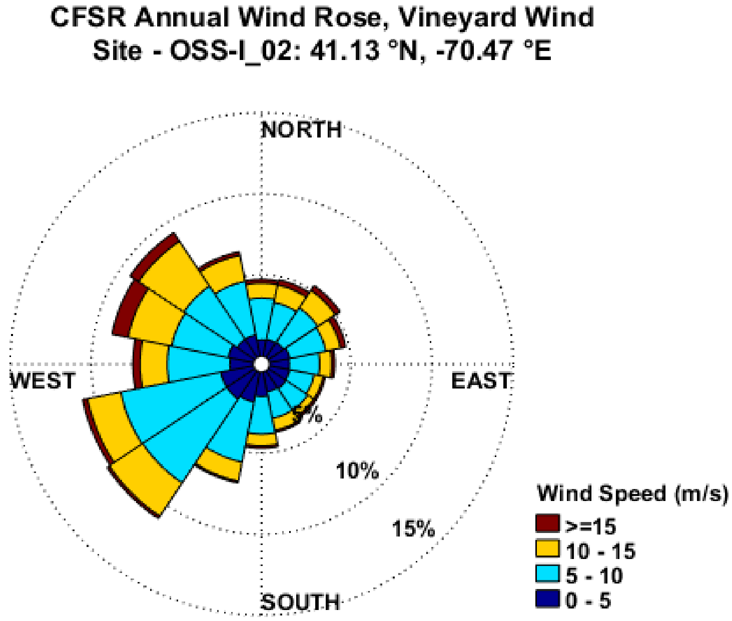


Figure 9. Annual CFSR rose near the spill site located south of Martha's Vineyard. Wind speeds in m/s, using meteorological convention (i.e., direction from which wind is blowing).

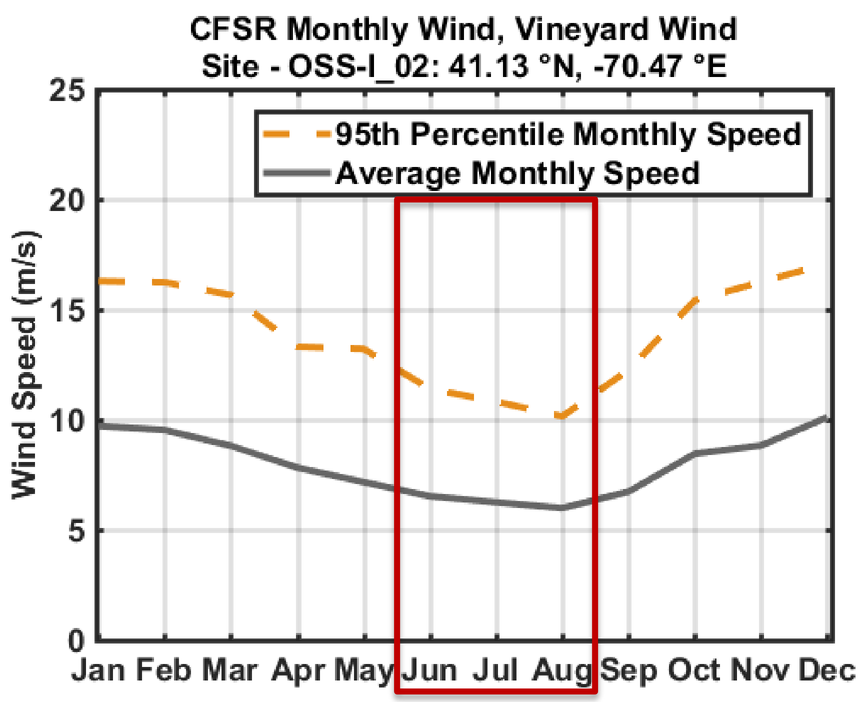


Figure 10. Monthly average and 95th percentile CFSR wind speed statistics (in m/s) near the spill site: monthly average (grey solid) and 95th percentile (orange dashed). Summer months are highlighted with a red box.

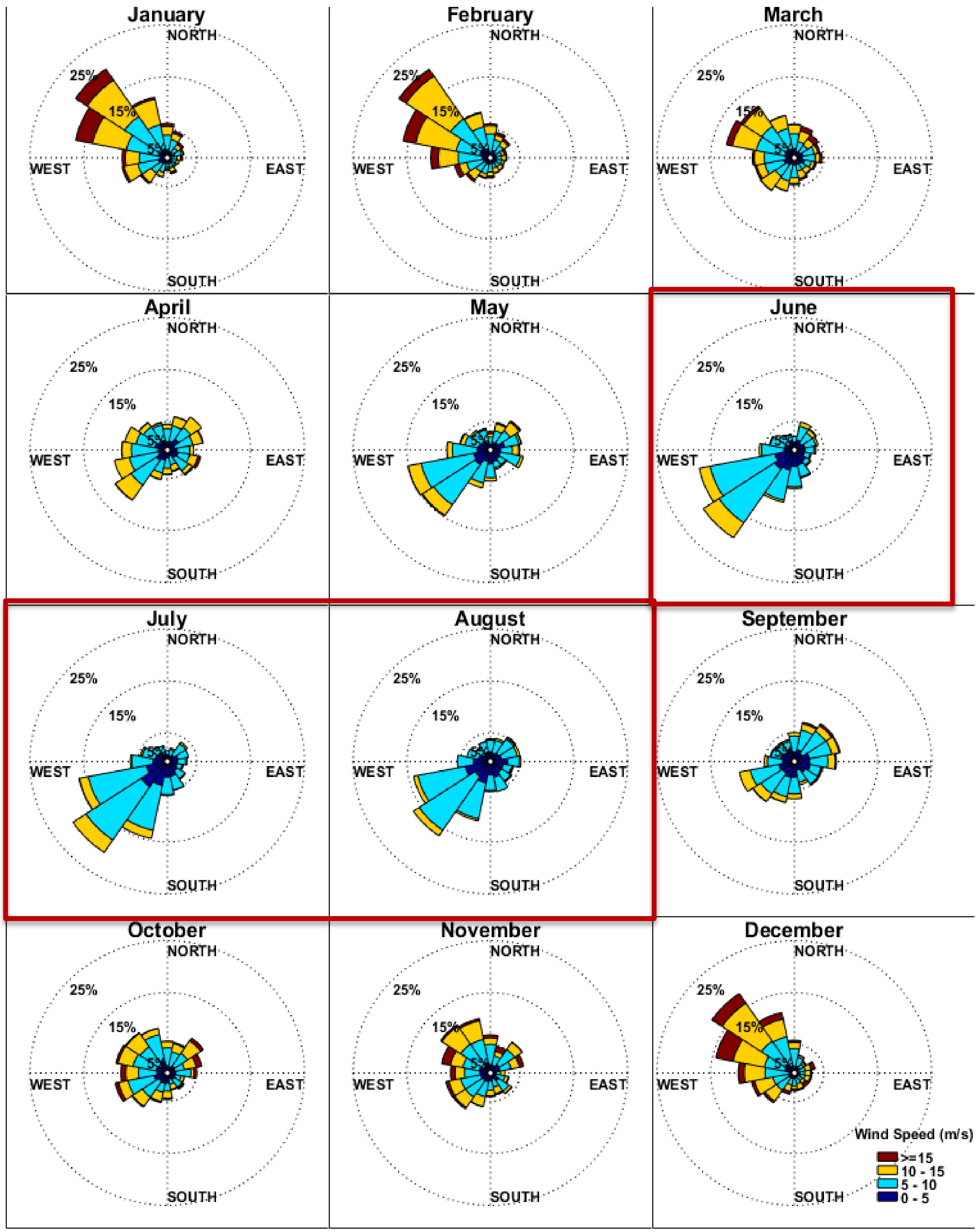


Figure 11. Monthly CFSR windroses near the spill site. Wind speeds in m/s, using meteorological convention (i.e., direction from which wind is blowing). Summer highlighted with red boxes.

2.3. Hydrodynamic Data Used in Oil Spill Model

The oil spill model uses hydrodynamic data as one of its inputs influencing the trajectory and fate of the spilled oil. The hydrodynamic input is in the form of files which define the current speed and direction throughout the water column across the model domain. The oil spill model is able to combine multiple current data files which represent different physical processes, different spatial domains, or different time domains depending on the particular scenario being modeled. For this oil spill modeling analysis, two data sets, including output from a global current data set (HYCOM Reanalysis) and output from a tidal model application (HYDROMAP), were used in combination to define the circulation in the area in which oil could be transported from the site. HYCOM Reanalysis (described in Section 2.3.1) is a subset from a model run over a large domain (global) that captures large scale currents at a relatively coarse resolution in space with a grid on the order of ten kilometers and time with output on the order of multiple hours (daily 24 hours). The HYDROMAP tidal model application (described in Section 2.4.1) is of a smaller regional extent which has variable resolution that is relatively finer in space with a grid on the order of tens of meters to a kilometer and time with output on the order of tens of minutes. The oil spill model is able to combine these two data sets in order to produce the full circulation in the area of interest.

2.3.1. Global Current Dataset – HYCOM Reanalysis

Current data were obtained from the HYCOM (HYbrid Coordinate Ocean Model) hindcast reanalysis, 1/12-degree global simulation assimilated with NCODA (Navy Coupled Ocean Data Assimilation) which was done by the U.S. Naval Research Laboratory (Halliwell 2004). These data capture the oceanic large-scale circulation in the area of interest. NCODA uses the model forecast as a first guess in a three-dimensional (3D) variational scheme and assimilates available satellite altimeter observations from the Naval Oceanographic Office (NAVOCEANO) Altimeter Data Fusion Center, *in-situ* Sea Surface Temperature (SST), and available *in-situ* vertical temperature and salinity profiles from XBTs (Expendable Bathythermographs), Argo floats, and moored buoys. Surface forcing of HYCOM was derived from the 1-hourly U.S. NCEP CFSR atmospheric model with a horizontal resolution of 0.3125 degree, which induces wind stress, wind speed, heat flux, and precipitation (HYCOM 2016). The bathymetry was derived from the General Bathymetric Chart of the Oceans (GEBCO) dataset. For this study, a 10-year period of daily model output was collected (2001 to 2010).

The following figures describe the variability of current speed and direction near the potential spill site based on the regional HYCOM Reanalysis dataset:

- Current intensity and direction maps (Figure 12): Spatial distribution of HYCOM averaged surface current speeds (in cm/s) and current directions for the area of interest;
- Monthly current speed statistics (Figure 13): Monthly average and 95th percentile HYCOM current speed (in cm/s) near the spill site;
- Vertical profile of horizontal current speed (Figure 14): Annual average and 95th percentile of HYCOM horizontal current speed profile (in cm/s) with depth at the site

location, and the corresponding current roses at surface, 20 m, and 35 m presenting the direction towards which the current is flowing, and

- Monthly current roses (Figure 15): Monthly HYCOM current roses (in cm/s) near the spill site, and the direction towards which current is flowing.

Based on the analysis of these regional data, the following conclusions can be drawn:

- Surface currents at the spill site are not very strong (around 20 cm/s in average) and quite consistent throughout the year.
- Currents are mostly going towards an east and east-southeast direction at the surface layer.
- The vertical profile indicates the current speed decreases from the surface to the bottom layer. Although the direction of surface current is mostly eastward/east-southeastward, the middle and bottom layer show relatively more variability with current going towards both an east and west direction.

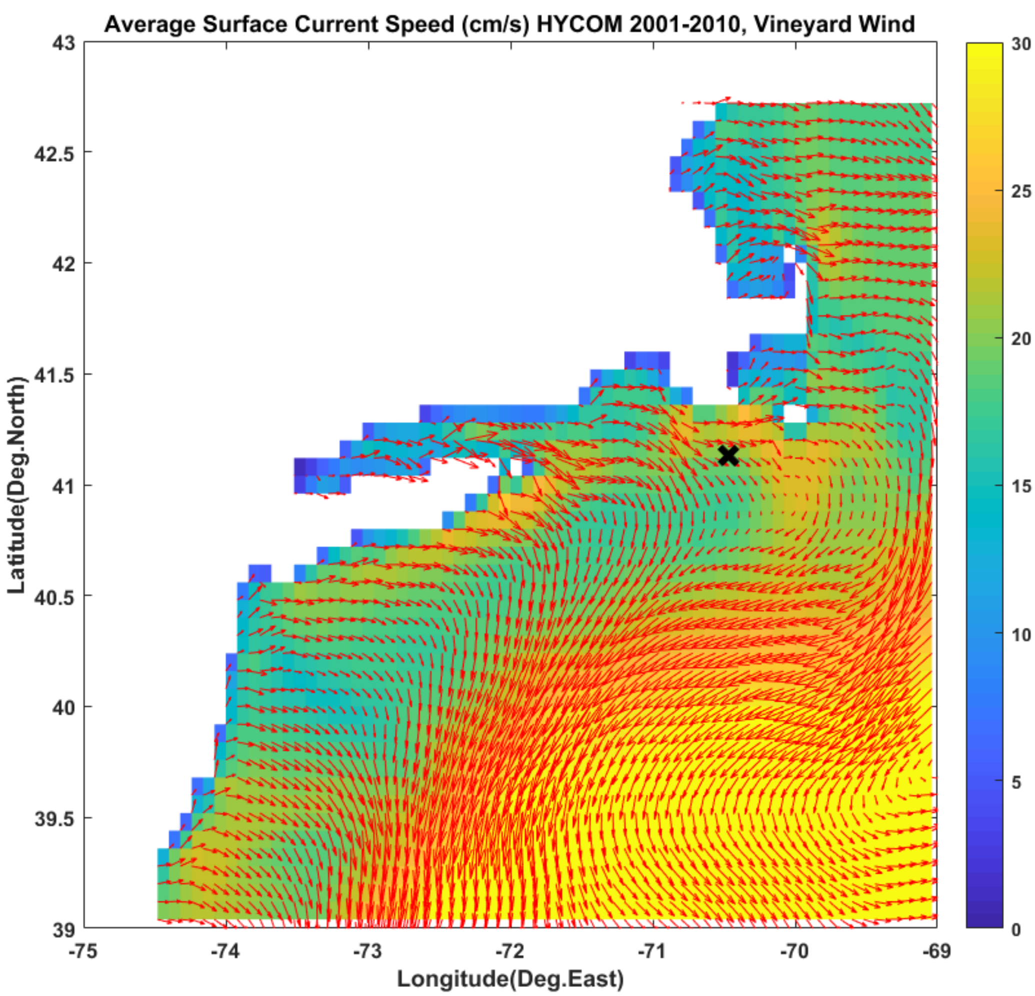


Figure 12. Spatial distribution of HYCOM averaged surface current directions (current speeds in cm/s). The black "x" mark indicates the potential spill site.

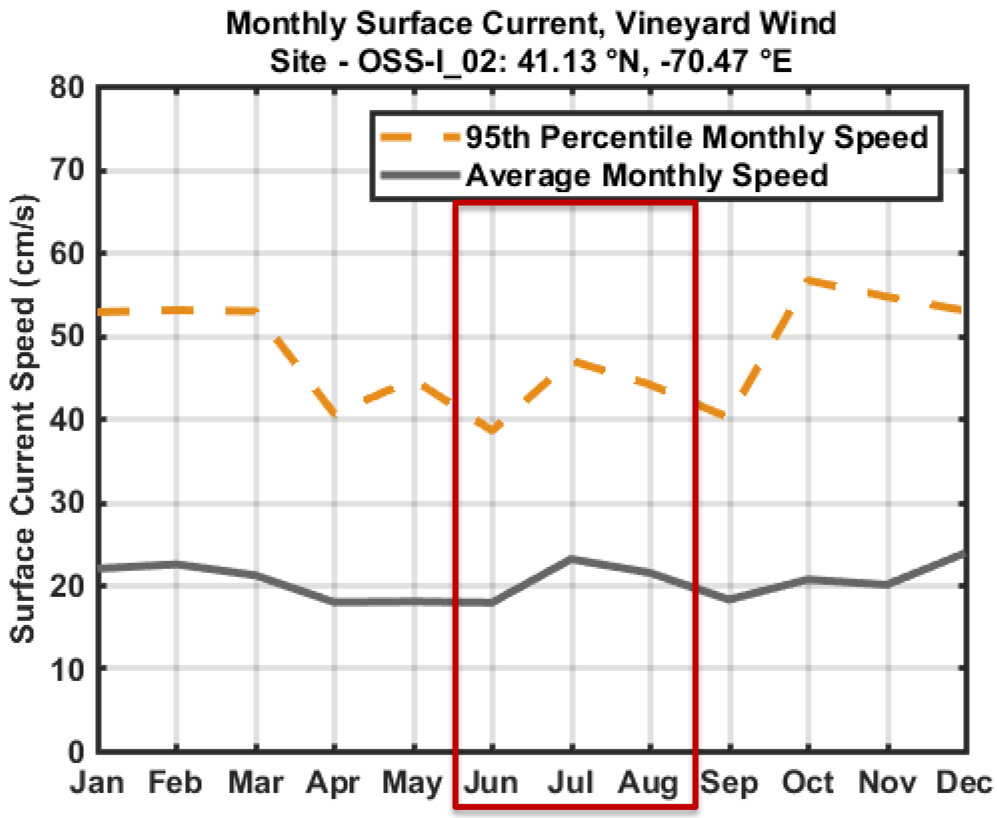


Figure 13. Monthly average (grey solid) and 95th percentile (orange dashed) HYCOM current speed (cm/s) statistics near the spill site. Summer highlighted with a red box.

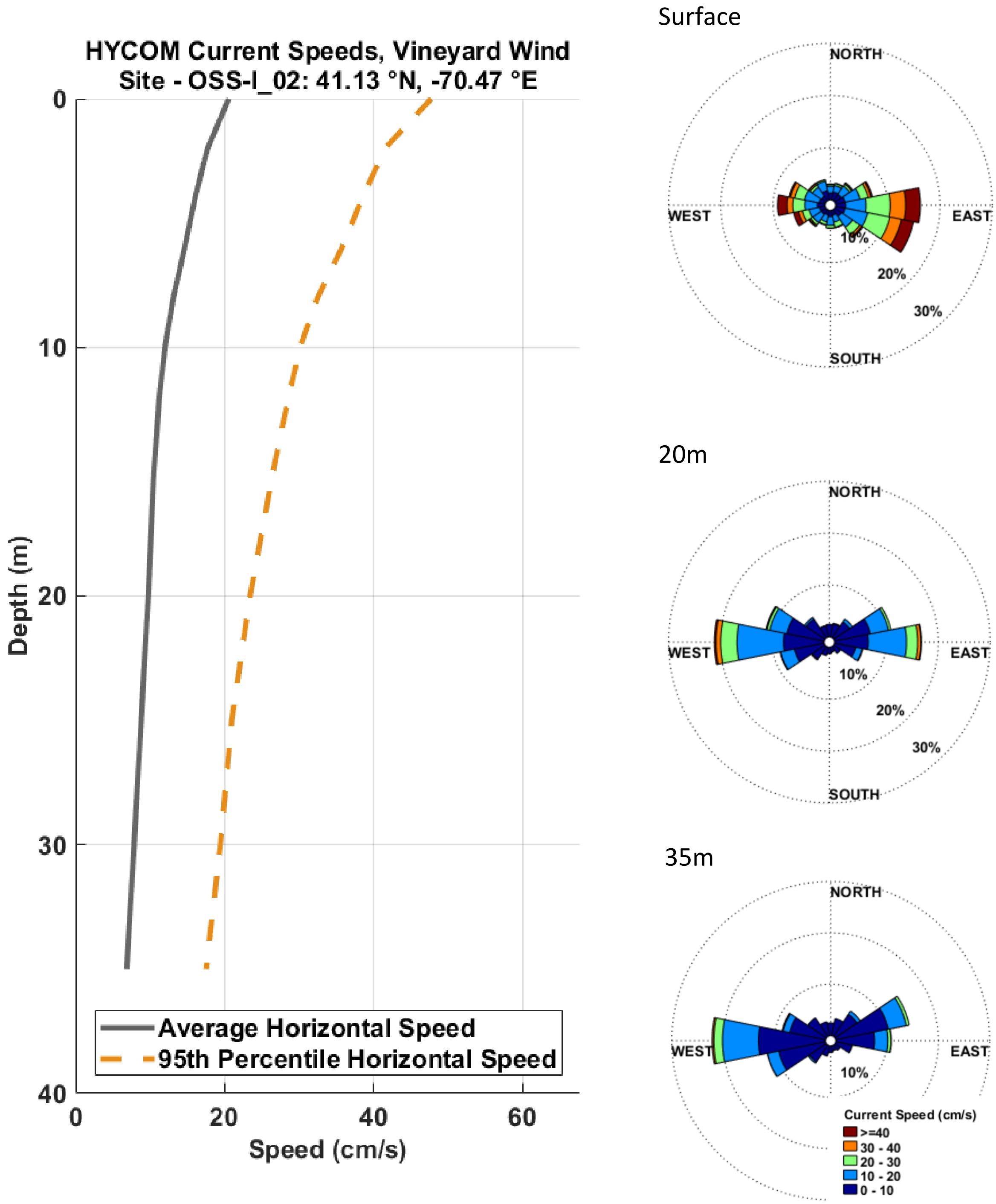


Figure 14. HYCOM average (solid grey) and 95th percentile (dashed orange) of 2001-2010 horizontal current speed (cm/s) dataset variation with depth near the spill site; and the current roses of annual current at surface, 20 m, and 35 m water depths. The roses show the direction towards which the current is flowing.

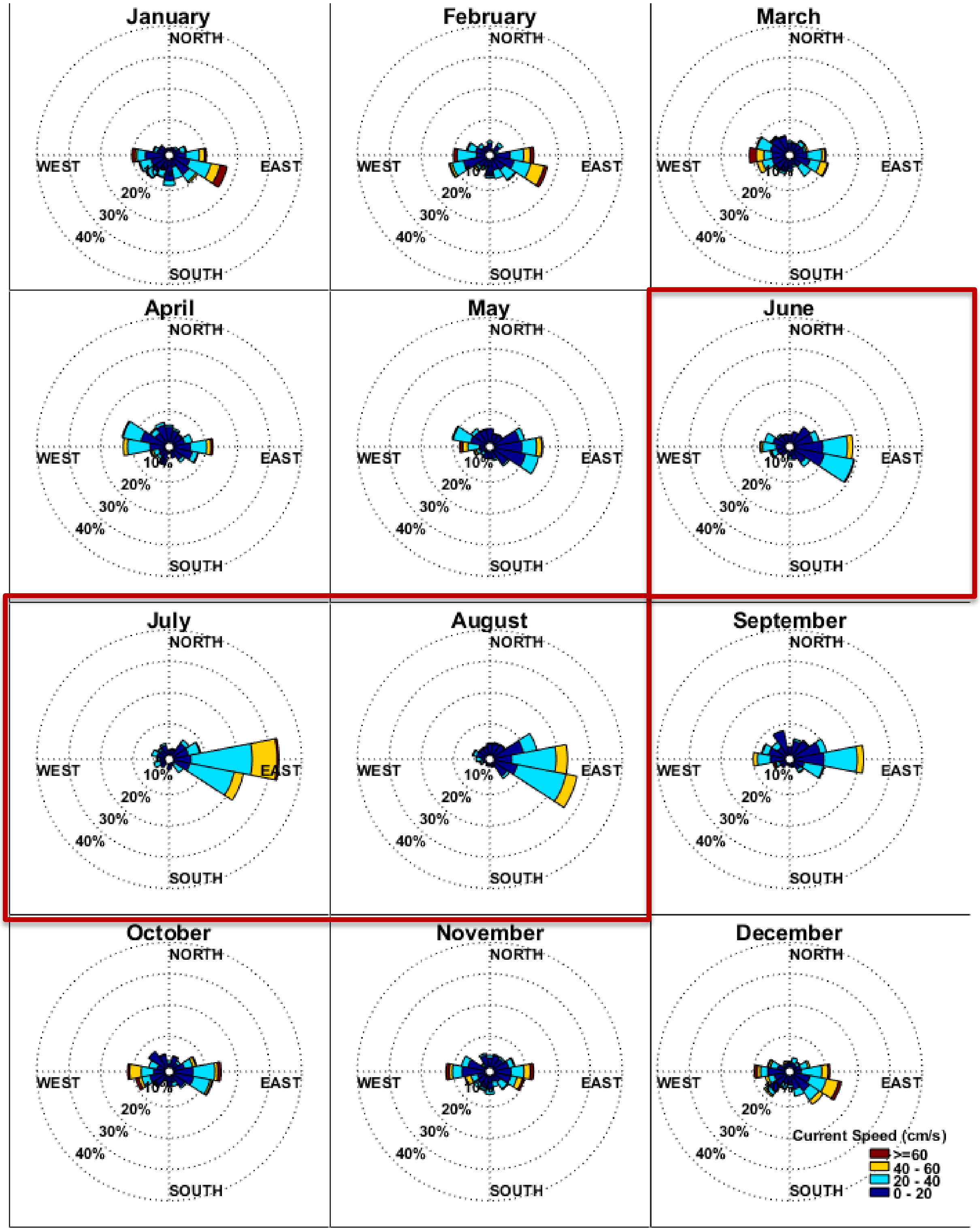


Figure 15. Monthly HYCOM surface current roses near spill site located south of Martha's Vineyard; following oceanographic convention (direction towards which currents are heading), current speeds in cm/s. Summer highlighted with red boxes.

2.4. Surface Transport

To compare the potential for surface wind-driven transport versus current-driven transport, an assessment of the wind drift speed versus current speed was performed close to the spill site as shown in Figure 16. For this study, the wind drift was estimated as 3.5% of the wind speed. Based on this analysis, wind drift seems to be the primary agent of the surface transport most of the year, indicating that the winds control most of the movement of the surface floating slicks at the site. However, during the month of July, wind intensity decreases; consequently, surface currents may control the movement of floating slicks during this period.

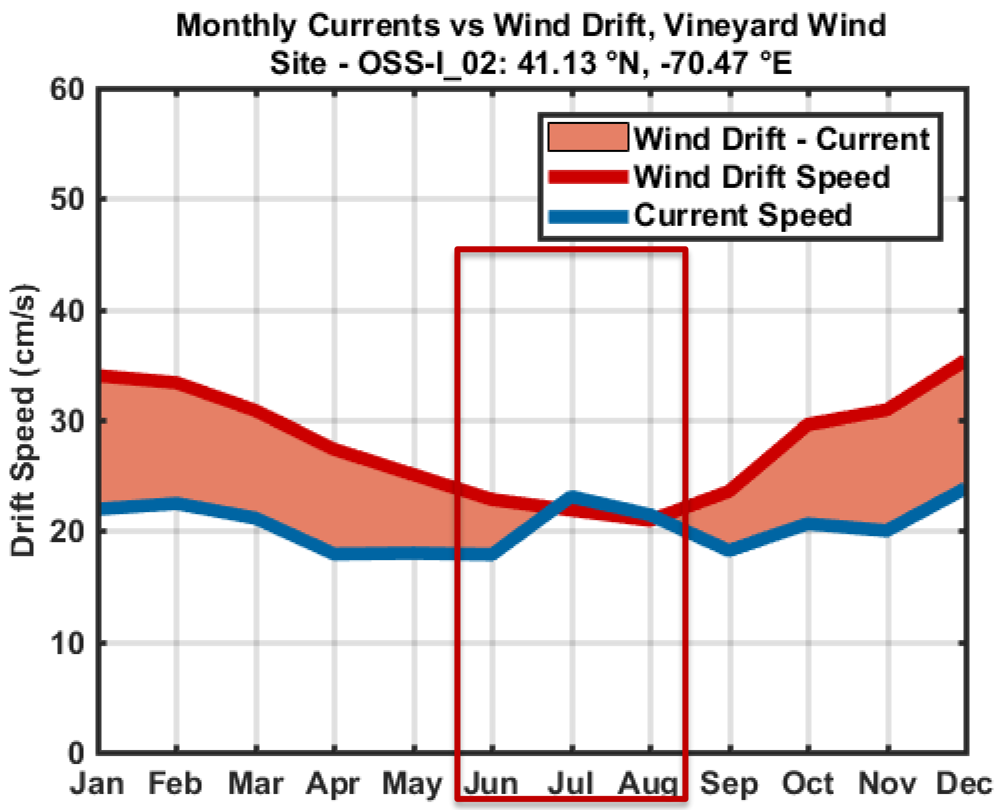


Figure 16. Surface drift forcing comparison statistics near the Vineyard Wind spill site: monthly-averaged CSFR wind drift compared with HYCOM current speed. Wind drift is calculated as 3.5% of the wind speed. Periods with predominant current transport are shaded pink. Summer highlighted with a red box.

2.4.1. HYDROMAP Tidal Circulation Model

A regional hydrodynamic model application was developed that encompassed the Vineyard Wind Offshore Project (Wind Development Area and Offshore Export Cable Corridors) for use in the sediment transport modeling of the cable installation activities. That model application (grid and tidal forcing) was used to generate cyclical tidal model output for the oil spill modeling; surface wind forcing was not included since the net wind driven effects would be captured by the other model inputs (HYCOM large scale currents and CFSR driven wind drift).

The previous model application was generated using RPS's in-house developed hydrodynamic model HYDROMAP. HYDROMAP is a globally re-locatable hydrodynamic model capable of simulating complex circulation patterns due to tidal forcing, wind stress and fresh water flows quickly and efficiently anywhere on the globe. HYDROMAP employs a novel step-wise-continuous-variable rectangular ("SCVR") gridding strategy with up to six levels of resolution. The term "step-wise-continuous" implies that the boundaries between successively smaller and larger grids are managed in a consistent integer step. The advantage of this approach is that large areas of widely differing spatial scales can be addressed within one consistent model application. Grids constructed by the SCVR are still "structured," so that arbitrary locations can be easily located to corresponding computational cells. This mapping facility is particularly advantageous when outputs of the hydrodynamics model are used in subsequent application programs (e.g., Lagrangian particle transport model) that use another grid or grid structure.

The details of the model and the model application which was validated to periods with *in-situ* data can be found in the "Hydrodynamic and Sediment Dispersion Study for the Vineyard Wind Project" (COP Appendix III-A). The present model application utilized the same grid and bathymetry and the same model forcing with the exception of surface winds. The model generated output in the form of cyclical set of current fields for each tidal constituent (M2, S2,N2, O1,K1) over its respective cycle (e.g., 12.42 hours for the M2) relative to a time datum; a summary of the harmonic constituent properties is presented in Table 2. The oil spill model is able to then reconstruct the full tidal circulation by combining, through superposition, the current components (u[east-west] and v[north-south] velocities) from each individual constituent for any time based its characteristics.

Table 2. Summary of harmonic constituents for which the associated current fields were generated.

Name	Period (hours)	Speed (deg/hour)	Description
M2	12.421	28.98410	Principal lunar semidiurnal constituent
S2	12.000	30.00000	Principal solar semidiurnal constituent
N2	12.658	28.43973	Larger lunar elliptic semidiurnal constituent
K1	23.934	15.041069	Lunar diurnal constituent
O1	25.819	13.943035	Lunar diurnal constituent

The tidal currents in the model domain are highly variable in space and time. Tidal currents are always changing in response to the rising and falling waters levels. In this region, the currents are dominated by the M2 tide, and therefore have approximately two cycles daily (meaning the water elevation rises and falls twice daily [two high tides and two low tides]), resulting in an oscillation of current speeds and directions with four peaks daily (i.e., max flood current as water moves into a region, max ebb current as water moves out of a region). Snapshots of the associated speed and directions for instances of ~ peak ebb and ~ peak flood current for the vertically averaged M2 tidal constituent are shown in Figure 17 and Figure 18, respectively. Note that the vertical average is shown in these figures; however, the three-dimensional profiles were generated for use in the oil spill modeling. These figures show the spatial variability of current speed through color contours and direction with arrows (subset from the model grid resolution for clarity). The other constituents have similar patterns with much less magnitude and the total tidal current is the addition of all constituents which can increase or decrease the speed relative to the M2 alone. However, the M2 constituent provides a good picture of the relative spatial trends in speed and direction. From these figures, it is noted that speeds in the Wind Development Area (WDA) have tidal current peaks less than ~ 0.30 m/s, while current speeds through the Muskeget Channel (between Martha's Vineyard and Nantucket) and over Nantucket shoals (South East of Nantucket) peak over 1 m/s, though the speeds are reduced as the currents oscillate between ebb and flood.

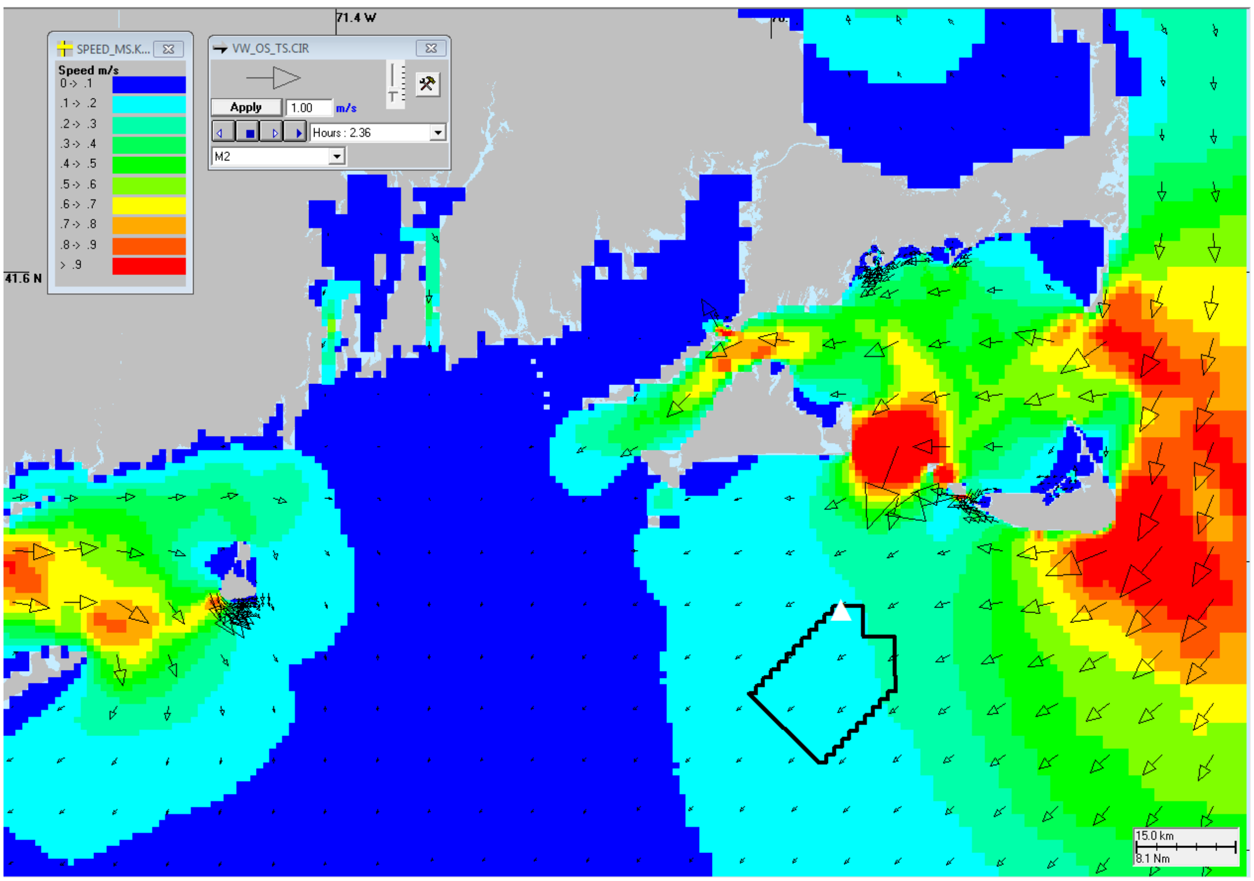


Figure 17. Snapshot of M2 ~ peak ebb current speeds and directions. Colors represent speed in accordance to legend in the upper left corner of the image and arrows indicate the direction current is flowing. The WDA outline is shown in black and the ESP is shown with a white triangle marker.

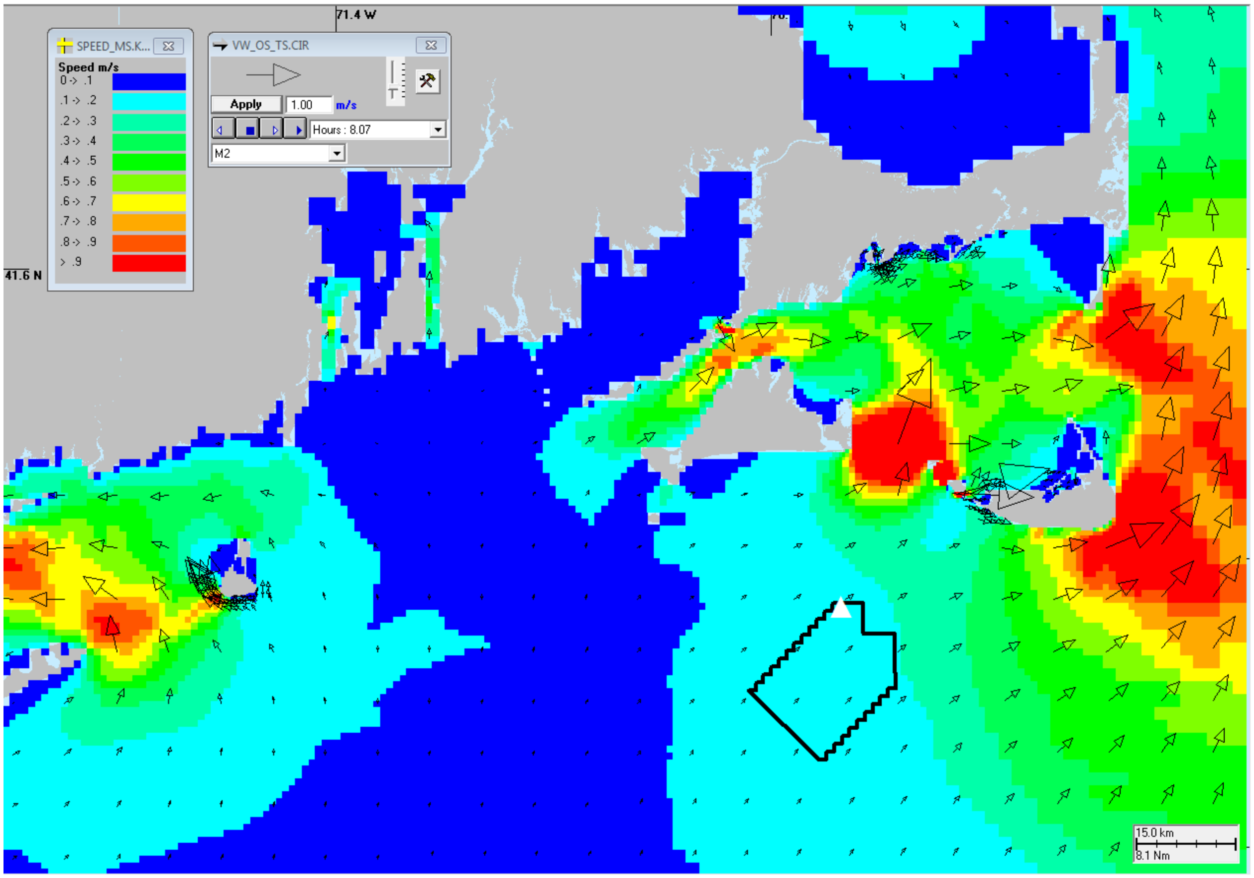


Figure 18. Snapshot of M2 ~ peak flood current speeds and directions. Colors represent speed in accordance to legend in the upper left corner of the image and arrows indicate the direction current is flowing. The WDA outline is shown in black and the ESP is shown with a white triangle marker.

3. Oil Spill Modeling Setup

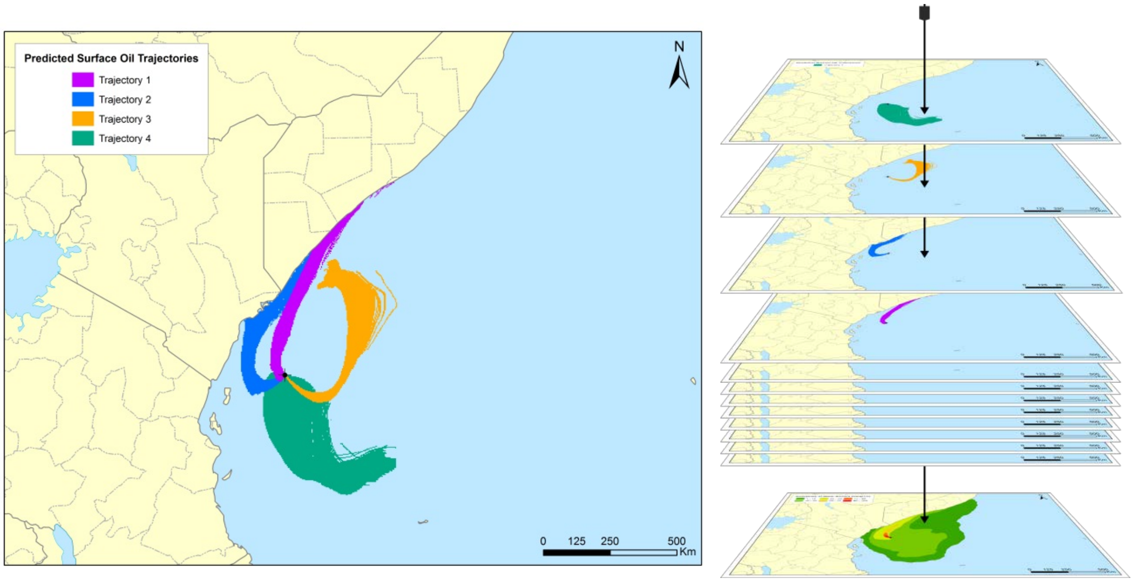
3.1. Modeling Methodology

RPS's proprietary oil spill modeling framework OILMAP/SIMAP was used for all simulations performed in this study. The model quantifies the transport and fate of different components of hydrocarbon mixtures through different compartments of the marine environment over time. The modeling system uses a three-dimensional Lagrangian model where each component of the spilled oil (floating, dispersed, shoreline, etc.) is represented by an ensemble of independent mathematical particles or "spillets". Each spillet comprises a subset of the total mass of hydrocarbons spilled and is transported by both currents and surface wind drift. Additional information on the modeling system is contained in Appendix A.

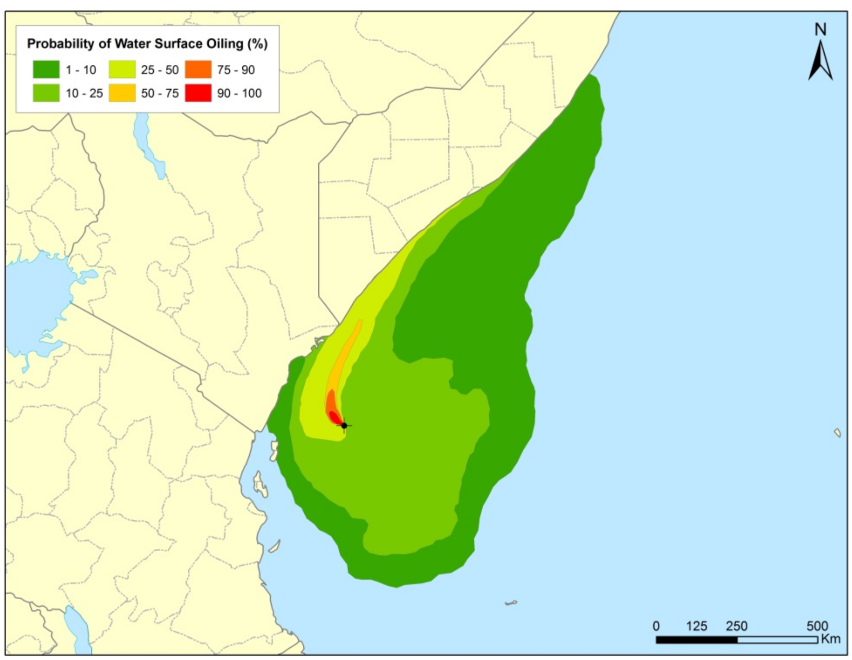
Stochastic Simulations

Stochastic simulations provide insight into the probable behavior of potential oil spills in response to temporally- and spatially-varying meteorological and oceanographic conditions in the study area. The stochastic model computes surface trajectories for an ensemble of hundreds of individual cases for each spill scenario, thus sampling the variability in regional and seasonal wind and current forcing by starting the simulation at different dates within the timeframe of interest.

The stochastic analysis provides two types of information: 1) the footprint of sea surface and shoreline areas exposed to oil above a certain threshold of concern and the associated probability of oil contamination, and 2) the shortest time required for oil to reach any point within the areas predicted to be oiled. The areas and probabilities of oiling are generated by a statistical analysis of all the individual stochastic runs (Figure 19). It is important to note that a single run will encounter only a relatively small portion of this footprint. In addition, the simulations provide shoreline oiling data expressed in terms of minimum and average times for oil to reach shore, and the percentage of simulations in which oil is predicted to reach shore. Results from this modeling step are presented in Section 4.



Examples of four individual spill trajectories predicted by OILMAP/SIMAP for a particular spill scenario. The frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all 100+ model runs are overlain (shown as the stacked runs on the right) and the number of times that a trajectory reaches a given location is used to calculate the probability for that location.



Probability of surface oil exceeding a given threshold for the example scenario. This figure overlays 100+ individual model runs to calculate the percentage of runs that caused oiling above the threshold in a given area. This figure does not depict the areal extent of a single model run/spill.

Figure 19. Diagram of RPS stochastic modeling approach; an ensemble of individual trajectories creates the stochastic probability footprint.

3.2. Thresholds of Concern and Weathering

The stochastic approach applied in the spill risk assessment provided an evaluation of the likelihood of exposure to oil above ecological thresholds of concern, expressed as mass per unit area and concentration. The thresholds listed in Table 3 were used in the stochastic analysis, and followed a similar methodology as used in BOEM's previous study assessing potential catastrophic oil spills from offshore wind structures (Bejarano et al. 2013).

Table 3. Oil thickness thresholds applied in the spill risk assessment for sea surface and shoreline probability determinations.

Threshold Type	Average Concentration Threshold	Rationale	Visual Appearance	References
Oil on Sea Surface	10 g/m² ≈ 10 µm (0.01 mm) on average over the grid cell	**Ecological:** Observed lethal effects to birds on water at this threshold. Sublethal impacts to marine mammals, sea turtles, and floating Sargassum mats.	Fresh oil at this thickness corresponds to a slick being a dark brown or metallic sheen.	French et al. 1996; French McCay et al. 2009;French McCay et al. 2011; French McCay et al. 2012; French McCay 2016
Shoreline Oil	100 g/m² ≈ 100 µm (0.1 mm) on average over the grid cell	**Ecological:** This is a screening threshold for potential ecological effects on shoreline flora and fauna, based upon a synthesis of the literature showing that shoreline life has been affected by this degree of oiling. Sublethal effects on epifaunal intertidal invertebrates on hard substrates and on sediments have been observed where oiling exceeds this threshold. Assumed lethal effects threshold for birds on the shoreline.	May appear as black opaque oil.	French et al. 1996; French McCay 2009; French McCay et al. 2011; French McCay et al. 2012**;** French McCay 2016

3.3. Oil Spill Scenarios

Vineyard Wind has identified two potential locations for ESPs, one closer to shore (ESP 1) and one farther from shore (ESP 2). Each location will include one 400 MW conventional ESP; if an 800 MW ESP is used, it will be installed in the ESP position located closest to shore (ESP 1) and the ESP 2 position will not be used. Release scenarios for the stochastic simulations assumed a spill from an instantaneous, catastrophic loss of the complete contents of the original or revised ESP locations closest to shore[3], which were assumed to be the worst case discharges, yet also very conservative (Table 4). Two thousand particles were used in OILMAP/SIMAP to simulate the surface release of oil, as a near instantaneous release tracked over the course of 20 days. The stochastic model was run for two oil spill volumes using over 400 simulations covering the span of 10 years (2001 to 2010). These results were then reanalyzed over 4 seasons, each consisting of over 100 simulations (Table 5). As described in Section 2, a combination of HYCOM Reanalysis and HYDROMAP modeled tidal circulation were used as current inputs to the model while CFSR was used as wind inputs.

Table 4. Release location used in oil spill modeling

Site	Description	Latitude N (decimal degrees)	Longitude W (decimal degrees)
400 MW ESP	ESP location closest to shore (ESP 1) includes 1 conventional ESP	41.13317	70.46972
800 MW ESP	ESP revised location closest to shore (ESP 1 – revised, located slightly farther offshore than original ESP 1 location)	41.122180	70.483691

Table 5. Oil spill scenarios defined for the oil spill modeling.

[3] The Project includes two ESP locations: one closer to shore (ESP 1) and one farther from shore (ESP 2). The model scenarios both use the ESP position that is located closest to shore (ESP 1); however, in the time interval between the first and second drafts of this report, a review of ongoing survey data led to the relocation of the ESP closest to shore to a new position that is slightly farther offshore (referred to as ESP 1 – revised). Therefore, the model scenario for the 800 MW ESP incorporates the revised ESP position (ESP 1 – revised) that is slightly farther offshore than the original ESP position (ESP 1) modeled for the 400 MW ESP scenario. The ESP 2 position was not modeled since it is located farthest from shore.

ID	Site	Oil Type	Season	Total Volume Released
1	400 MW ESP	Oil Mixture	Spring: (March-May)	1,539 bbl ($245\ m^3$)
2			Summer: (June-August)	
3			Fall: (September-November)	
4			Winter: (December-February)	
5	800 MW ESP	Oil Mixture	Spring: (March-May)	2,954 bbl ($460\ m^3$)
6			Summer: (June-August)	
7			Fall: (September-November)	
8			Winter: (December-February)	

3.4. Oil Characteristics

Characteristics of potential oils to be used within the ESPs were supplied by Vineyard Wind or drawn from existing OILMAP/SIMAP databases as summarized below. Naphthenic, hydraulic and diesel oil make up the largest portions of the ESP oils, and were used to create an oil mixture to use for simulations in OILMAP/SIMAP. Table 6 shows the breakdown of oils that make up the oil mixture used in modeling simulations. The properties for oils that make up the oil mixture are presented in Table 7 through Table 9, while Table 10 shows the oil mixture as a weighted average of each of the oil characteristics used in OILMAP/SIMAP.

Table 6. Oils used to create an oil mixture to simulate a single release for each site.

Site	Oil	Barrels	kg	% by Mass
400 MW ESP	Diesel	67.80	8,958	4.24
	Hydraulic	4.15	572	0.27
	Napthenic	1,466.77	200,778	95.48
800 MW ESP	Diesel	130.18	17,199.4	4.24
	Hydraulic	7.97	1,098.2	0.27
	Napthenic	2,816.20	385,493.8	95.48

Table 7. Oil properties for Diesel Oil

Property	Value	Reference
Density @ 25 deg. C (g/cm^3)	0.831	Jokuty et al. (1999)*
Viscosity @ 25 deg. C (cp)	2.76	Jokuty et al. (1999)*
Surface Tension (dyne/cm)	27.5	Jokuty et al. (1999)*
Fraction THC 1: boiling point < 180^{o}C	0.164	Jokuty et al. (1999)*
Fraction THC 2: boiling point 180-264^{o}C	0.490	Jokuty et al. (1999)*
Fraction THC 3: boiling point 264-380^{o}C	0.319	Jokuty et al. (1999)*
Minimum Oil Thickness (mm)	0.00001	McAuliffe (1987)
Maximum Mousse Water Content (%)	0	-
Mousse Water Content as Spilled (%)	0	-
Water content of oil (not in mousse, %)	0	-

Table 8. Oil properties for Hydraulic Oil.

Property	Value	Reference
Density @ 25 deg. C (g/cm^3)	0.867	Anderson et al (2003)
Viscosity @ 25 deg. C (cp)	31.58	Anderson et al (2003)
Surface Tension (dyne/cm)	25.7	Anderson et al (2003)
Fraction THC 1: boiling point < 180^{o}C	0	Kaplan et al (2010)
Fraction THC 2: boiling point 180-264^{o}C	0.333	Kaplan et al (2010)
Fraction THC 3: boiling point 264-380^{o}C	0.238	Kaplan et al (2010)
Minimum Oil Thickness (mm)	0.0001	NRC (1985); field data from actual spills
Maximum Mousse Water Content (%)	0	-
Mousse Water Content as Spilled (%)	0	-
Water content of oil (not in mousse, %)	0	-

Table 9. Oil properties for Napthenic Oil.

Property	Value	Reference
Density @ 25 deg. C (g/cm^3)	0.861	NYNAS Nytro 4000x MSDS
Viscosity @ 25 deg. C (cp)	14.55	NYNAS Nytro 4000x MSDS
Surface Tension (dyne/cm)	40.0	NYNAS Nytro 4000x MSDS
Fraction THC 1: boiling point < 180^{o}C	0	Kaplan et al. (2010)
Fraction THC 2: boiling point 180-264^{o}C	0.333	Kaplan et al. (2010)
Fraction THC 3: boiling point 264-380^{o}C	0.238	Kaplan et al. (2010)
Minimum Oil Thickness (mm)	0.0001	NRC (1985); field data from actual spills
Maximum Mousse Water Content (%)	0	-
Mousse Water Content as Spilled (%)	0	-

Property	Value	Reference
Water content of oil (not in mousse, %)	0	-

Table 10. Oil properties for Oil Mixture used for modeling simulations.

Property	Value	Reference
Density @ 25 deg. C (g/cm^3)	0.860	Weighted average of 3 oils*
Viscosity @ 25 deg. C (cp)	14.09	Weighted average of 3 oils*
Surface Tension (dyne/cm)	39.4	Weighted average of 3 oils*
Fraction THC 1: boiling point < 180°C	0.007	Weighted average of 3 oils*
Fraction THC 2: boiling point 180-264°C	0.339	Weighted average of 3 oils*
Fraction THC 3: boiling point 264-380°C	0.241	Weighted average of 3 oils*
Minimum Oil Thickness (mm)	0.0001	Weighted average of 3 oils*
Maximum Mousse Water Content (%)	0	-
Mousse Water Content as Spilled (%)	0	-
Water content of oil (not in mousse, %)	0	-

4. Stochastic Modeling Results

OILMAP/SIMAP's stochastic model computed the probable surface and shoreline trajectories of a surface release of an ESP oil mixture (assuming two sizes of ESP's) for four seasons. Over 100 simulations define each spill scenario. Stochastic trajectory results were summed to calculate probabilities of surface oiling and minimum travel time for each spill scenario including oil contamination to the water surface oil and shoreline.

The stochastic results for all spill scenarios are summarized in Table 11. The time to reach the shoreline and the average mass of oil washed ashore were calculated based on all the individual trajectories that led to oil reaching shore with more than 0.1% of the initial spilled volume. The percentage of simulations reaching shore was based on the number of trajectories out of the total number of individual simulations run for the stochastic modeling in which at least 0.1% of the spilled volume was predicted to reach shore. Thickness thresholds for shoreline contamination were not used in the below calculations, and as such results present conservative probabilities and timing. It is also important to note that the time to reach shore is based on the minimum time for any shoreline contamination to occur, and does not indicate the thickness of shoreline contamination occurring at that time.

Table 11. Oil spill stochastic results -- predicted shoreline impacts for each scenario.

ID	Oil Type	Season	Total Volume Released	Sims. Reaching Shore (%) [1]	Time to Reach Shore (days)		Contamination to shoreline (% of total release)	
					Min.	Avg.	Max.	Avg.
1	Oil Mixture	Spring: (Mar.-May)	1,539 bbl	80.8%	0.54	3.93	55.6%	22.1%
2	Oil Mixture	Summer: (June-Aug.)	1,539 bbl	88.3%	0.60	2.84	62.4%	25.32%
3	Oil Mixture	Fall: (Sept.-Nov.)	1,539 bbl	74.2%	0.62	3.65	61.8%	18.5%
4	Oil Mixture	Winter: (Dec.-Feb.)	1,539 bbl	37.3%	0.43	3.64	36.1%	13.2%
5	Oil Mixture	Spring: (Mar.-May)	2,954 bbl	80.0%	0.65	4.14	55.3%	22.0%
6	Oil Mixture	Summer: (June-Aug.)	2,954 bbl	85.0%	0.63	3.07	63.4%	24.8%
7	Oil Mixture	Fall: (Sept.-Nov.)	2,954 bbl	71.7%	0.65	3.75	62.4%	17.7%
8	Oil Mixture	Winter: (Dec.-Feb.)	2,954 bbl	34.7%	0.56	3.83	34.6%	12.7%

[1] The percentage of simulations reaching shore is based on the number of trajectories out of the ensemble of stochastic individual simulations. Since these calculations are based on total mass reaching shore, thickness thresholds were not incorporated.

Results from the stochastic modeling are provided in maps depicting the probability and timing of oil contamination on the surface and shoreline in excess of the threshold oil thicknesses described in Section 3.2. Figures 21 to 28 and Figures 33 to 40 present surface oiling for each spill scenario. Figures 29 to 32 and Figures 41 to 44 present shoreline oiling for each spill scenario. Each figure contains two maps portraying the following information:

1. **Probability of Oil Contact Figures**: The probability of oiling maps for each scenario define the area and the associated probability in which sea surface and shoreline oiling above the defined thresholds (Table 3) would be expected should a worst case oil release scenario occur. The colored area in the stochastic maps indicates areas that *may* receive oil pollution in the event of that particular spill scenario. The 'hotter' the color (e.g., reds), the more likely an area would be affected; the cooler the colors (e.g., greens), the less likely an area would be affected. The probability of oil contamination was based on a statistical analysis of the resulting ensemble of individual trajectories for each spill scenario. These figures do not imply that the entire contoured area would be covered with oil in the event of a spill, nor do they provide any information on the quantity of oil that would be found in a given area.

2. **Minimum Travel Time Figures**: The footprint of the one minimum travel time map per scenario corresponds to the oil contamination probability maps for oil above the threshold of concern (Table 3). These figures illustrate the shortest time required for oil to reach any point within the footprint at a thickness or concentration exceeding the defined threshold for surface and shoreline oil contamination. These results are based on the ensemble of all individual trajectories.

It is important to note that the probability of a spill trajectory passing through a certain water surface area and the probability of a spill trajectory hitting a shoreline segment near that water surface area are different. For example, in the schematic shown in Figure 20, there are four trajectories total, which do not overlap near the shore. Thus, the surface oiling probability at a surface water grid cell near the shore (yellow cell) is 25%, since only 1 out of 4 trajectories crosses that grid cell. However, the probability of shoreline oiling within the green bracketed segment near the yellow surface water cell is 75%, since 3 out of 4 trajectories intercept that particular shoreline segment. Where 2 of the 4 trajectories do overlap within a surface water grid cell, the probability of oiling is 50% (purple cell). In addition, oil contamination to the shoreline has a cumulative effect over an individual run, since oil that hits the shoreline is stranded there, and more oil can pile up. In contrast, oil contamination on the surface only shows the maximum concentration at each grid cell for any given time (i.e., oil can move through a cell in excess of the threshold but still not exceed the threshold at any given time).

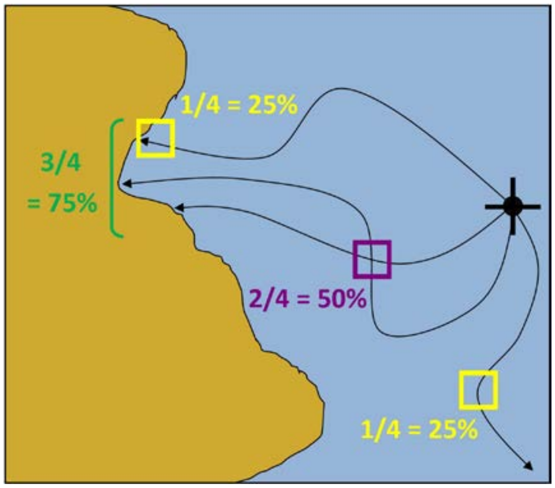


Figure 20. Illustration of the difference between surface and shoreline oiling probabilities. Surface probabilities in yellow and purple, shoreline probabilities in green.

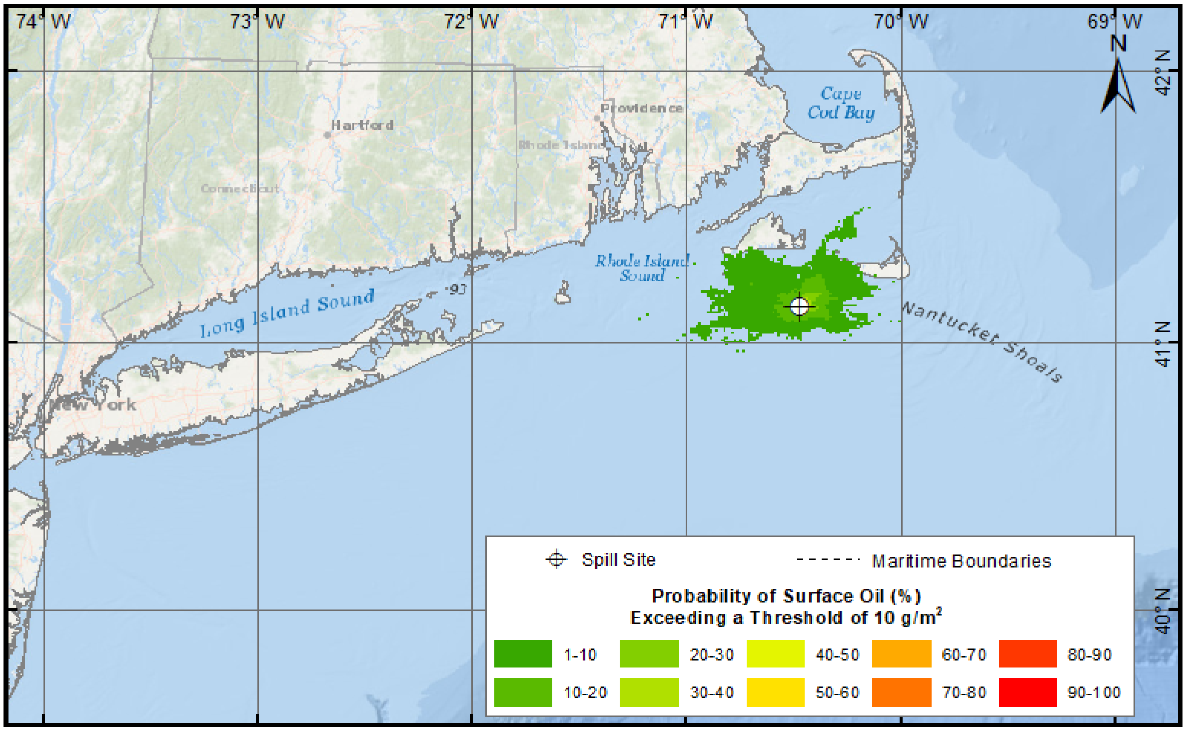
4.1. 400 MW Site

4.1.1. Oil Contamination to Water Surface

Figures 21 to 28 provide the results of surface oil contamination for the spill scenarios over each season. In all four seasons, the sea surface area exposed to oil exceeding the 10 g/m^2 threshold is contained within approximately 20-25 miles of the 400 MW ESP spill location, with the largest stochastic contour being 1-10% probability. Three of the seasons (spring, summer and fall; Figures 21-26, respectively) demonstrate a sea surface area exposed to oil exceeding the threshold of similar size; while the winter scenario depicts a relatively smaller footprint centralized around the spill site. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which Vineyard Wind would implement in the case of a spill.

As described above and shown in Figure 20, the difference in the footprint for the surface and shoreline oil contamination is a result of the surface oil less than 100 µm (100 g/m^2 on average over the grid cell) traveling farther distances and beginning to pile up on shore. It is important to note that oil contamination on the surface only shows the maximum concentration at each grid cell for any given time (i.e., oil can move through a cell in excess of the threshold but still not exceed the threshold at any given time).

1,539 barrel instantaneous release of oil mixture (March to May)



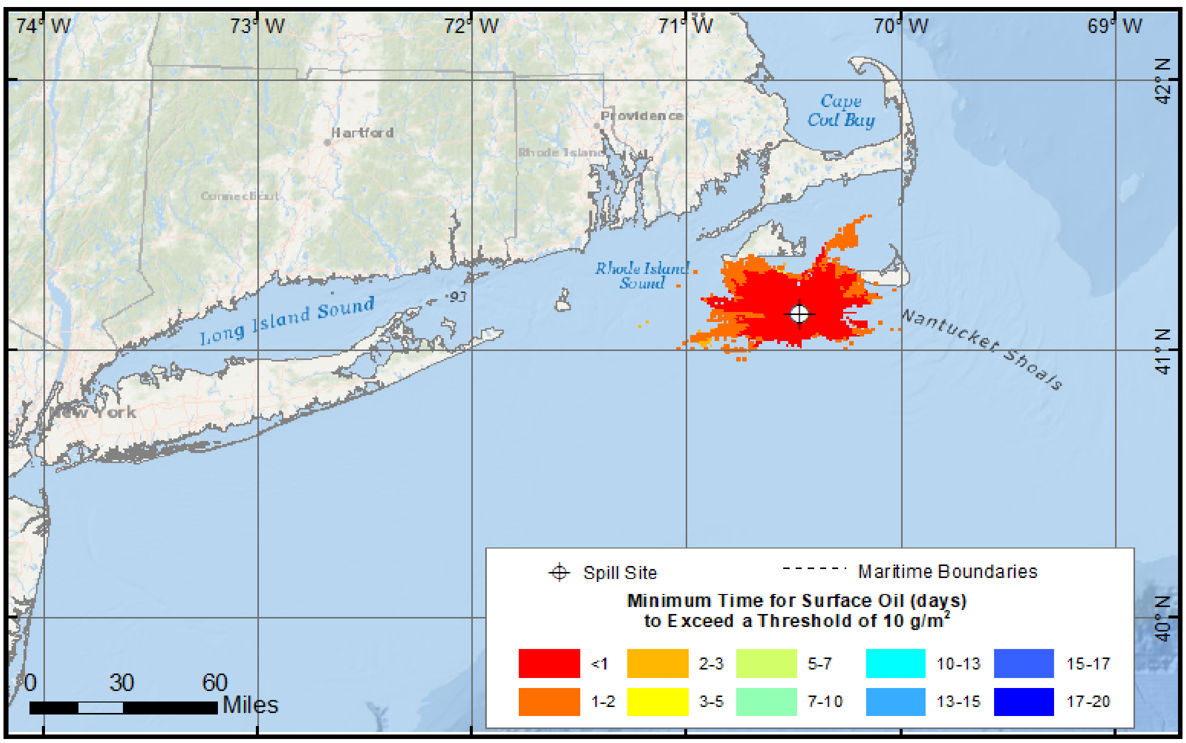


Figure 21. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during spring months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

1,539 barrel instantaneous release of oil mixture (March to May)

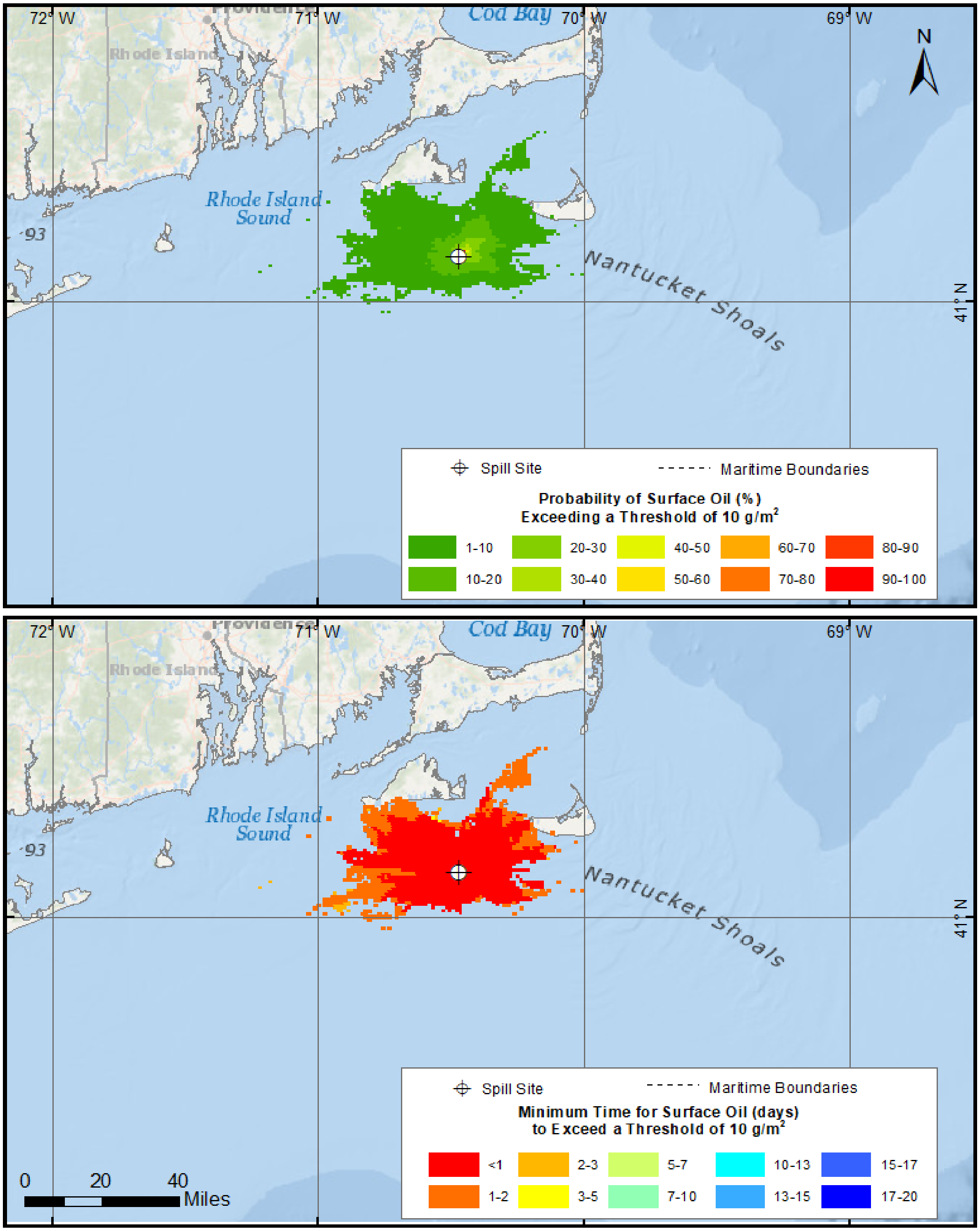


Figure 22. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during spring months for an instantaneous release from the 400 MW ESP location . Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

1,539 barrel instantaneous release of oil mixture (June to August)

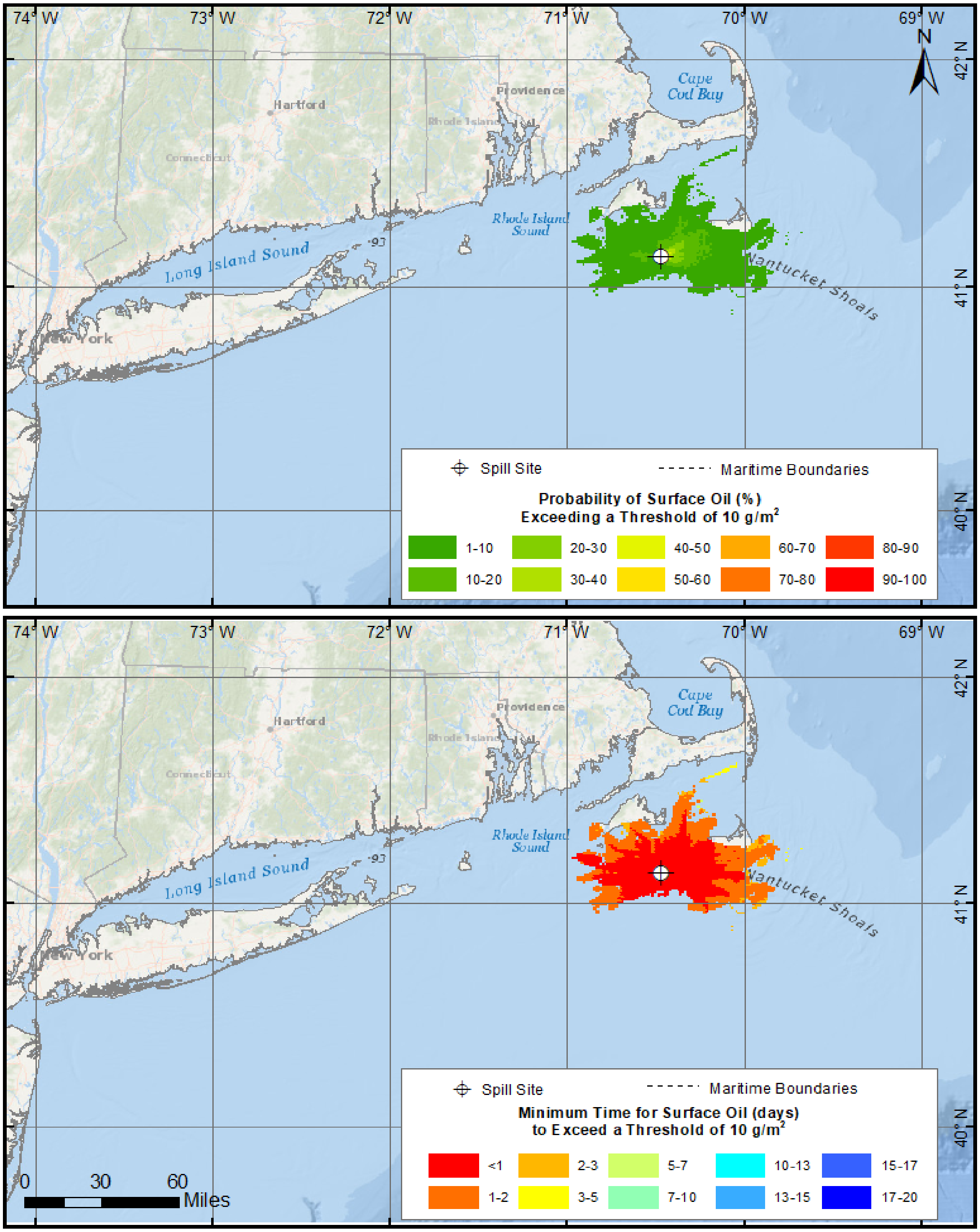


Figure 23. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during summer months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m^2.

1,539 barrel instantaneous release of oil mixture (June to August)

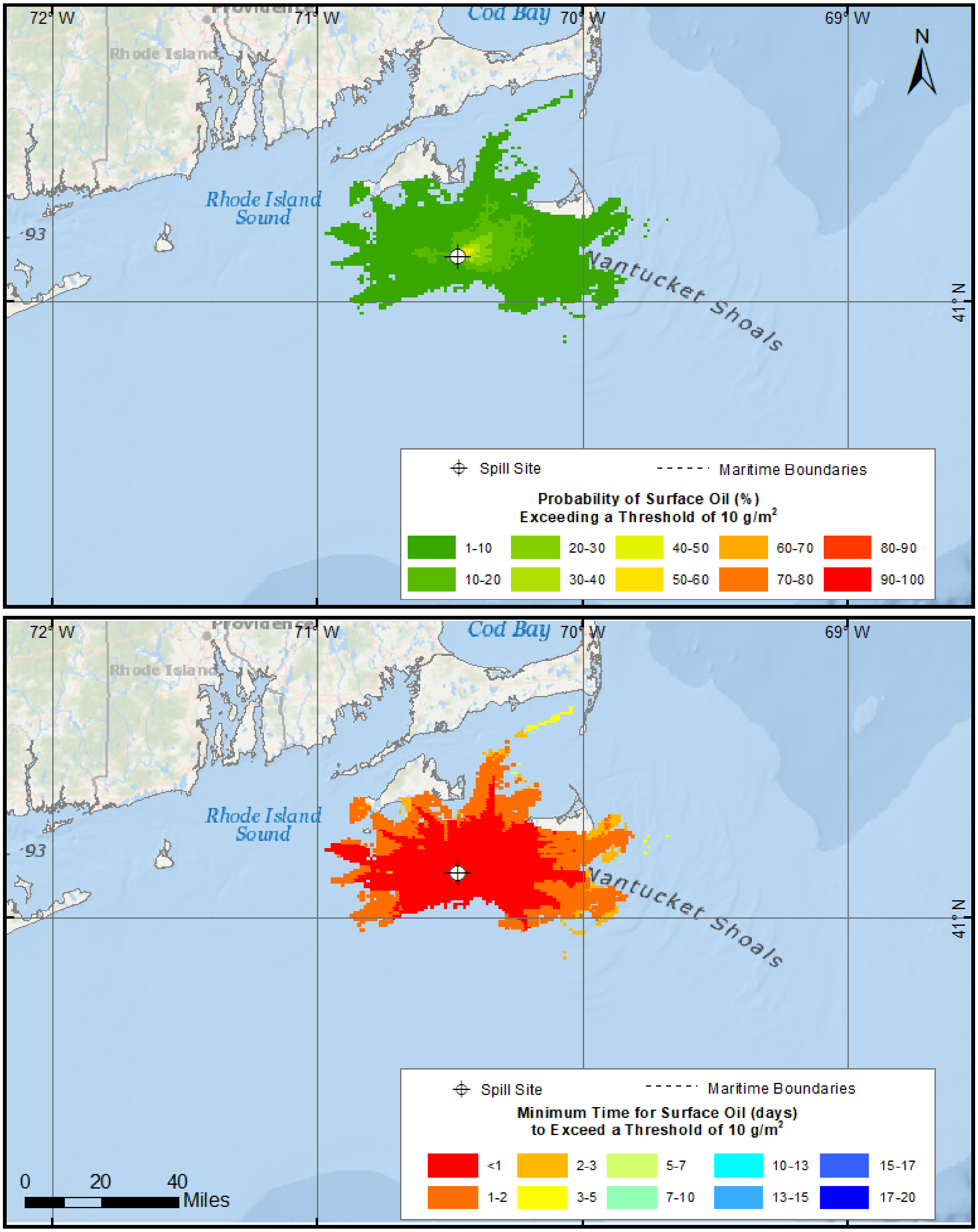


Figure 24. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during summer months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

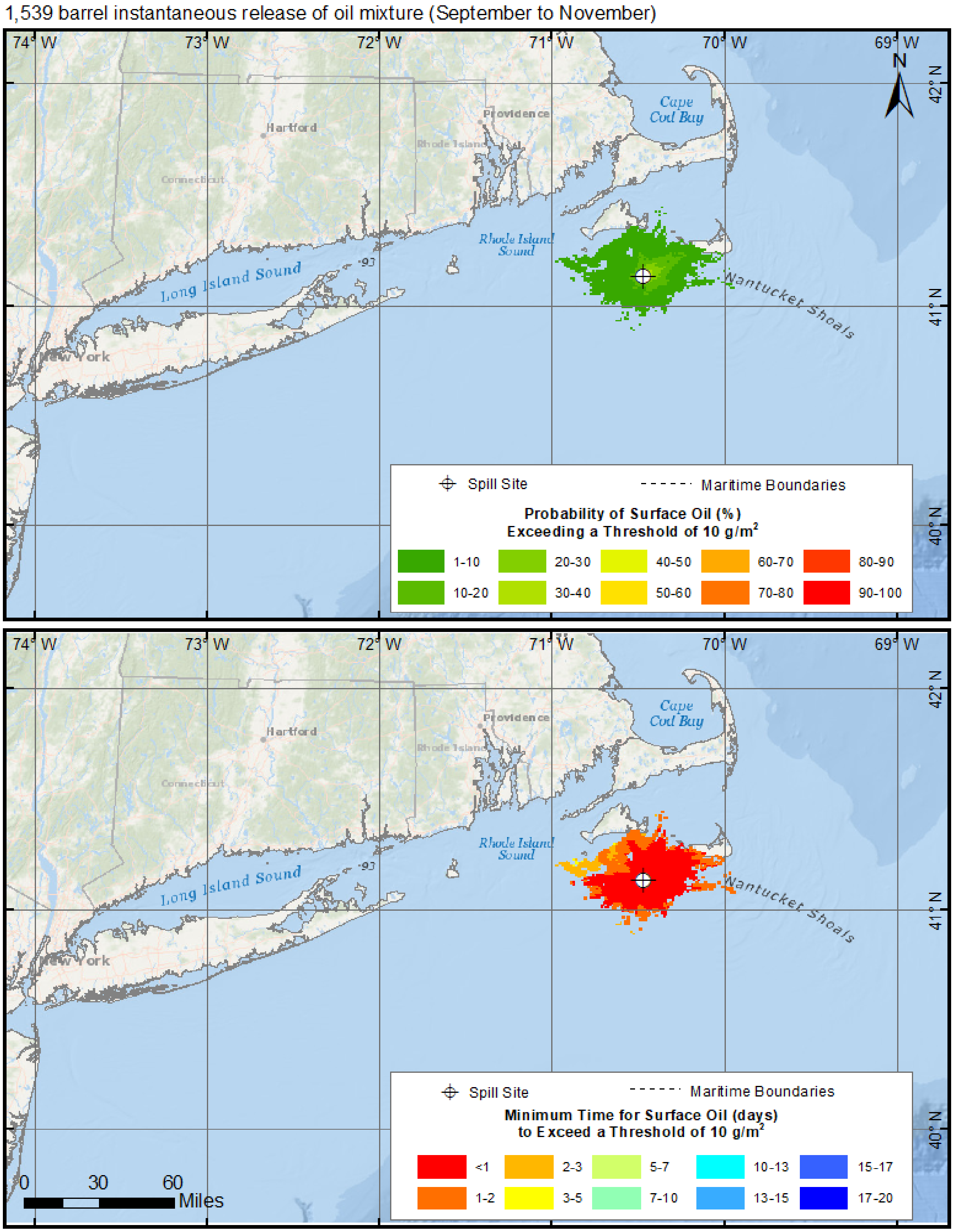
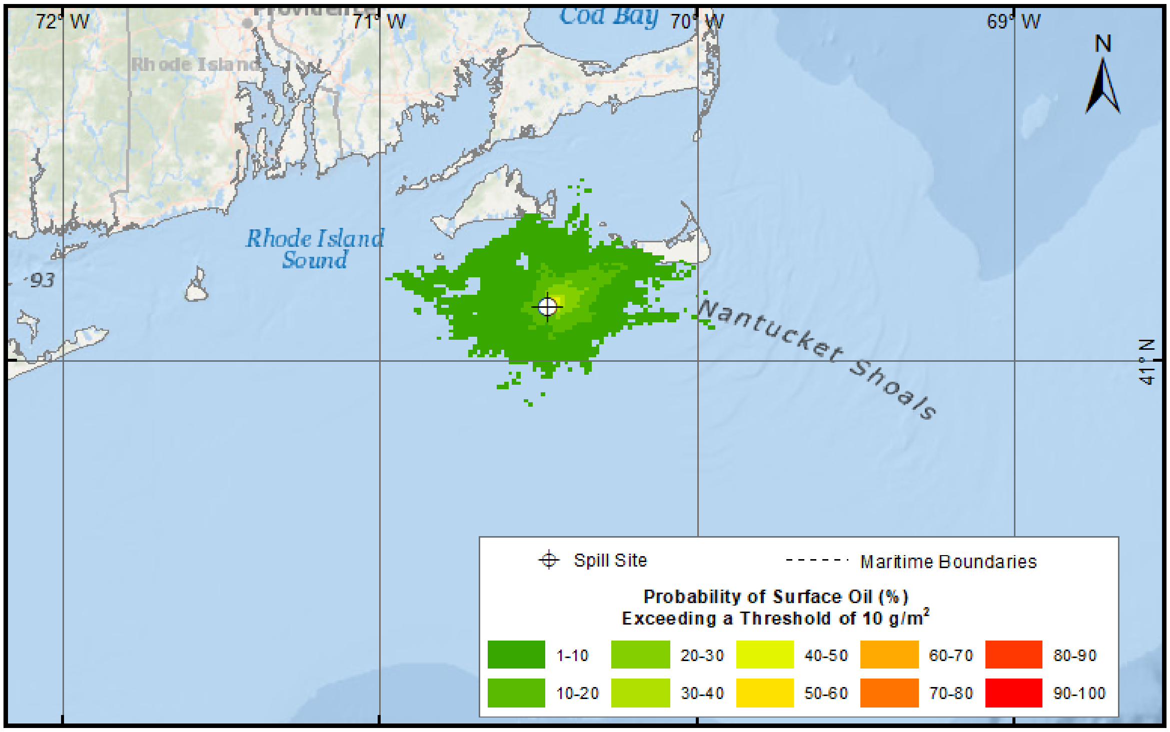


Figure 25. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during fall months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

1,539 barrel instantaneous release of oil mixture (September to November)



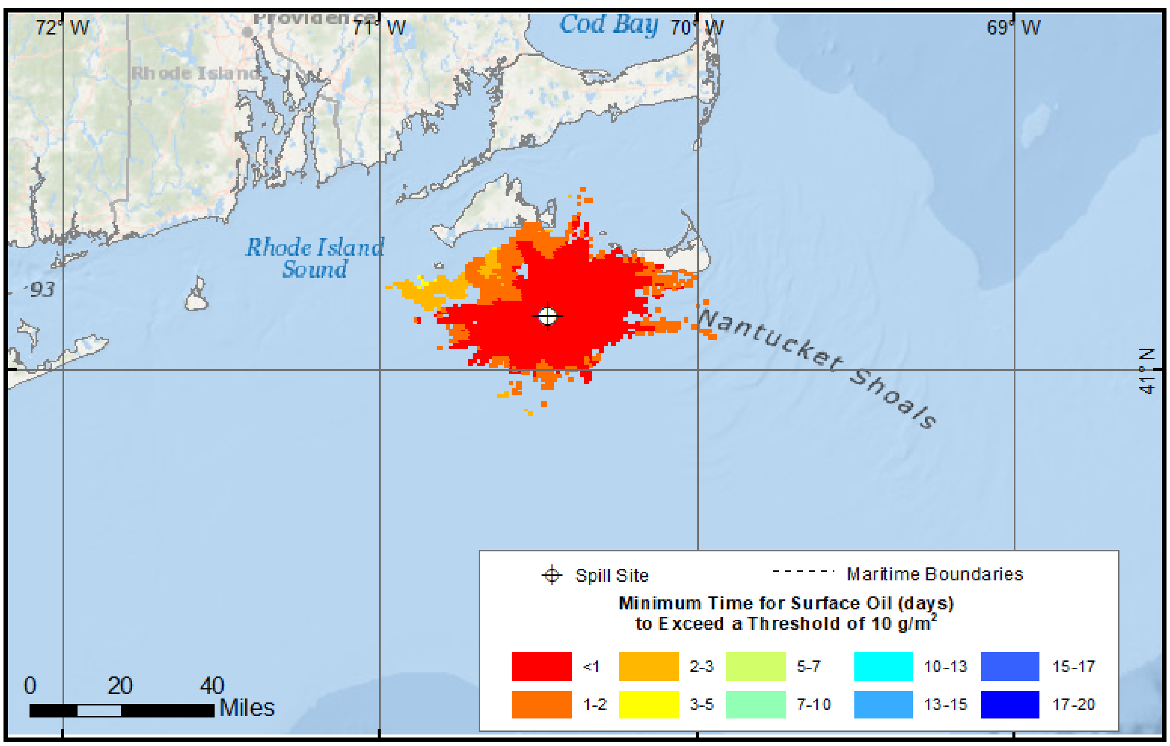


Figure 26. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during fall months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

1,539 barrel instantaneous release of oil mixture (December to February)

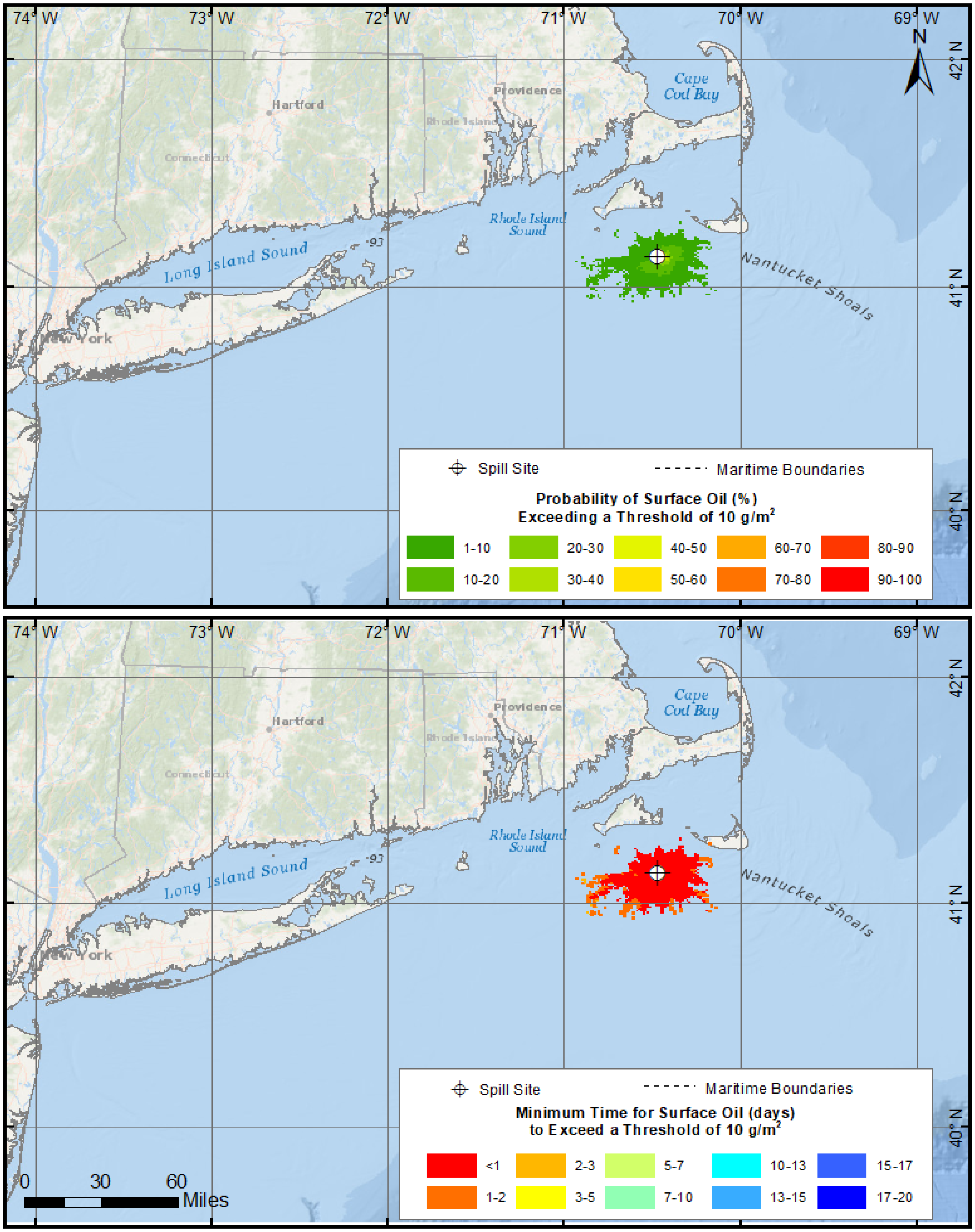


Figure 27. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during winter months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m^2.

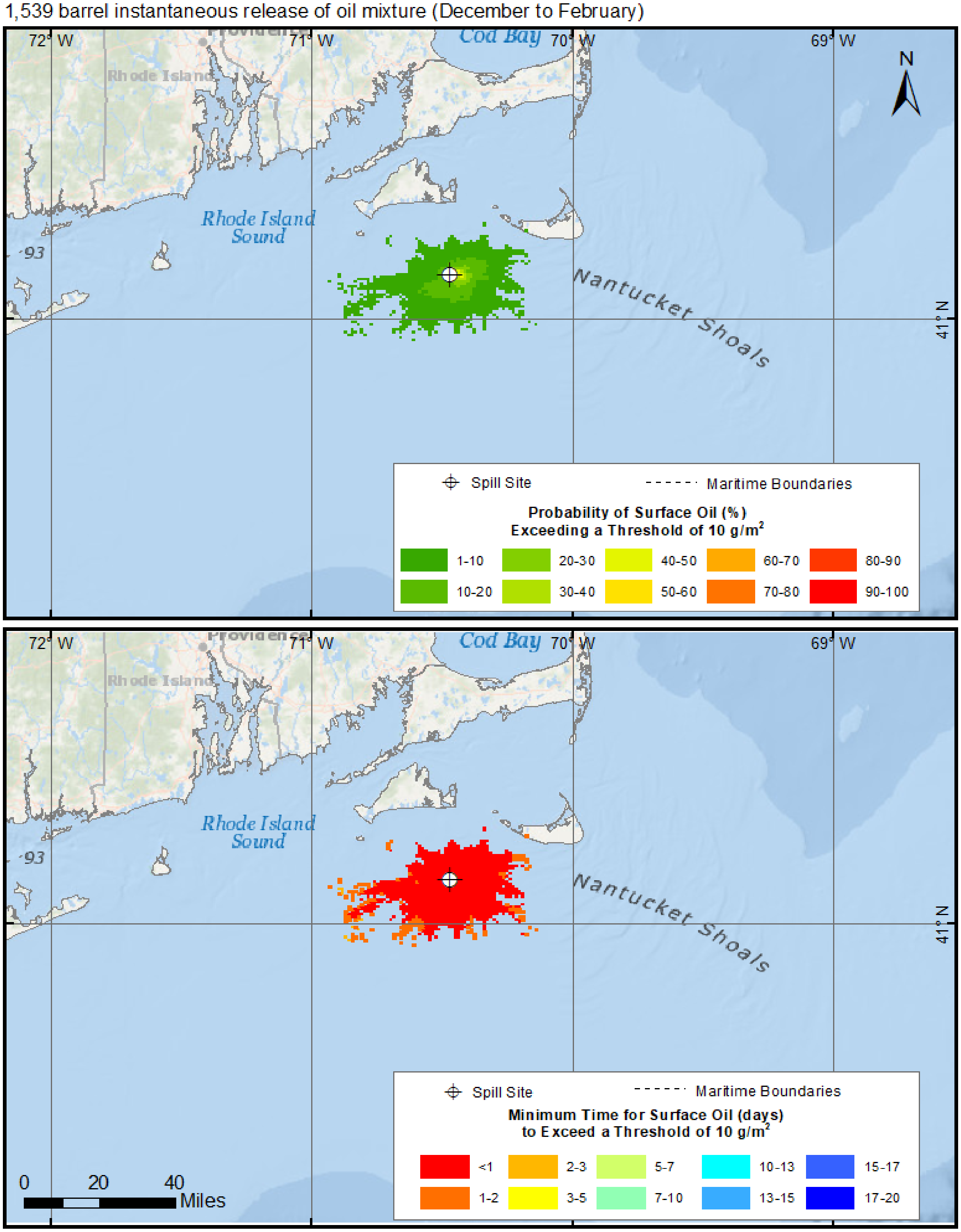


Figure 28. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during winter months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

4.1.2. Oil Contamination to Shore

The following figures illustrate the results of oil contamination to the shoreline for the worst-case oil spill scenarios over each season at the 400 MW site. Figures 29-32 indicate that, in all seasons, there is a 1-30% probability that oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) released from the 400 MW ESP location would reach the shorelines of Martha's Vineyard and Nantucket within 1-3 days of the release. There is a lower probability (<10%) of oil above the threshold reaching the shorelines of Rhode Island and Massachusetts >3 days following the release. There is also a relatively small (<10%) potential for shoreline contamination to occur above 100g/m^2 on parts of Long Island and Connecticut; however, the timing for this to happen is much longer (>10 days) in most cases, and would likely be largely mitigated with response measures.

The season in which there would be expected to have the largest spatial extent of oiling is the spring due to the prevailing winds and currents during that time period. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which Vineyard Wind would implement in the case of a spill.

As described above and shown in Figure 20, the difference in the footprint for the surface and shoreline oil contamination is a result of the surface oil less than 100 µm (100 g/m^2 on average over the grid cell) traveling farther distances and beginning to pile up on shore. It is important to note that oil contamination to the shoreline has a cumulative effect over an individual run, since oil that hits the shoreline is stranded there, and more oil can pile up.

1,539 barrel instantaneous release of oil mixture (March to May)

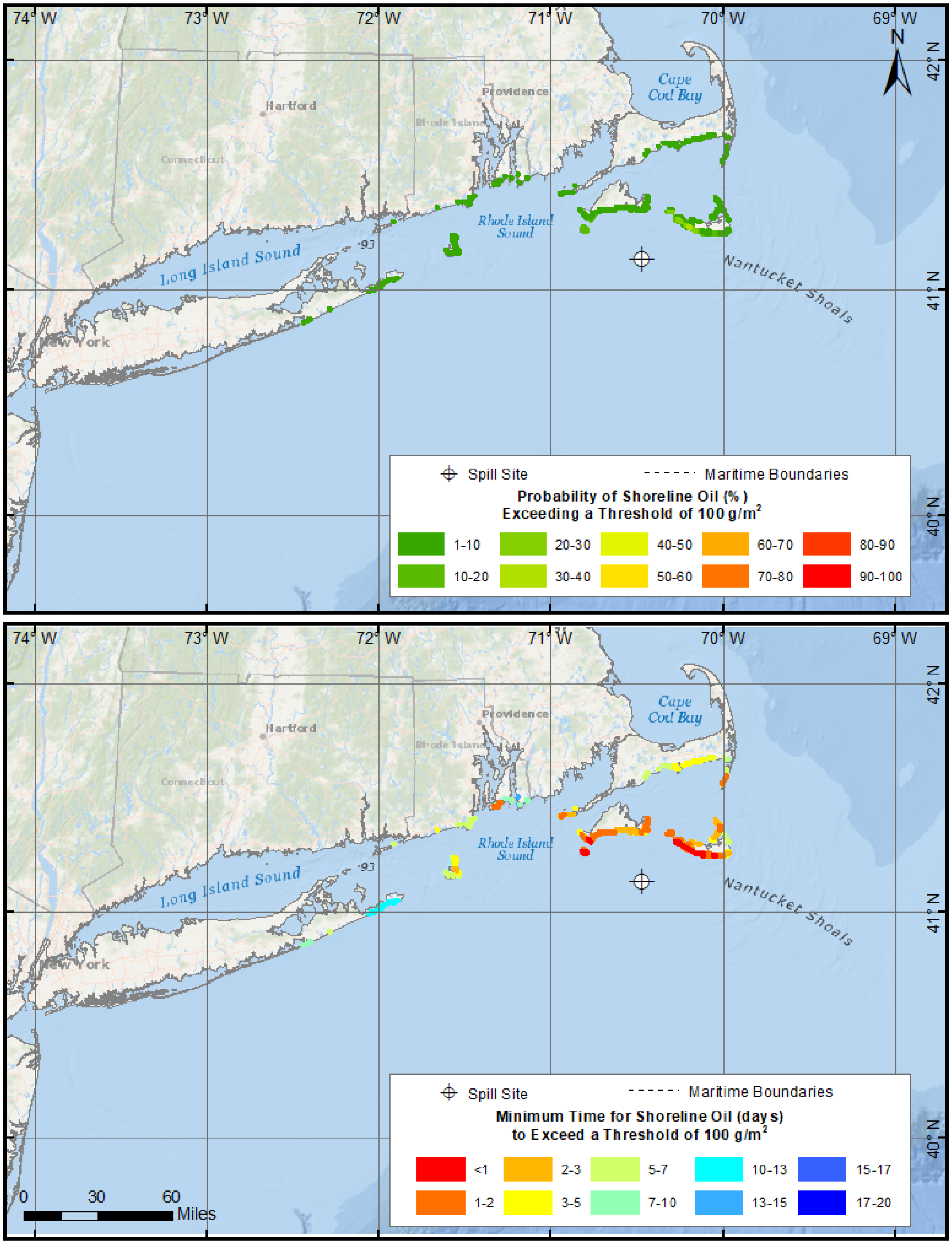


Figure 29. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during spring months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m².

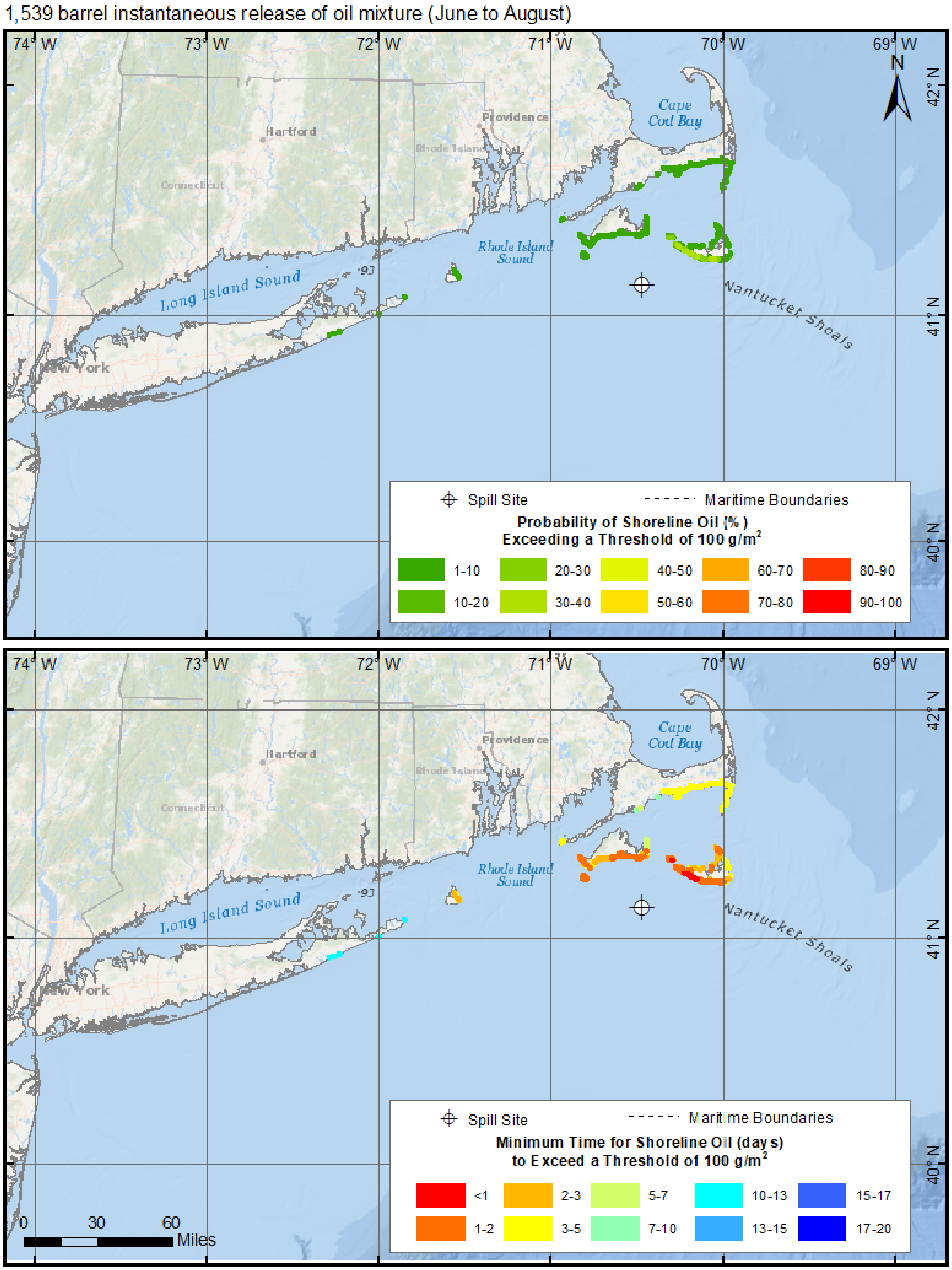
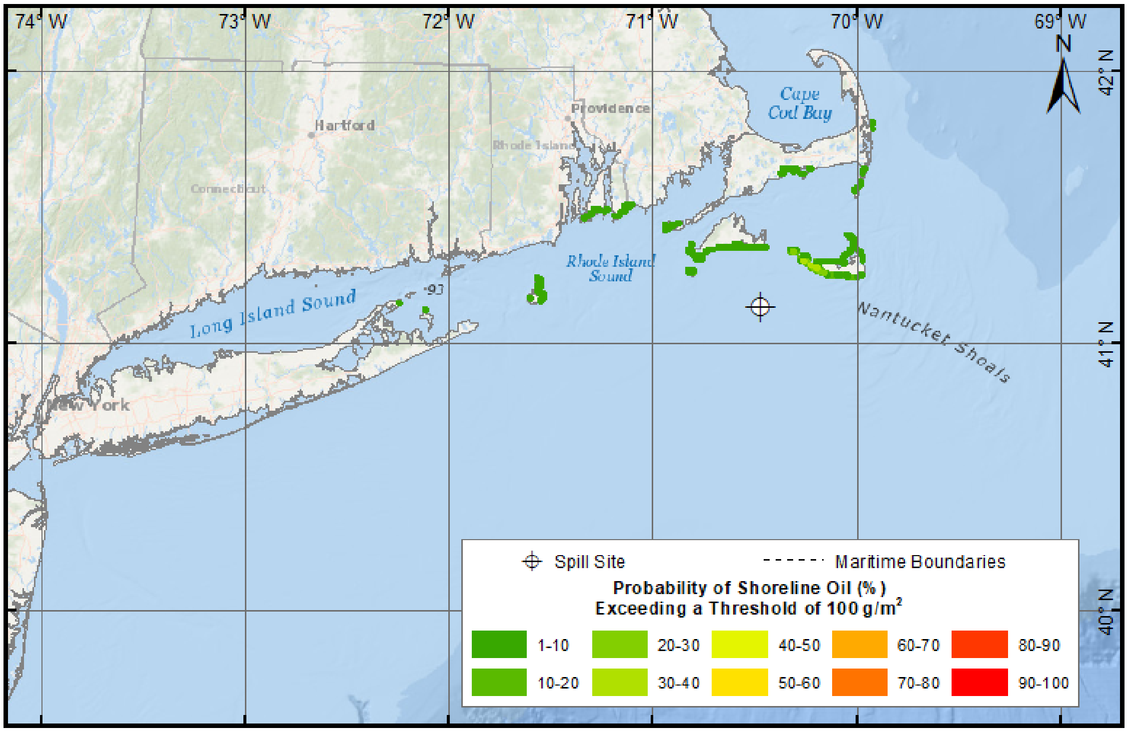


Figure 30. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during summer months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m².

1,539 barrel instantaneous release of oil mixture (September to November)



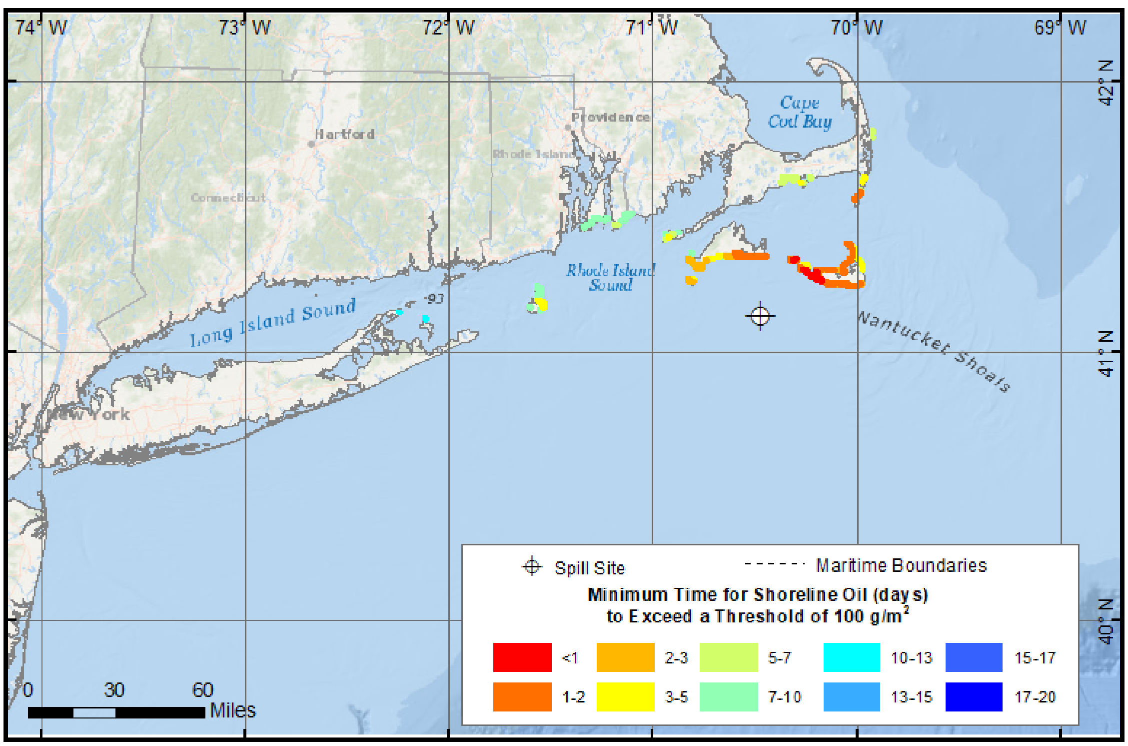


Figure 31. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during fall months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m^2.

1,539 barrel instantaneous release of oil mixture (December to February)

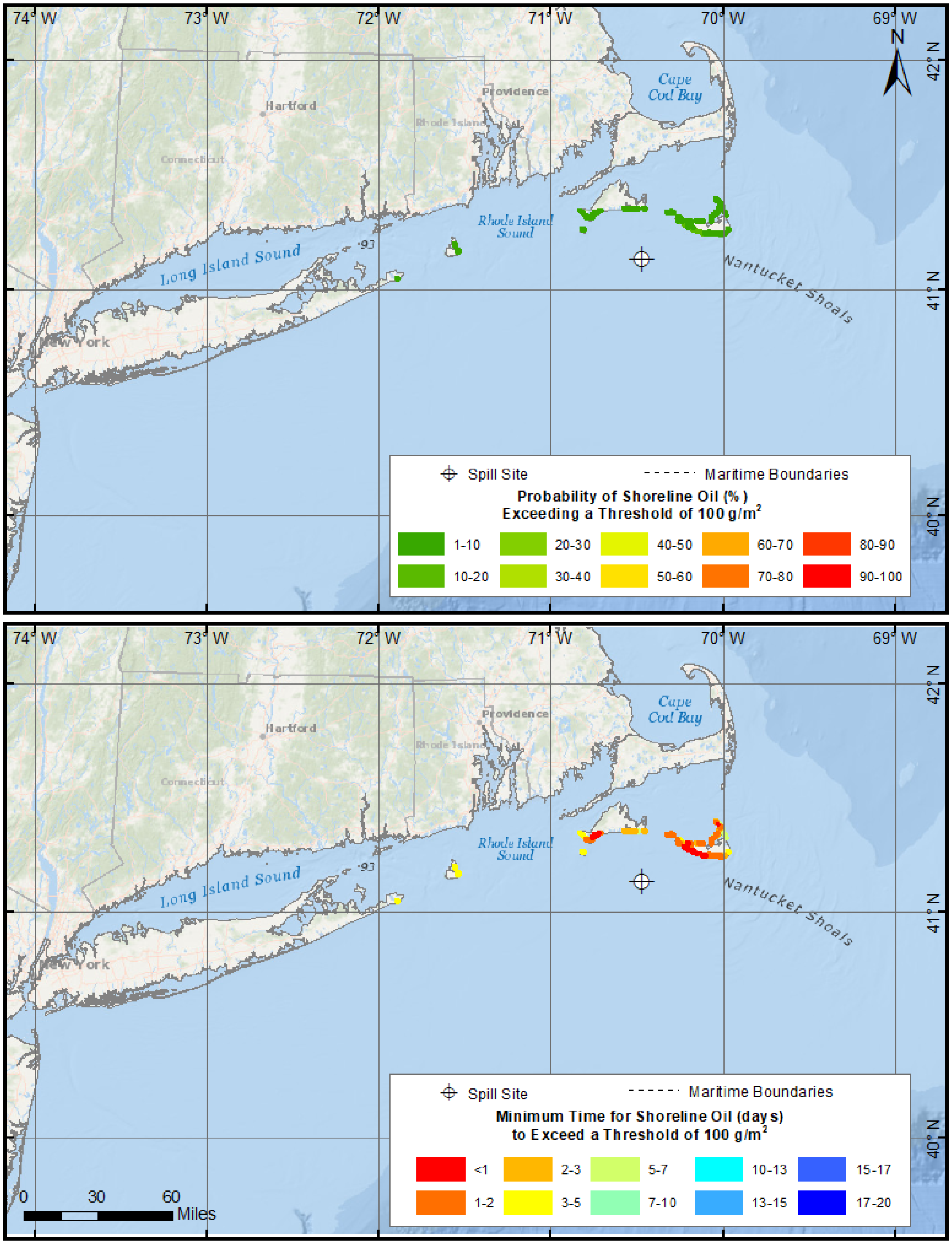


Figure 32. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during winter months for an instantaneous release from the 400 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m².

4.2. 800 MW Site

4.2.1. Oil Contamination to Water Surface

Figures 33 to 40 provide the results of surface oil contamination for the spill scenarios over each season. In all four seasons, the sea surface area exposed to oil exceeding the 10 g/m^2 threshold is contained within approximately 30-50 miles of the 800 MW ESP spill location, with the largest stochastic contour being 1-10% probability. Three of the seasons (spring, summer and fall; Figures 33-38, respectively) demonstrate a sea surface area exposed to oil exceeding the threshold of similar size; while the winter scenario depicts a relatively smaller footprint centralized around the spill site. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which Vineyard Wind would implement in the case of a spill.

As described above and shown in Figure 20, the difference in the footprint for the surface and shoreline oil contamination is a result of the surface oil less than 100 µm (100 g/m^2 on average over the grid cell) traveling farther distances and beginning to pile up on shore. It is important to note that oil contamination on the surface only shows the maximum concentration at each grid cell for any given time (i.e., oil can move through a cell in excess of the threshold but still not exceed the threshold at any given time).

2,954 barrel instantaneous release of oil mixture (March to May)

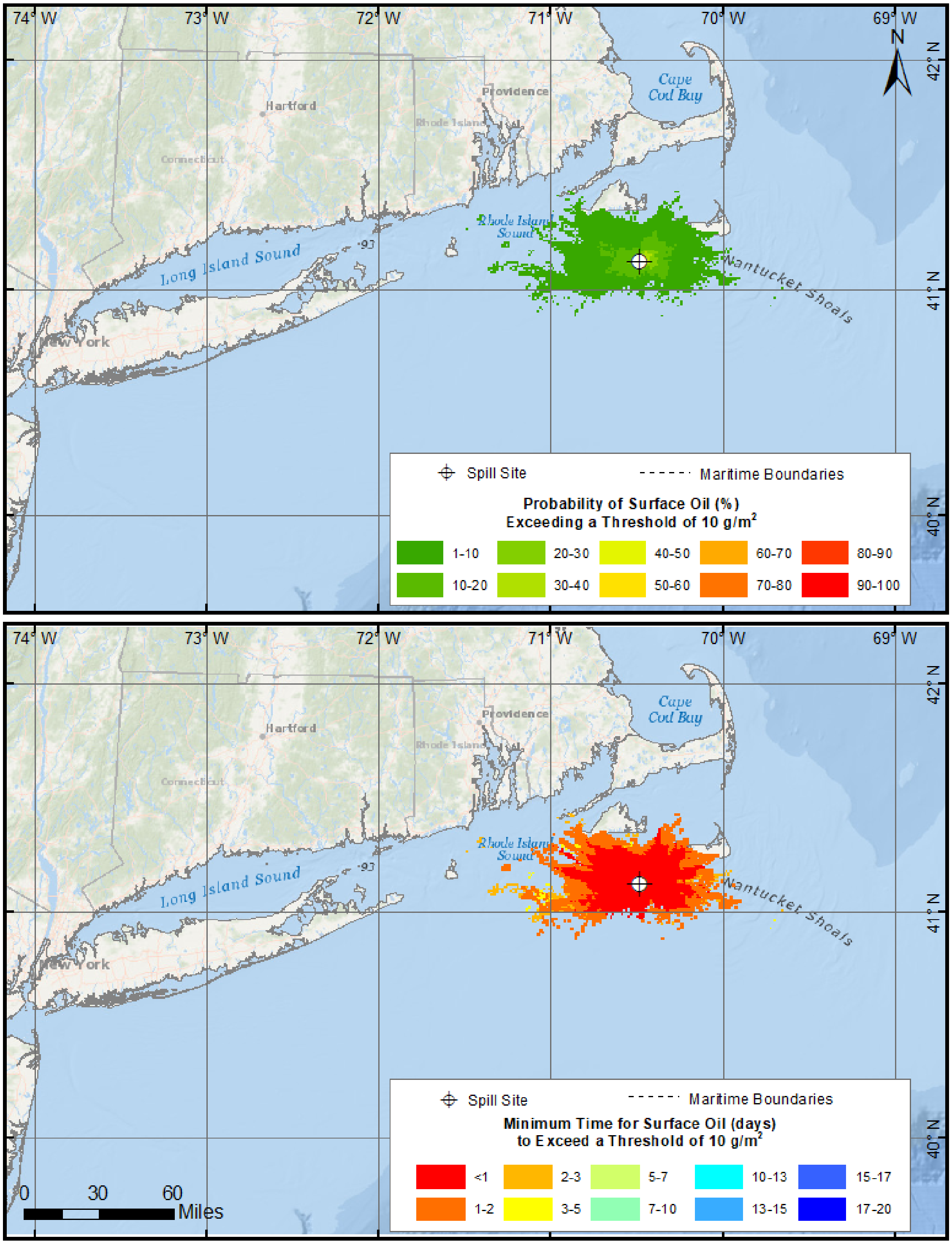


Figure 33. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during spring months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

2,954 barrel instantaneous release of oil mixture (March to May)

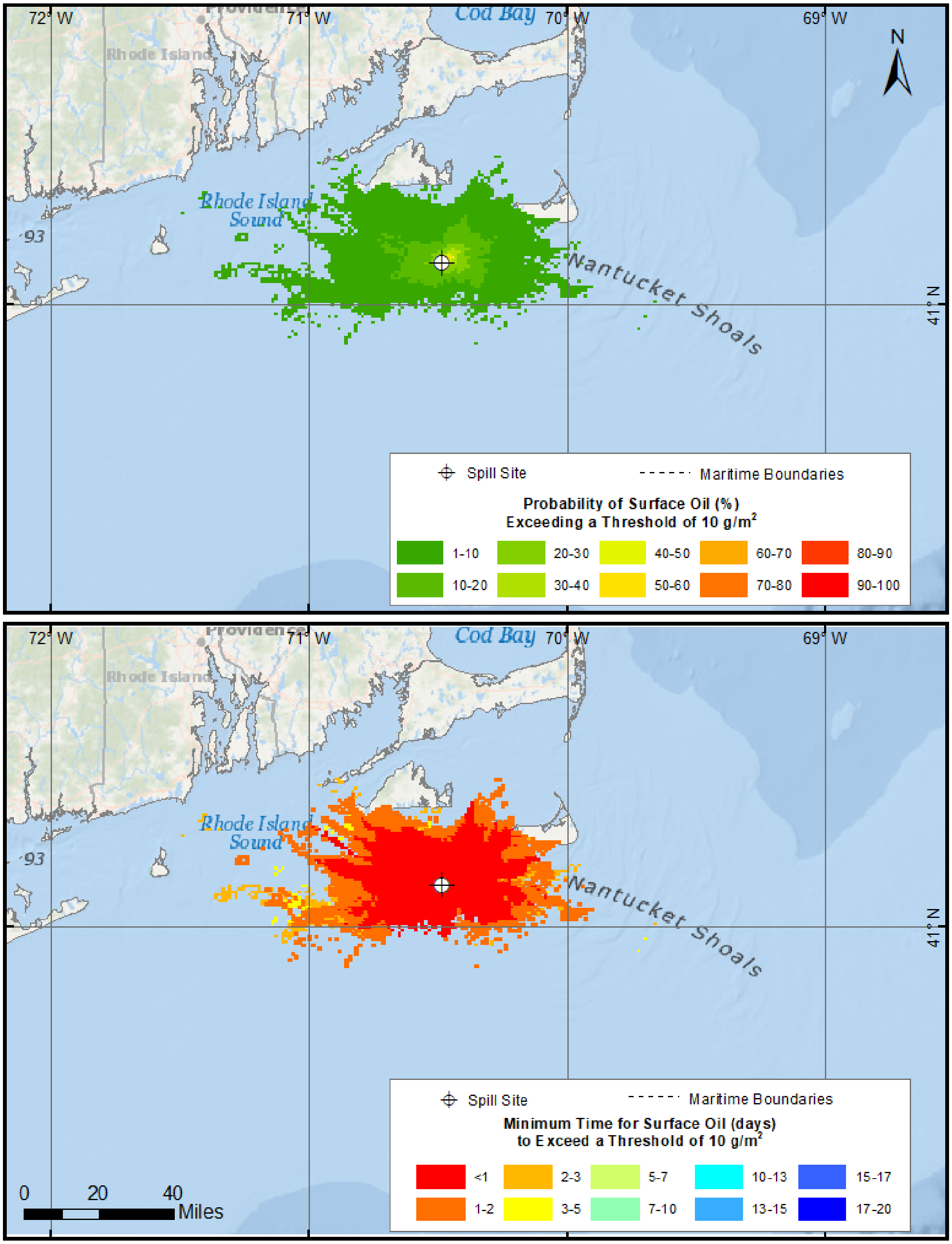


Figure 34. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during spring months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

2,954 barrel instantaneous release of oil mixture (June to August)

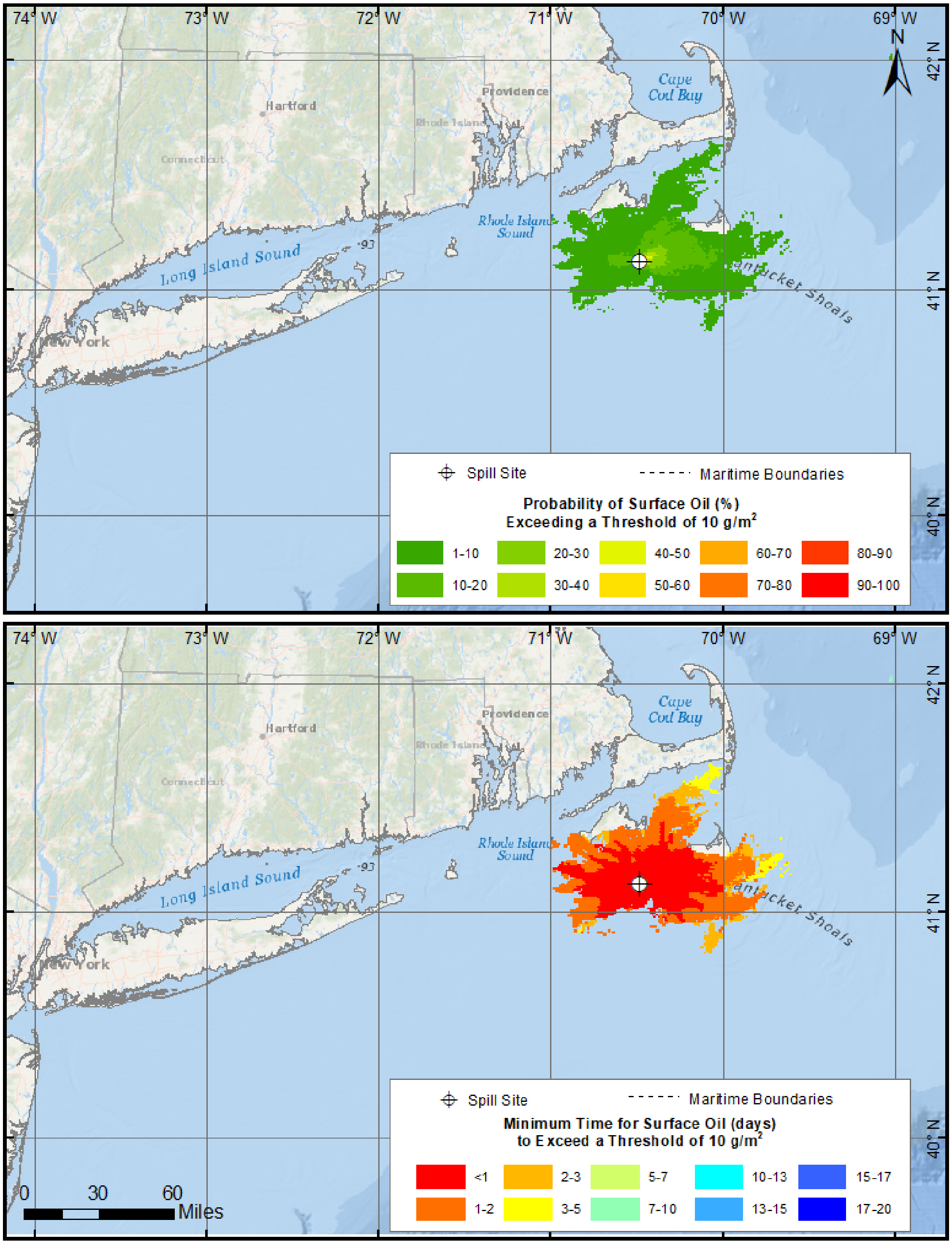


Figure 35. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during summer months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

2,954 barrel instantaneous release of oil mixture (June to August)

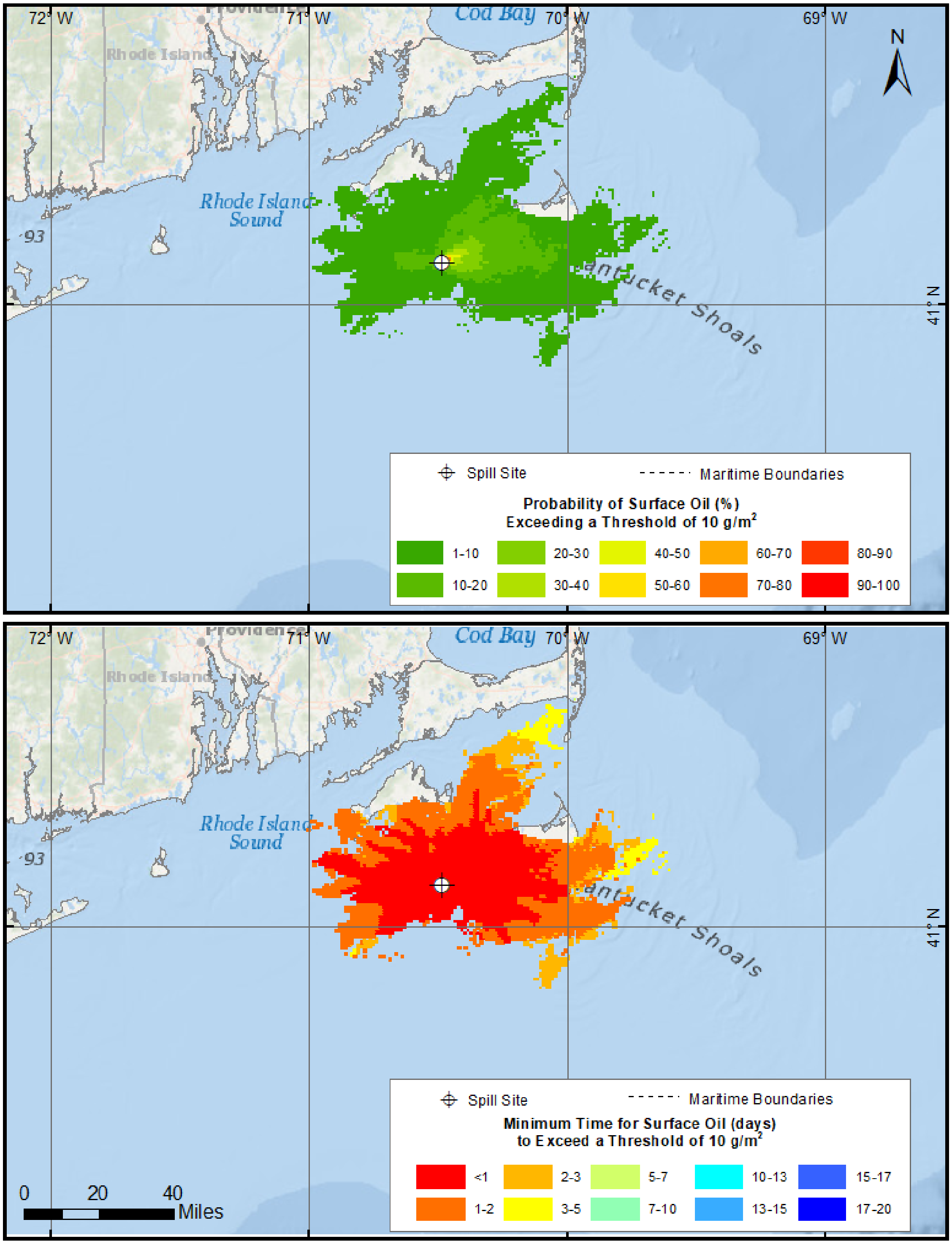


Figure 36. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during summer months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

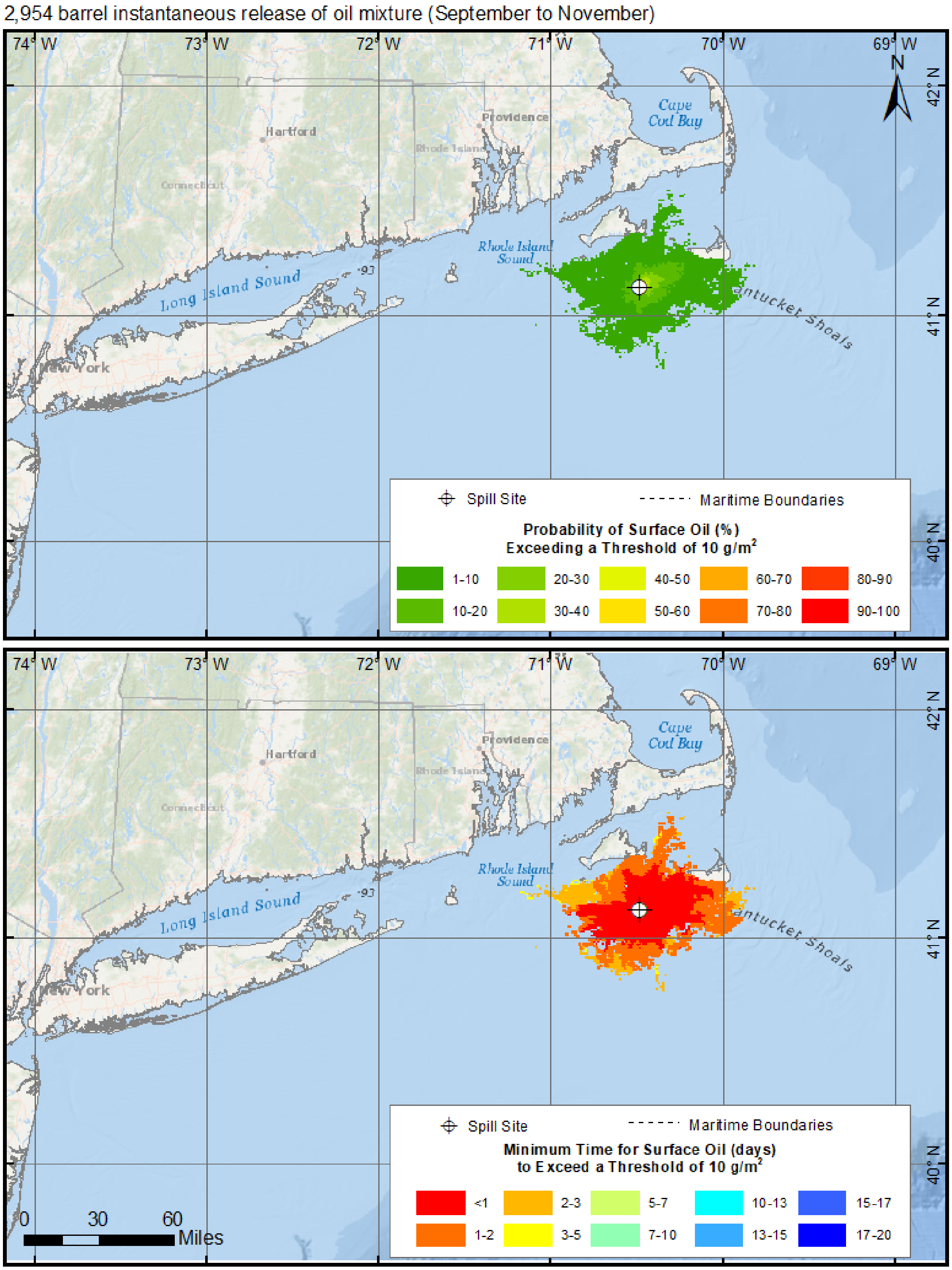


Figure 37. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during fall months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

2,954 barrel instantaneous release of oil mixture (September to November)

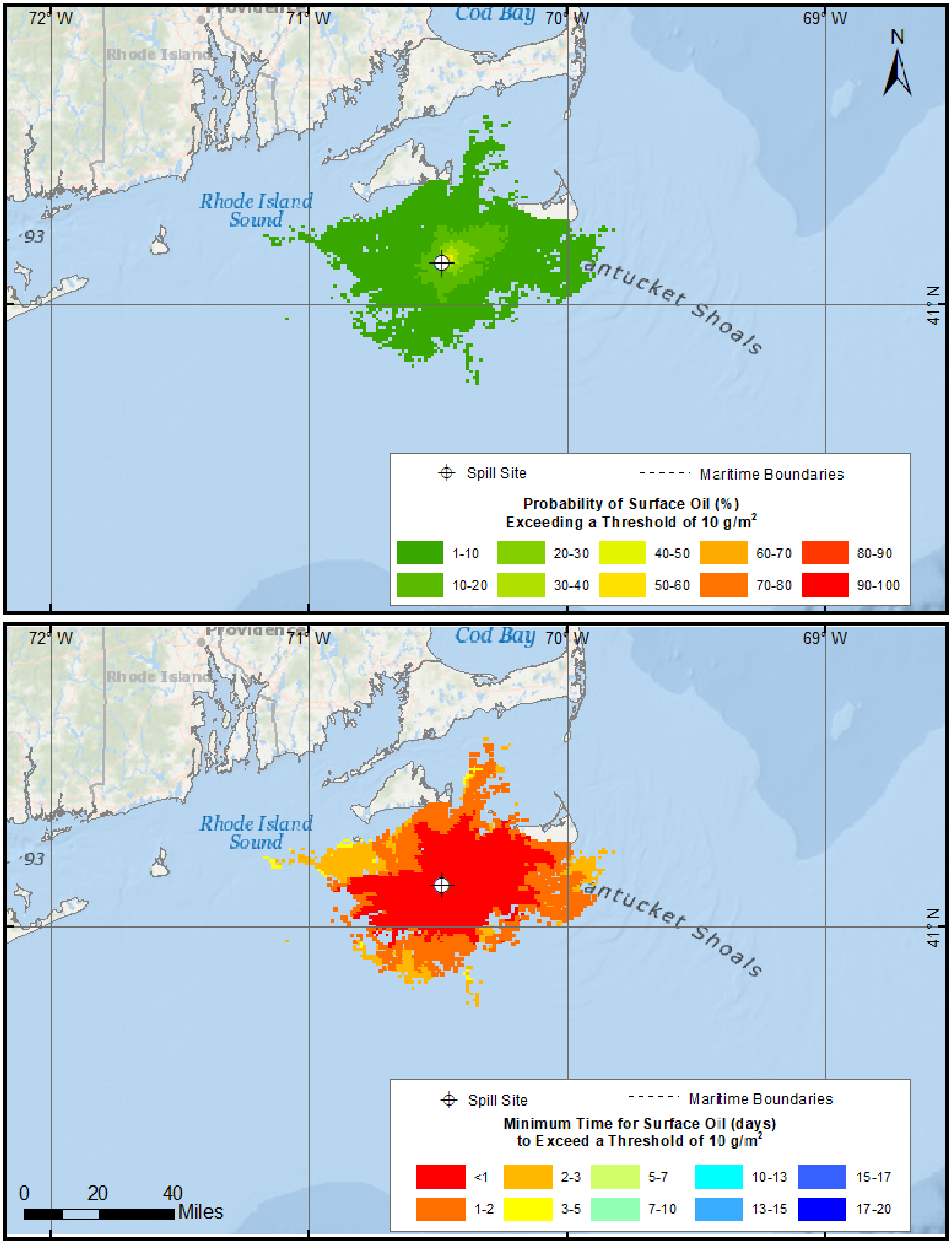


Figure 38. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during fall months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

2,954 barrel instantaneous release of oil mixture (December to February)

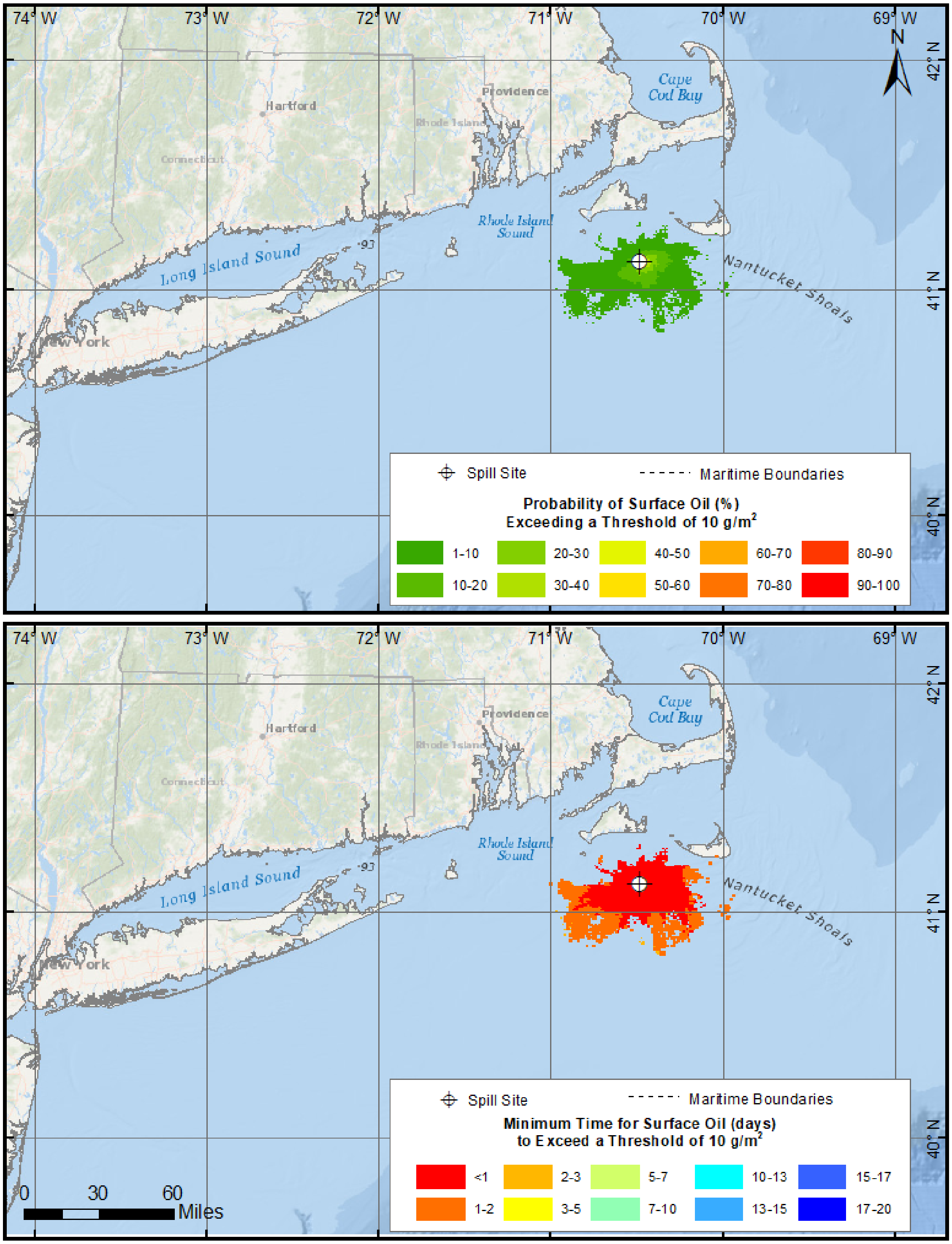


Figure 39. Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during winter months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

2,954 barrel instantaneous release of oil mixture (December to February)

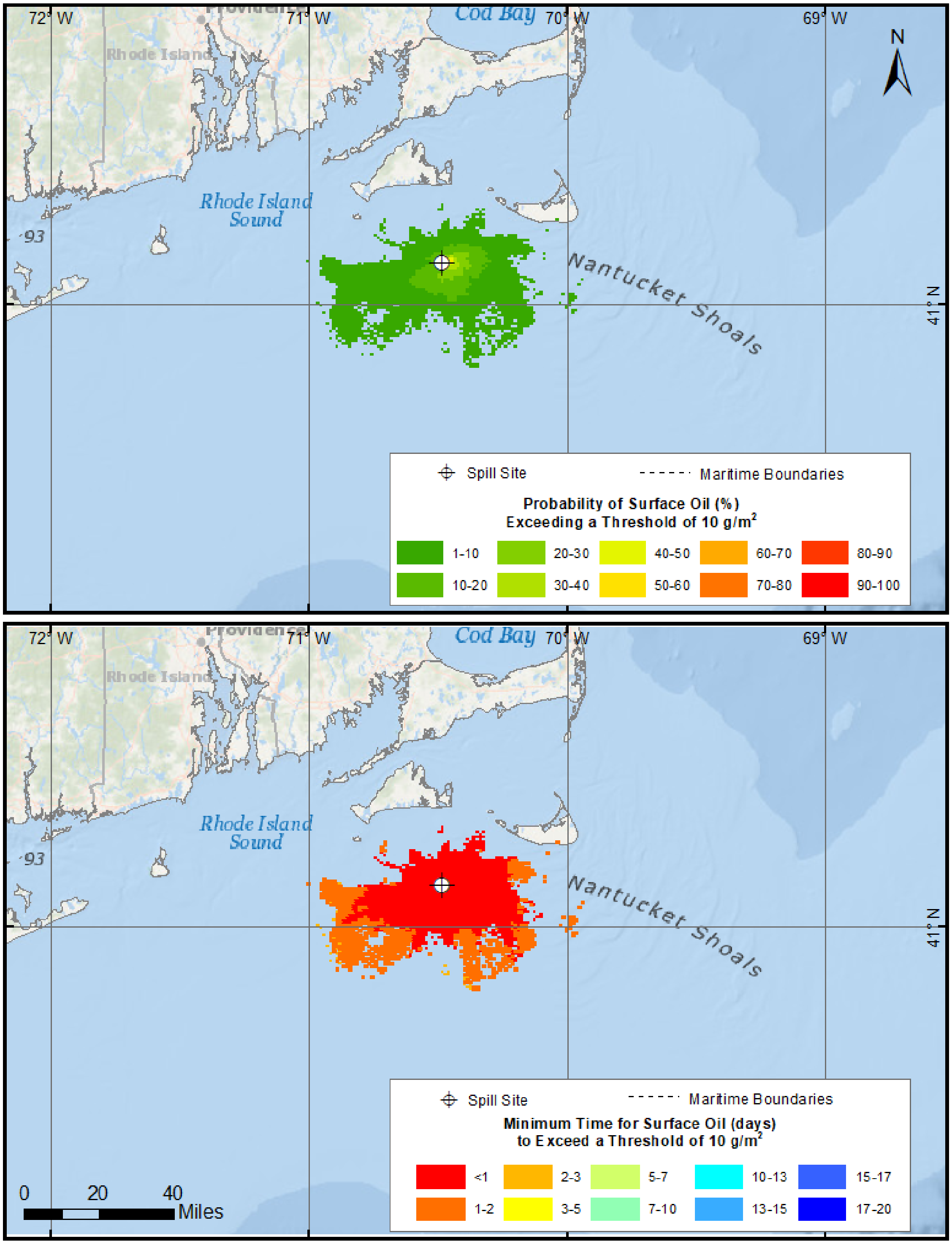


Figure 40. Detail View Top Panel - Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during winter months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for surface oil thickness to exceed 10 g/m².

4.2.2. Oil Contamination to Shore

The following figures illustrate the results of oil contamination to the shoreline for the worst-case oil spill scenarios over each season at the 800 MW site. Figures 41 - 44 indicate that, in all seasons, there is a 1-40% probability of oil above a minimum thickness of 100 µm (100 g/m2 on average over the grid cell) reaching the shorelines of Martha's Vineyard and Nantucket within 1-3 days of the release. There is a lower probability (<10%) of oil above the threshold reaching the shorelines of Rhode Island and Massachusetts >3 days following the release. There is also a relatively small (<10%) potential for shoreline contamination to occur above 100 g/m^2 on parts of Long Island and Connecticut; however, the timing for this to happen is much longer (>10 days) in most cases, and would likely be largely mitigated with response measures.

As was the case for the oil release scenarios from the 400 MW site, the season in which there would be expected to have the largest spatial extent of oiling is the spring due to the prevailing winds and currents during that time period. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which Vineyard Wind would implement in the case of a spill.

As described above and shown in Figure 20, the difference in the footprint for the surface and shoreline oil contamination is a result of the surface oil less than 100 µm (100 g/m^2 on average over the grid cell) traveling farther distances and beginning to pile up on shore. It is important to note that oil contamination to the shoreline has a cumulative effect over an individual run, since oil that hits the shoreline is stranded there, and more oil can pile up.

2,954 barrel instantaneous release of oil mixture (March to May)

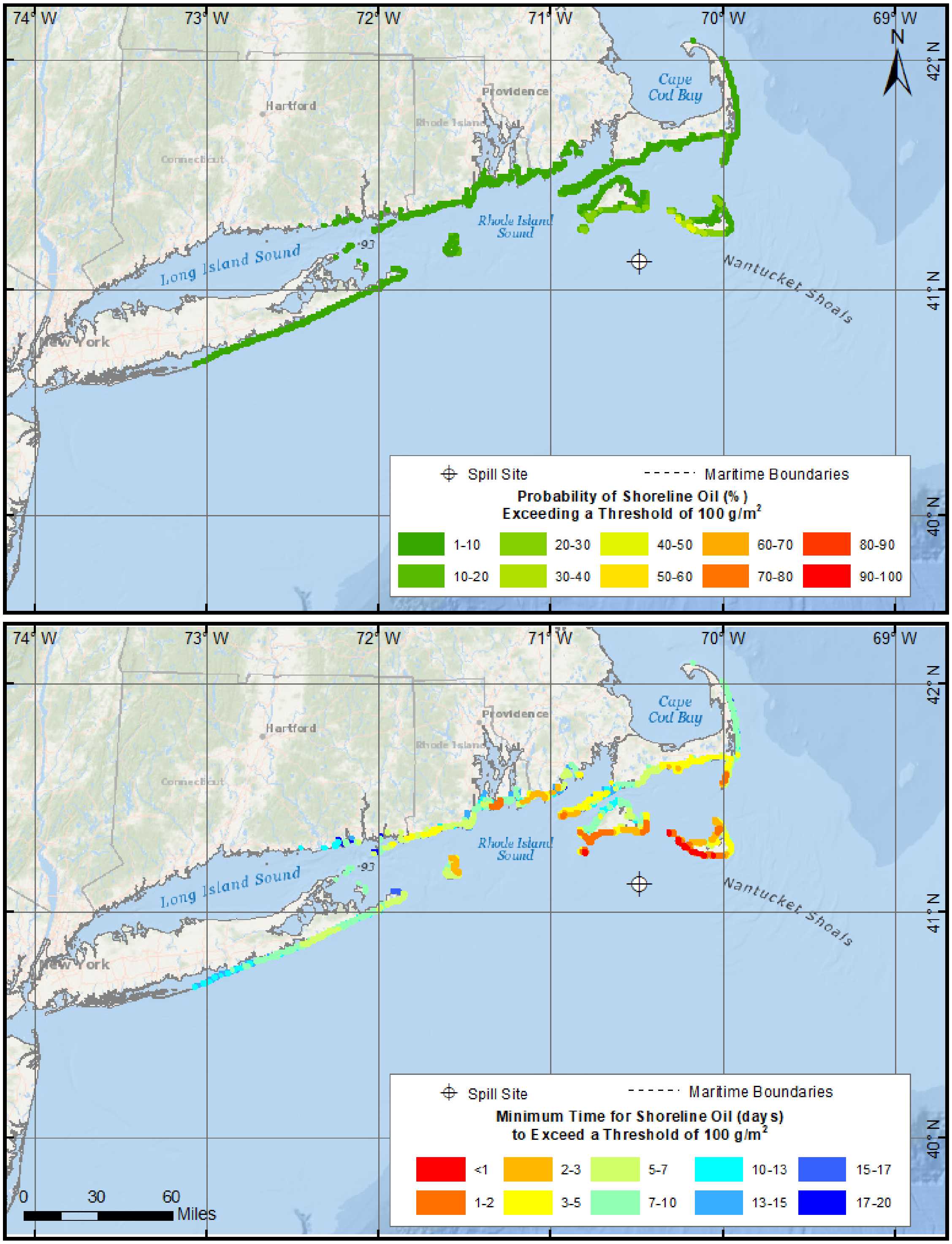
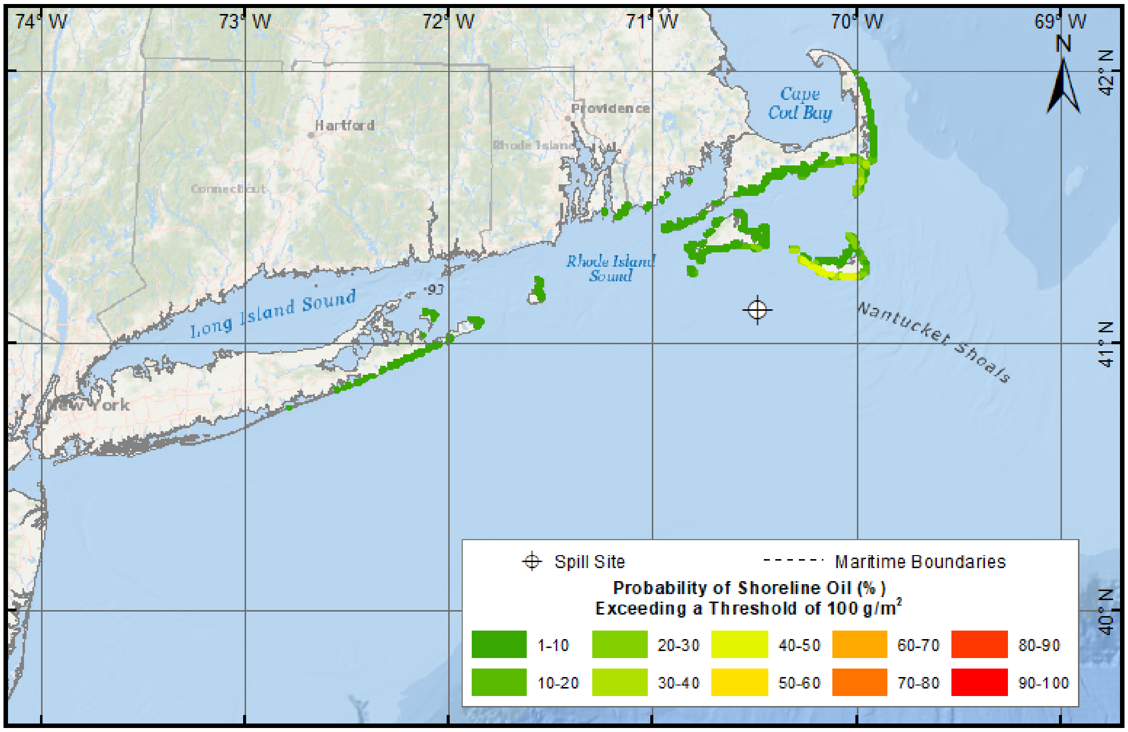


Figure 41. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during spring months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m².

2,954 barrel instantaneous release of oil mixture (June to August)



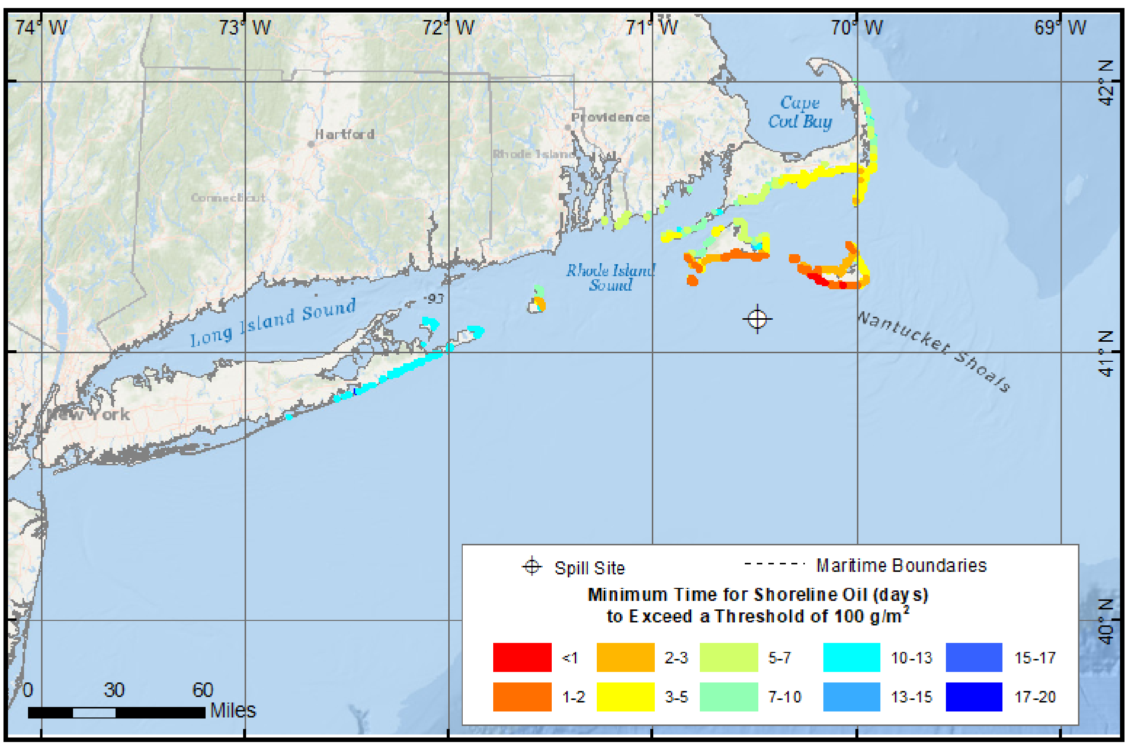


Figure 42. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during summer months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m².

2,954 barrel instantaneous release of oil mixture (September to November)

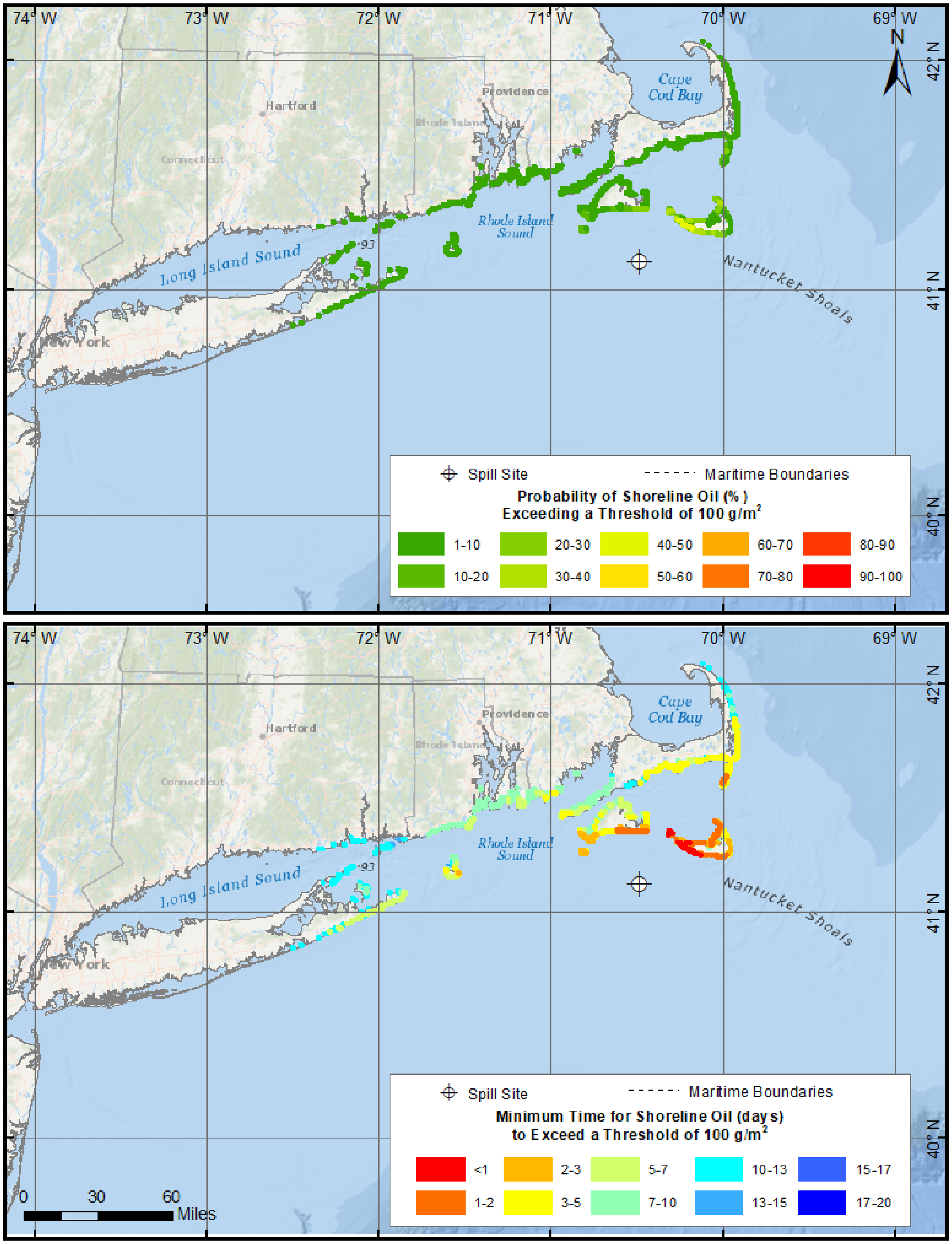


Figure 43. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during fall months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m^2.

2,954 barrel instantaneous release of oil mixture (December to February)

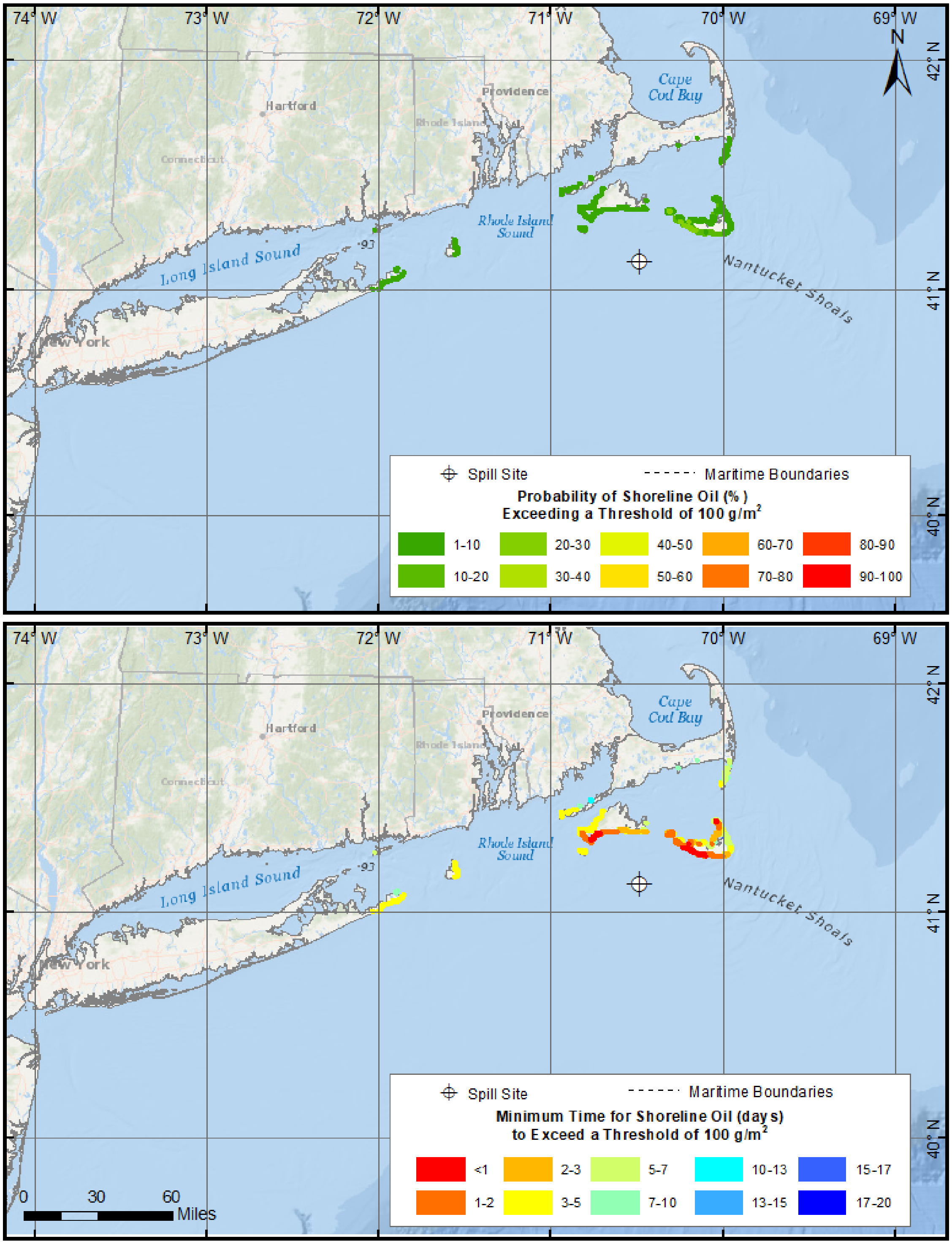


Figure 44. Top Panel - Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during winter months for an instantaneous release from the 800 MW ESP location. Bottom Panel – Minimum time for shoreline oil thickness to exceed 100 g/m².

4.3. Conclusions

This oil spill modeling study assesses the trajectory and weathering of a catastrophic release of all oil contents from the topple of an ESP located closest to shore within the WDA for two different scenarios: a 400 MW ESP and an 800 MW ESP, where the 800 MW ESP has a more conservative (higher) discharge volume. Both of these scenarios simulate worst case discharges involving a relatively small and finite release of oil, with an extremely small probability of such a catastrophic event occurring. In addition to the low probability of such an event, the oil spill scenarios modeled in this study assume that no oil spill response or mitigation would occur. This is also a very conservative assumption because as discussed in further detail in Section 2.3.4 of the OSRP (COP Appendix I-A), response equipment employed on water would be used to prevent the spread of the spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted.

Based on the environmental datasets analyzed as input for the oil spill modeling, the following conclusions can be drawn:

- Winds in the region are moderate, generally blowing from the northwest (winter) or southwest sector (summer) with monthly average wind speeds ranging from 6 to 10 m/s. The strongest winds are found in December and January with the weakest in August.
- Currents at the spill site are up to approximately 30 cm/s speed on average, and their direction changes in the representative seasons.
- In the area of interest, winds are usually more influential than the associated currents in regards to surface transport; however the winds in this region are often much more variable. During the month of July when wind intensity decreases, surface current may control the movement of floating slicks.
- Though there are strong seasonal trends in winds, it is important to note that the direction and magnitude of winds can change from day to day, and the wind roses presented below show monthly averages.

Based on the results of the stochastic spill trajectory analysis assessing potential spills of all oil contents of one ESP located closest to shore, the following conclusions can be made:

- The sea surface area exposed to oil exceeding the 10 g/m^2 threshold is contained within approximately 20-25 miles of the 400 MW ESP spill location and 30-50 miles of the 800 MW ESP spill location for all four seasons, with the area for the winter simulation being relatively smaller than the other three seasons.
- In all seasons, there is a 1-40% probability of oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) reaching the shorelines of Martha's Vineyard and Nantucket within 1-3 days of the release. There is a lower probability (<10%) of oil above the threshold reaching the shorelines of Rhode Island and Massachusetts >3 days following the release. There is the relatively small (<10%) potential for shoreline contamination to occur above 100 g/m^2 on parts of Long Island and Connecticut;

however, the timing for this to happen is much longer (>10 days) in most cases, and would likely be largely mitigated with response measures.

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Appendix A – Oil Spill Modeling System - Description

OILMAP/SIMAP Introduction

OILMAP and SIMAP are part of RPS' comprehensive oil spill modeling system comprised of several interactive modules to reproduce the transport and fate of oil releases in different environments: land, water, and atmosphere. The impact assessment module – SIMAP – was derived from the physical fates and biological effects submodels in the Natural Resource Damage Assessment Models for Coastal and Marine and Great Lakes Environments (NRDAM/CME and NRDAM/GLE), which were developed for the U.S. Department of the Interior (USDOI) as the basis of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) Natural Resource Damage Assessment (NRDA) regulations for Type A assessments (French et al., 1996; Reed et al., 1996). The physical fates model has been validated with more than 20 case histories, including the *Exxon Valdez* and other large spills (French McCay, 2003, 2004; French McCay and Rowe, 2004), and test spills designed to verify the model's transport algorithms (French et al., 1997). The wildlife mortality model has also been validated with more th an 20 case histories, including the *Exxon Valdez*, that verify the values are reasonable (French and Rines, 1997; French McCay 2003, 2004; French McCay and Rowe, 2004). The technical documentation for SIMAP is in French McCay (2003, 2004, 2009).

Applications for OILMAP/SIMAP include impact assessment; hindcast/forecast of spill response; Natural Resource Damage Assessment (NRDA); contingency planning; ecological risk assessment; cost-benefit analysis, and drills and education. The model may be run for a hindcast/forecast of a specific release, or be used in stochastic mode to evaluate the probable distribution of contamination.

OILMAP/SIMAP contains several major components:

- The physical fates model estimates surface distribution and subsurface concentrations of the spilled oil and its components over time.
- The biological effects model estimates impacts resulting from a spill scenario on fish, invertebrates, wildlife, and for each of a series of habitats (environments) affected by the spill.
- The probability of impact from an oil discharge is quantified using the three-dimensional stochastic model.
- Currents that transport contaminant(s) and organisms are entered using the graphical user interface or generated using a (separate) hydrodynamic model. Alternatively, existing current data sets may be imported.
- Environmental, chemical, and biological databases supply required information to the model for computation of fates and effects.

- The user supplies information about the spill (time, place, oil type, and amount spilled) and some limited environmental conditions at the time (such as temperature and wind data).

As with RPS' other modeling systems, OILMAP/SIMAP is easily applied to a wide variety of conditions. It is set up and runs within RPS' standard Geographic Information System (GIS) or ESRI's ArcView GIS, and can be applied to any aquatic environment (fresh or salt) in the world. It uses any of a variety of hydrodynamic data file formats (1-, 2- and 3-dimensional; time varying or constant) and allows 2-D vertically-averaged current files to be created within the program system when modeled currents are not available. Outputs include easily interpreted visual displays of dissolved and particulate concentrations and trajectories over time, as appropriate to the properties of the chemical being simulated. An optional biological exposure model is available to evaluate areas and volumes exposed above concentrations of concern and to predict the impacts on exposed fish and wildlife.

OILMAP/SIMAP specifically simulates the following processes:

- initial plume dynamics;
- slick spreading, transport, and entrainment of floating oil;
- evaporation and volatilization (to atmosphere);
- transport and dispersion of entrained oil and dissolved aromatics in the water column;
- dissolution and adsorption of entrained oil and dissolved aromatics to suspended sediments;
- sedimentation and re-suspension;
- natural degradation
- shoreline entrainment, and
- boom and dispersant effectiveness.

The physical and biological models require environmental, oil and biological data as inputs. One of RPS' strengths is the ability to synthesize data from disparate sources. The data come from many sources including government and private data services, field studies and research. Modeling techniques are used to fill in "holes" in the observational data, thus allowing complete specification of needed data. The environmental database is geographical, including data of the following types: coastline, bathymetry, shoreline type, ecological habitat type, and temporally varying ice coverage and temperature. This information is stored in the simplified geographic information system. The chemical database includes physical-chemical parameters for a wide variety of oils and petroleum products. Data have been compiled by RPS from existing, but diffuse, sources.

An oil spill is simulated using site-specific wind, current, and other environmental data gathered from existing information, on-line services, and/or field studies. Shoreline and habitat types, as well as bathymetry, are mapped and gridded for use as model input. The physical, chemical, and toxicological properties of the spilled oil are provided by the oil database or updated to the specific conditions of the release. The model estimates the fate of the oil over time. The model outputs are time-varying concentrations and mass per unit area on surfaces (i.e., water surface, shoreline, sediments), which quantifies exposure to aquatic biota and habitats. Atmospheric loading in space and time is also computed, and provides input to air dispersion models.

Decay / Degradation Processes

Degradation, also known as decay, is the result of several processes in the water column and sea surface. Decay represents both biodegradation and photolysis. Photolysis is a chemical breakdown process energized by ultraviolet light from the sun as it penetrates the oceans sea surface layer. Biodegradation occurs when microbes metabolize oil as a carbon source, producing carbon dioxide and water as by-products. The biodegradable portion of various crude oils can vary, ranging from 11% to 90% (NRC, 1985, 1989). Not all types of organisms utilize the same oil components, nor are all types of organisms present in all locations.

In the RPS oil spill model, degradation is applied to all oil components present in the sea surface, shoreline, and in the water column. The degradation rate captures all degradation processes (e.g. photolysis and biodegradation) and is calculated for each environmental compartment. Degradation rates are constant throughout the simulation and based on empirical evidence. Oil degradation rates in OILMAP's oil database are based on French et al., 1996. The following table lists the different degradation rates used in this modeling study for each compartment, expressed in day^{-1}. It should be noted that these rates are being re-evaluated based on new findings in particular for the water column; however the rates used in this study can be considered conservative (i.e. slightly underestimating decay in the water column).

Table A-1. Oil Decay rates used in OILMAP for each marine compartment and oil components (THC range).

Environmental Compartment	Oil exposed to air (surface (0-1m), shoreline)	Oil in water column	Oil in sediments
Daily Decay Rate (1/day)	0.001	0.240 – THC1 (1-180 C) 0.078 – THC2 (180-265 C) 0.042 – THC3 (265-380C) 0.01 – Residual oil	0.001

Model Uncertainty / Limitations

The model has been developed over many years to include as much information as possible to simulate the fates and effects of oil spills. However, as in all science, there are significant gaps in knowledge and the ability to simulate the detailed behavior of organisms and ecosystems. Typically assumptions based on available scientific information and professional judgment are made in the development of the model, which represent our best assessment of the processes and potential mechanisms for effects (consequences) that would result from oil spills.

The major sources of uncertainty in the oil fates and biological effects model are:

- Oil contains thousands of chemicals of varying physical and chemical properties that determine their fate in the environment. In addition, those chemicals (their properties) change over time. The model must treat the oil as a mixture of a limited number of hydrocarbon components, grouping chemicals by physical-chemical properties.
- The fates model contains a series of algorithms that are simplifications of complex physical-chemical processes. These processes are understood to varying degrees, but can dramatically vary depending on the environmental conditions (e.g. cold vs warm waters).
- Organisms are assumed uniformly distributed in affected habitats they occupy for the duration of the spill simulation. The accuracy of this assumption varies between organisms, but the objective is to assess potential effects for an average-expected condition, which is what this assumption most closely resembles.
- Biological effects are quantified based on acute exposure and toxicity of contaminant concentrations as a function of degree and duration of exposure. The SIMAP model used is not designed to address long-term, chronic exposure to pollutants.
- The model treats each spill as an isolated pollution event and does not account for any potential cumulative effects.
- Various physical / environmental parameters including river flow, depth / sea bottom roughness, total suspended solids concentration, etc. were not sampled extensively at each location of the extended domain (hundreds of square kilometers). What limited data that did exist was applied to each location, leading to a certain degree of homogenization of the environmental (marine/coastal) conditions.

In addition, in any given oil spill, the fates and effects will be highly related to the specific environmental conditions, the precise locations of organisms, and a myriad of details related to the event. Thus, the results are a function of the scenarios simulated and the accuracy of the input data used. The goal of this study was not to capture every detail that could potentially occur, but to describe the range of possible consequences so that an informed analysis could be made as to the likely effects of spills under various scenarios. The model inputs are designed to provide representative conditions to such an analysis. Thus, the modeling is used to provide quantitative guidance in the analysis of the spill scenarios being considered.

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Appendix I-B

Draft Safety Management System

VINEYARD WIND SAFETY MANAGEMENT SYSTEM DESCRIPTION

VINEYARD WIND SAFETY MANAGEMENT SYSTEM

Vineyard Wind LLC

Document Title:	**VINEYARD WIND SAFETY MANAGEMENT SYSTEM**
Company	Vineyard Wind LLC
Date:	3/12/2018
Document Type:	Plan
Revision:	1
Previous versions:	
Authors:	

TABLE OF CONTENTS

1 INTRODUCTION

This document provides an overall description of the key elements to be included in the Safety Management System for the Vineyard Wind Offshore Wind Farm. It describes, in general, the policies of Vineyard Wind with response to the safety requirements set forth in the Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP).

The Safety Management System (SMS) is a dynamic document and is expected to be further developed as the project develops. However, the core principals of the SMS will remain the same. Specifically, the SMS will describe and in compliance with:

APPLICABLE REGULATIONS AND GUIDANCE depending on specific work and location

- 30 CFR 585.810 gives BOEM the authority to regulate all renewable energy development activities on the Outer Continental Shelf (OCS).
- 30 CFR 585.627(d) requires safety management system description in the COP that describes:
  - How Vineyard Wind will ensure the safety of personnel or anyone on or near its offshore and onshore wind facilities; Vineyard Winds worksites will be continually analysed for existing and potential hazards
  - Remote monitoring, control, and shutdown capabilities;
  - Emergency response procedures;
  - Fire suppression equipment,
  - How and when the Safety Management System will be established and verified; and
  - How to ensure that personnel are properly trained
- 30 CFR 585.811 The Safety Management System to be fully functional when Vineyard Wind begins activities described in the approved COP. Vineyard Wind will conduct all activities described in approved COP in accordance with the Safety Management System as described, as required by §585.810.
- OSHA regulations apply for construction activities (29 CFR 1926) on land and up to 3nm offshore.
- OSHA regulations apply for general industry activities such as operations and maintenance (29 CFR 1910) on land and up to 3nm offshore apply.
- OSHA regulations apply for shipyard, marine terminals and longshoring activities (29 CFR 1915, 1916 and 1917).
- United States Coast Guard regulations 33 CFR Subchapter N and 46 CFR apply for inspected vessels:

(i) Workplace Safety and Health – 33 CFR Part 142;

(ii) Design and Equipment – 33 CFR Part 143;

(iii) Lifesaving Appliances – 33 CFR 144.10;

(iv) Firefighting Equipment – 33 CFR Part 145; and

(v) Operations – 33 CFR Part 146.

2 ABBREVIATIONS AND ACRONYMS

BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
COP	Construction Operations Plan
EHS	Environment, Health, and Safety
JSA	Job Safety Analysis
LOTO	Lock Out/Tag Out
MOC	Management of Change
OCS	Outer Continental Shelf
OSHA	United States Occupational, Health, and Safety Administration
PIC	Person in Charge
SMS	Safety Management System
USCG	United States Coast Guard

3 MANAGEMENT COMMITMENT

The commitment of Vineyard Wind's Leadership and Management is paramount to the implementation of a Safety Management System by creating a culture of "Zero Injury" with the goal of eliminating safety related incidents. Vineyard Wind Management will take the approach of leadership by example, will set clear policy, allocate necessary resources and designate parties to provide subject matter expertise.

To achieve the objective of Zero Injury, Vineyard Wind will:

- Ensure a systematic approach to the management of EHS, and implement a safety management system designed to ensure compliance with regulations as a minimum and to achieve continuous performance improvement

- Take responsibility and provide clear leadership
- Be a leader in promoting best practice in the offshore wind energy industry
- Set targets for EHS audits, improvement metrics and reporting of performance
- Require all Contractors to manage EHS in line with Vineyard Wind policy
- Ensure that EHS compliance is the responsibility of all managers, teams and individuals
- Empower everyone to stop any work, or prevent work from starting, where adequate controls of EHS risks are not found to be in place without retribution
- Include EHS performance in the appraisal of all staff
- Encourage and promote involvement by all employees regardless of job title

Vineyard Wind is committed to the safety of all employees, contractors, visitors and vendors at all Vineyard Wind facilities. To guide Vineyard Wind in executing their commitment to safety, and building on lessons learned from the offshore wind, oil & gas, and other industries, a combination of regulatory sources has been assessed to support the development of the strongest possible safety management program. The Safety Management System outlined in this document draws on regulations from 33 CFR 140 - 145 and incorporates information based on certain elements of 30 CFR 250, Subpart S, Safety and Environmental Management Systems (SEMS). In addition, OSHA regulations have been consulted to identify any additional safety standards and practices that could be incorporated into the Vineyard Wind SMS.

3.1 Roles

The following table defines the roles that are tasked with fostering and implementing a Safety Management System:

Role	
Executive Leadership	Those leaders who set the tone and provide support at the highest levels of leadership for the implementation of a Safety Management System.
Steering Committee	Senior Leaders comprised of representatives from functional areas that are positioned to support and drive SMS success.
Management	All other levels of Management outside of Executive Leadership and the Steering Committee.
Employee	All employees not previously categorized.

3.2 Training Requirements

Individuals who have duties that fall within the scope of Leadership and Management Commitment, will receive training in the form of reviewing this document and the SMS report materials. Directors, managers and supervisors shall have an acute awareness of US construction, USCG, OSHA and maritime health, safety and environmental legislation in order to successfully lead on EHS matters

Management will have the required training to insure:

- Provide overall leadership to the project team
- Responsibility for the safe management of all works associated with the project
- Ensure that the project is fully and competently staffed for managing EHS and that objectives are clearly defined
- Ensure that all levels of staff receive adequate and appropriate training
- Ensure that disciplinary procedures are adequate to act against those who breach EHS practices

  Set a personal example

4 EMPLOYEE INVOLVEMENT

It is of great importance to Vineyard Wind that all employees are engaged in the safety program. Employee involvement in the Safety Management program will be maximized through initial safety orientation, continuous safety awareness training, and management programs that include:

- Safety Meetings
- Safety Committee Membership
- Safety Training Program
- Safety Recognition Program
- Safety Incentive Program

Vineyard Wind will establish a disciplinary policy that clearly defines the expectations of all employees. The policy encourages employees to use good judgement when undertaking work and follow established safety policies and procedures. The disciplinary policy clearly defines consequences and disciplinary actions when safety policies are violated.

5 SAFETY POLICIES

Specific safety policies and associated training will be developed in accordance with 29 CFR 1910 – Occupational Safety and Health Standards, 29 CFR 1926 – Safety and Health Regulations for Construction, and 30 CFR 585 – Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf.

Vineyard Wind Safety Policies will be adhered to through training, regular safety meetings, documentation and audits. The follow safety topics comprise the Vineyard Wind Safety Program.

- Smoking Policy

- Drug and Alcohol Policy
- Following Manufacturer's Transportation, Installation, Operations and Maintenance Manuals
- Bypassing of Safety Systems
- Policy of working in Teams for Safety
- Policy related to critical equipment
- Fitness for Duty
- Stop Work Authority
- Policy related to Emergencies
- Lockout and Tagout
- Marine survival training
- CPR and First Aid
- Vessel or site specific induction
- Emergency escape training / confined space rescue training
- Knowledge of the H&S conditions at site
- Wind Turbine rescue from height training (if job includes WTG access)
- Turbine tower lift rescue / recovery training
- Electrical awareness including a basic understanding of electrical safety and the electrical safety rules in place on the project
- Fire safety awareness

5.1 Organizational Reporting Structure

Vineyard Wind will develop an organizational structure that ensures responsibilities are delineated and accountability is described for all levels of the organization. This section includes the minimum organizational structure that will be in place prior to project implementation. As needed, positions and duties will be added to the structure, consistent with the safety needs of the project and in coordination with project contractors.

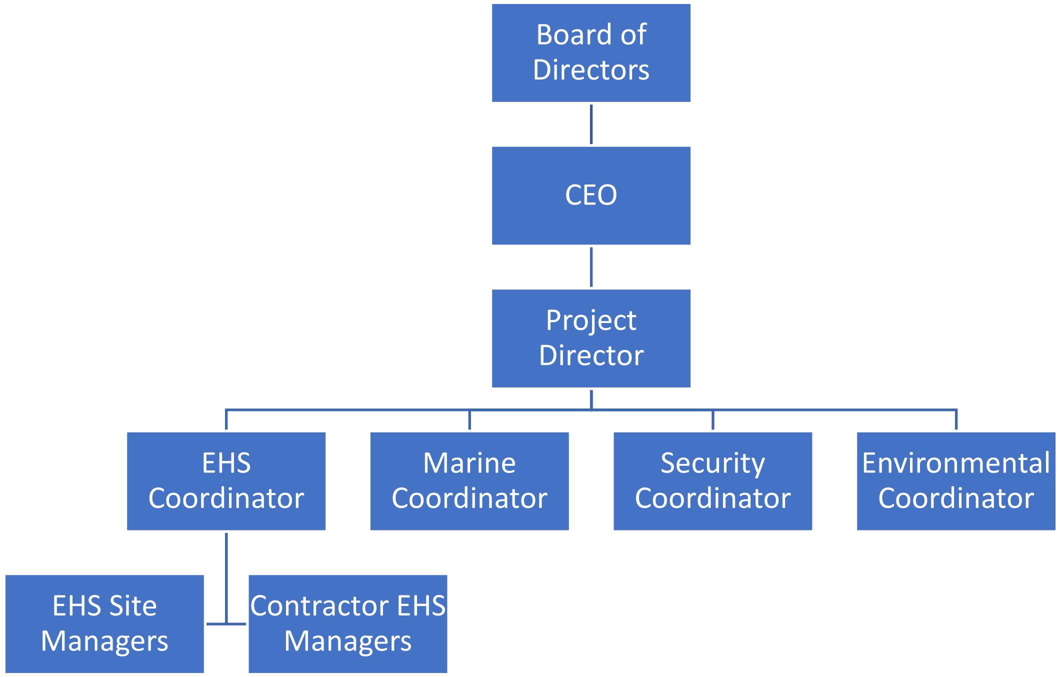

Figure 5-1 Vineyard Wind Safety Organization

5.2 Key Roles and Description of Responsibilities

This section lists the responsibilities of project personnel with respect to administering the SMS. Other duties may be required of these individuals that are not included in this document.

5.2.1 Project Director

The Project Director will lead the project and will work to ensure that the project is constructed safely, in accordance with the environmental permits, and to proper quality standards. The Project Director will be Vineyard Wind's authorized representative during the engineering and construction period for all matters related to the SMS including coordination with government authorities, first-responder emergency agencies, and coordination between contractors.

5.2.2 Health and Safety Coordinator

The Health and Safety Coordinator will report to the Project Director and will be responsible for monitoring compliance with the approved Construction and Operations Plan, the SMS, all safety-related regulatory requirements, and overall health and safety conditions for the project. The Health and Safety Coordinator will review all contractor's safety management plans for compliance with the COP SMS, regulatory, and contract requirements. The Health and Safety Coordinator will establish a "safety first" working mentality at the project sites and on vessels involved in transport and construction.

5.2.3 Environmental Coordinator

The Environmental Coordinator will report to the Project Director and will ensure that all local, state and federal permit requirements and laws relating to environmental protection and reporting are adhered to. The Environmental Coordinator will monitor contractors for compliance with project specific environmental requirements and shall be responsible for verifying compliance with environmental protection programs and protocols for environmental incident response. The Environmental Coordinator will coordinate deployment of certified marine mammal observers and other environmental resource observers on the vessels as required by the conditions of the project permits and approvals. The Environmental Coordinator will ensure contractors have compliant oil spill response plans, hazardous waste plans, and waste management plans in place.

5.2.4 Marine Coordinator

The Marine Coordinator will report to the Project Director and will ensure compliance with permit requirements and applicable laws relating to the project vessel activities (including installation vessels, transport vessels, service vessels, tugs, rescue boats, etc.). The Marine Coordinator will be kept informed of all planned vessel deployment each day. The Marine Coordinator will be the primary liaison with the USCG, port authorities, state and local law enforcement, marine patrol, and commercial operators (including ferry, tourist, and fishing boat operators). The Marine Coordinator will be responsible for all marine updates such as coordination with USCG regarding any required Notice to Mariners.

It will be the Marine Coordinator's responsibility to be knowledgeable of weather forecasts and have a communications plan in place with all contractors and vessels involved in the project.

The Marine Coordinator will be kept informed of all diving and dredging activities. The Marine Coordinator will coordinate with the USCG and local law enforcement authorities for planning in the event of trespassing vessels within any safety zone established for the offshore project construction activity.

The Marine Coordinator will conduct regular meetings with contractors to discuss vessel operation and deployments as appropriate for the level of marine activities scheduled.

5.2.5 Security Coordinator

The Security Coordinator will report to the Project Director. The Security Coordinator will liaise with all contractors and subcontractors on the project to address security provisions. In addition to the physical security of the onshore project staging area and port areas, the Security Coordinator is expected to work closely with the Health and Safety Coordinator and the Marine Coordinator to ensure that appropriate agency notification plans are in place with federal, state, and local government first responders.

The Security Coordinator will become responsible for security of the offshore WTGs and ESP once these are commissioned.

5.3 Safety Committee

To ensure continuous adherence to safety standards and regulations, and to maintain the strong safety culture of Vineyard Wind, a Safety Committee will be established comprised of key members of the management team and representatives across all work disciplines

To maintain the goal of continuous improvement the Safety Committee will perform reviews of safety practices and ensure alignment between the COP, SMS, safety regulations, personnel training, and working conditions. The Safety Committee will be responsible for addressing any safety issues that arise with Vineyard Wind employees, contractors, vendors, visitors, etc. and for establishing, approving and maintaining company safety standards, including the COP and SMS.

The safety committee will review daily and weekly safety meetings findings and suggestions.

6 CONTRACTOR MANAGEMENT

Third party contractors and support services will be integrated into the safety management system. Specific requirements will be developed for contracting, including:

- Minimum requirements for bridging documents
- Contractor safety audits
- Minimum contractor safety training
- Contractor roles in an emergency

Contractors are required to follow the same policies and procedures that Vineyard Wind employees follow for maintaining safety. Vineyard Wind will manage all contractors to ensure safety policies and practices are adhered to. Contractors EHS representative should be well versed in the projects SMS and be responsible for;

- Day-to-day site EHS supervision (onshore/offshore)
- EHS monitoring, inspection and auditing
- Support the EHS Director in establishing and fulfilling project training needs
- Participate in planning and coordination of all marine operations relating to the project
- Assist with preparation and maintenance of all EHS documentation;
- Management of PPE inventory, inspection and testing
- Participation in EHS meetings, risk reviews and workshop
- Set a personal example.

Contractor operations should not expose Vineyard Wind employees or the public to hazards in violation of governmental regulations and Vineyard Wind policy. Contractors will submit proof of training and copies of certificates to the Site EHS Manager before the start of any work activity. The competencies and training records of all employees will be requested and examined by the Site EHS Manager before commencing work activities.

6.1.1 Audits

Safety programs for all contractors will be subject audit by Vineyard Wind. Audits may include review of safety policies, procedures, training records, etc. and may be performed prior to contracting and during the course of the contract.

6.1.2 Training

All contractors will be fully qualified to perform the roles for which they are contracted, including any prescribed safety standards and training. Vineyard Wind will provide safety orientation to familiarize contractors with any site-specific safety issues. Contractors may be required to demonstrate, through documentation or practical application, their knowledge and understanding of safety requirements for offshore wind farm construction.

7 MANAGEMENT OF CHANGE

Vineyard Wind will maintain a procedure for Management of Change (MOC), which helps to identify the potential risks associated with the change and receive any required approvals prior to the introduction of such changes.

The MOC process provides a coherent, systematic, and simple mechanism for identifying and controlling hazards through the change process with emphasis on the transition phase. When well implemented, MOC ensures that the safety of wind farm and its personnel is safeguarded by the evaluation of hazards, threats, and other potential undesired events related to a significant change, and the intended benefits of the change are fully realized as planned.

7.1 Roles and Responsibilities

The Project Director will be responsible for the implementation of the Management of Change program. All MOC documentation will be maintained by the Health and Safety Coordinator.

7.2 MOC Review and Audit Requirements

Any Company employee can initiate the MOC process. The following table depicts the required frequency of recurring actions defined in the MOC program:

Action	Frequency
Audit	Every 3 years
Document Review	Annually
Management Review	Annually
Training	Initial and as needed refresher

7.3 Management of Change Process

The Management of Change policy shall be utilized for at least the following changes whether they are temporary or permanent:

- Physical Changes, including work site changes such as changes in construction vessels, working platforms, access and egress locations, etc.
- Organizational Changes, including changes in personnel, individual responsibilities, contractor or sub-contractor changes, etc.

- Technological Changes, including changes in equipment, equipment design, software controls or the technology used on the work site, etc.
- Procedural Changes, including changes to processes (i.e., work schedules, materials, equipment unavailability, new equipment, or operating conditions.

Vineyard Wind will develop a form to facilitate the processing of changes. The change form will, at a minimum, include a description and the purpose of the change, the technical basis for the change, safety and health considerations, documentation of changes for the operating procedures, maintenance procedures, inspection and testing, P&IDs, electrical classification, training and communications, pre-startup inspection, duration (if a temporary change), approvals, and authorization.

For a more complex or significant design change, a hazard and risk evaluation procedure will be used, such as a Hazard Identification (HAZID) workshop (The HAZID is further described in Section 11). Risk assessments should demonstrate that the risks with controls are 'As Low as Reasonably Practical.' Contractors also have a responsibility to carry out risk assessments based on the risks associated with their scope of work.

Documentation of changes will be kept in an accessible location to ensure that design changes are available to any member of Vineyard Wind who may require them.

7.4 Management of Change Communication

The communication of changes to appropriate personnel is essential to safety and preventing incidents. The following table lists activities that fulfil those requirements:

Action	Frequency
MOC Committee Meeting	As Needed; for any Organizational, Procedural, or Technological change
MOC Email Notification	For each implemented change

7.5 Training Requirements

All individuals will receive initial training on the MOC program and will also receive annual refresher training.

7.6 Management Review

On an annual basis, management will review progress on the MOC process and advise improvements or areas to refocus. Ensure that the MOC policy has been properly implemented and all elements have been completed and documented.

7.7 Audits and Assessments

Audits of the MOC program shall validate that the exercise of the MOC policy includes the following:

- Reason for change
- Authority for approving changes
- Analysis of implications
- Acquisition of required work permits
- Documentation of change process
- Communication of change to affected parts of the organization
- Time limitations
- Qualification and training of personnel affected by the change (including contractors)

7.8 Continuous Improvement

Management of Change metrics and risk assessments are an input into the Management Review and Risk Management elements. This element shall be reviewed annually for updating and audited every 3 years.

8 UNSAFE WORKING CONDITIONS

All employees, contractors, and subcontractors have the personal responsibility and work-place authority to report any unsafe work practice or to immediately stop any unsafe work practice during operations.

Unsafe work conditions may be reported anonymously. Emergent safety issues shall be addressed immediately.

8.1 Reports of Unsafe Work Conditions

All employees, contractors, and subcontractors shall report any violation of any Company safety regulation or any other hazardous or unsafe working condition on any Company owned or leased property, facility, structure, or equipment.

All employees, contractors, subcontractors, visitors or guests to any Vineyard Wind property, have the right to report any possible violation of applicable safety regulations or unsafe condition to the US Coast Guard. The identity of the reporting person shall not be known to the Company without consent of the person making the report.

8.2 Stop Work Authority

All employees and contractors have the responsibility and authority to stop any unsafe task or operation where the risk to people, the environment, or equipment cannot be managed in accordance with company’s established safety policies, procedures or safe work practices.

No employee or contractor will be retaliated against for stopping work that is based on a good faith belief that it is unsafe.

9 SAFETY TRAINING AND COMPETENCE

As part of the company safety culture, safety training is on ongoing function of the Vineyard Wind safety program. Safety training and awareness will include the following topics, as well as any emergent safety issues that may arise. The training topics listed in this section are the minimum required training for all contractors and designated employees.

Orientation Training

Visitors

- Site safety rules for moving around on the site
- Safety equipment for moving around on the site
- Restricted areas
- Emergencies and rally points

Site workers

- Site safety rules for moving around on the site
- Safety equipment for moving on site
- Restricted areas
- Emergencies & associated procedures
- Driving rules (on site and off site)
- Hazardous substances
- Waste, dust emission and noise on site
- Permit systems
- Welfare arrangements
- PPE requirements
- The importance of conformance with the H&S procedures
- Employee’s role and responsibility in general
- Incident reporting procedure
- Security arrangements

Example of Minimum EHS training requirements depending on job function

- Working from heights

- Electrical safety
- Sea survival
- Confined space
- First aid and CPR
- Fire fighting

Example of Specialized and Task Specific Training

- Use of specialized equipment
- Scaffolding and personnel platform equipment
- Diving operations
- High Voltage and switching

Medical Audits and Fitness for Duty

Pre-employment screening completed by an occupational doctor may consist of the following:

- Medical history
- Occupational history
- Physical Examination
- Determination of fitness to work wearing PPE
- Baseline monitoring for specific exposures.

Periodic Medical Examination completed by an occupational doctor may include:

- Yearly update of medical and occupational history
- Yearly physical examination
- More frequent testing based on specific exposures

9.1 Workplace Safety and Health - 33 CFR 142

The Company will maintain compliance with applicable workplace safety and health regulations and will frequently review processes to identify/recognize hazards, propose and implement changes to maintain the workplace safety and/or free from recognized hazards Recognized

Hazard in this context is that defined by 33 CFR 150.60(c)(1) as "generally known among persons in the affected industry as causing or likely to cause death or serious physical harm to persons exposed to those conditions; and routinely controlled in the affected industry."

9.1.1 Personal Protective Equipment

All Vineyard Wind personnel and contractors will receive training, or should be able to demonstrate that they have received training on Personal Protective Equipment (PPE) and its requirements for use, maintenance, and care for all specific safety related equipment, as appropriate.

At a minimum, the following PPE will be included:

- Eye and face protection
- Head protection
- Foot protection
- Hearing protection
- Protective clothing
- Respiratory protection
- Safety belts and lifelines
- Personal flotation devices
- Eyewash equipment

In addition to care and maintenance of PPE, training will also address:

- Housekeeping
- Guarding of deck openings

9.2 Design and Equipment - 33 CFR 143

9.2.1 Lights and warning devices

Appropriate lights and warning signals will be deployed during construction and when the wind farm is operational. Requirements for lights, markings, and warning devices for structures are codified in 30 CFR 67. Vessels associated with contraction and operation of the wind farm will adhere to lights and warning devices requirements under the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) and any local rules, if applicable.

9.2.2 Means of Escape

All workers who require access to the offshore structures will receive training and participate in drills to test the means of escape from the structures. Training will include a description of a primary escape means, as appropriate for unmanned structures and in accordance with the requirements of 30 CFR 143.101.

9.2.3 Personnel Landings

Although personnel landings are not required for unmanned structures, during construction, it is anticipated that personnel landings may be used.

9.2.4 Guards and Rails

All required guards and rails will be installed, and appropriate training will be provided on the requirements for guards and rails for the unprotected perimeter of all floor or deck areas and openings, catwalks and stairways. Training will ensure all workers are aware of the requirements and have sufficient knowledge to report any deficiencies.

9.3 Lifesaving Equipment - 33 CFR 144.10

Training will be provided on the use and care of lifesaving equipment that will be available in accordance with applicable regulations, particularly the type and number of personal flotation devices and ring life buoys. It will also include the required markings, any affixed apparatus, and how they will be made accessible to personnel.

9.4 Firefighting Equipment - 33 CFR 145

Training will be provided on fire hazards associated with offshore wind farms and the appropriate firefighting equipment. It will also include a list of the rating and type of fire extinguishers for each structure and a description of the maintenance program for firefighting equipment as well as the fire detection systems.

Firefighting equipment and techniques will be consistent with the following standards, at a minimum:

- 29 CFR 1926 Subpart F (Fire Protection and Prevention)
- 29 CFR 1910 Subpart L (Fire Protection)
- 33 CFR Part 145 Firefighting Equipment
- Applicable NFPA standards

9.5 Operations - 33 CFR 146

9.5.1 Person in charge

Vineyard Wind will designate a Person in Charge of the wind farm. Designation will include contact information, title, and order of succession.

9.5.2 Maintenance of Emergency Equipment

Each piece of emergency equipment will be part of the Vineyard Wind maintenance program. All emergency equipment in use will be listed and include a description of the maintenance requirements or technical references for maintaining each piece of equipment.

9.5.3 Work vests

All workers who require transport and access to the wind farm will be required to wear an appropriate work vest. Vineyard Wind will provide awareness training on the type(s) of approved work vests and their uses, stowage, care, and inspection, including additional requirements for hybrid work vests, if used.

9.5.4 Notice of casualties

Vineyard Wind will notify the Coast Guard and/or BOEM of causalities. At a minimum, casualty reporting will be mandatory for:

- Death
- Injury to 5 or more persons in a single incident,
- Damage affecting the usefulness of primary lifesaving or firefighting equipment
- Injury causing any person to be incapacitated for more than 72 hours
- Damage to the facility exceeding $25,000 resulting from a collision by a vessel with the facility

Vineyard Wind will provide a written report of casualty in accordance with 33 CFR 146.30.

9.5.5 Diving casualties

There are specific reporting requirements for diving casualties. Vineyard Wind will adhere to requirements of reporting diving casualties in accordance with 46 CFR 197.484 and 197.486. Diving casualty reports are required under the follow circumstances:

- Loss of life.
- Diving-related injury to any person causing incapacitation for more than 72 hours.
- Diving-related injury to any person requiring hospitalization for more than 24 hours.

The notice will contain the following:

- Name and official number (if applicable) of the vessel or facility.
- Name of the owner or agent of the vessel or facility.
- Name of the person-in-charge.
- Name of the diving supervisor.
- Description of the casualty including presumed cause.
- Nature and extent of the injury to persons.

9.5.6 Pollution Incidents

Pollution incidents will be reported in accordance with 33 CFR 146.45. The approved Vineyard Wind Oil Spill Response Plan will be followed for specific pollution response actions.

9.5.7 Other Safety Procedures

In addition to the procedures for safe operations defined in this section, Vineyard Wind will develop and incorporate safety practices and procedures to reduce risks of casualties throughout its operations. Specific practices include:

- Drills and Exercises to test procedures
- Training Standards - This may include a list of training requirements for workers (listed in Section 6), previous certification, documentation, etc.
- Job Hazard Analysis, Job Safety Analysis, tool box talks before start of each job
- Work Permits
- Hot Work Procedures
- Routine Access/Egress Procedures (including safe use of ladders)
- Confined Space Entry
- Right to Know
- Material Handling (lifting operations)
- High Voltage and Medium Voltage Electricity, ARC Flash training (NFPA 70E)
- Working from Heights, including crane lift procedures, fall arresters, full-body harness, shock absorbers, lanyards, etc.
- Rescue from Heights
- First Aid
- Stop Work Authority
- Hearing Conservation
- Heat Stress
- Cold Weather
- Respiratory Protection

10 EMERGENCY RESPONSE

The SMS is primarily focused on preventing incidents. However, it is also important to be prepared if emergencies do occur. For this reason, Emergency Preparedness and Response plans are essential for responding effectively to an incident. Proper planning, training and drilling will ensure that any impact of an incident will be kept to a minimum for the public and the environment.

Emergency response plans will be developed for a range of emergency situations. Plan development will include procedures for testing emergency plans through drills and exercises. Plans will be developed, at a minimum, for the following scenarios:

- Collision between service vessel and structure
- Fire on structure and/or service vessel
- Evacuation
- Pollution Incidents
- Adverse weather
- Emergency Response and Search & Rescue
- Remote monitoring, Control and Shut Down procedures

10.1 Training Requirements for Emergency Response

Any individuals who will lead emergency responses, as well as those who will participate as emergency response team members, will receive initial training prior to their first involvement in an emergency response. These individuals shall also receive refresher training on an annual basis.

Learnings from past drill and actual events shall be incorporated into training. Learning from external events not related to Vineyard Wind shall also be incorporated.

11 HAZARD IDENTIFICATION AND RISK MANAGEMENT

Vineyard Wind will implement a systematic hazard identification and risk management program for existing and potential hazards. The goal will always be to reduce the hazard to a level as low as reasonably practicable.

Risk assessment methods will be used to decide on priorities and to set objectives for eliminating hazards and reducing risks. Wherever possible, risks are eliminated through selection and design of facilities, equipment and processes. If risks cannot be eliminated, they are minimized using physical controls, or as a last resort, through operating procedures and personal protective equipment.

Vineyard Wind will incorporate the use of Hazard Identification (HAZID) Workshops to help identify and manage risks. HAZID workshops are usually performed during initial facility planning and engineering, when considerable modifications, upgrades or re-design of existing facilities are carried out, or may be driven by events such as accidents, critical situations or near misses.

The purpose of a HAZID is to identify main hazards, review the effectiveness of selected safety measures and, where required, to expand the safety measures to achieve a risk as low as reasonably practicable.

The HAZID provides documentation that Vineyard Wind installations are operated in a manner that major hazards are identified, mitigated or eliminated. Vineyard Wind management will be kept up-to-date on the potential hazards and their possible effects.

Key elements of HAZID

- Identification of hazards and their potential effects

- Assessment of the related risks
- Develop a Risk Assessment Matrix and record in a risk register
- Implementation of controls to eliminate or reduce those risks to a level as low as reasonably practical
- Elimination of hazard with engineering and/or administrative controls and/or PPE
- Implementation of recovery measures to minimize the consequences of an incident
- Documentation of the decision-making process

Appendix I-C

Statement of Qualifications for Certified Verification Agent (CVA) Services

Appendix I-C is redacted in its entirety.

Appendix I-D

CVA Scope of Work and Verification Plan

Appendix I-D is redacted in its entirety.

Appendix I-E

Hierarchy of Standards

Appendix I-E is redacted in its entirety.