VINEYARD NORTHEAST

CONSTRUCTION AND OPERATIONS PLAN
VOLUME I

MARCH 2024

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VINEYARD OFFSHORE

PUBLIC VERSION

Vineyard Northeast COP Contents

COP Volume I

Vineyard Northeast COP Contents (Continued)

COP Volume II

Vineyard Northeast COP Contents (Continued)

Vineyard Northeast COP Contents (Continued)

Appendices

COP Volume I

COP Volume II

Vineyard Northeast COP

Volume I

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March 2024

Revision	Date	Description
0	July 2022	Initial submission.
1	March 2023	Updated to address Bureau of Ocean Energy Management (BOEM) and United States Coast Guard (USCG) Round 1 Comments (dated January 13, 2023), include minor revisions to the potential Southern New York Offshore Export Cable Corridor (OECC), and make minor corrections.
2	April 2023	Made minor revisions to the Massachusetts and Connecticut OECCs as well as the [redacted] Onshore Substation Site Envelope, made updates consistent with revisions to other parts of the COP, and made other minor corrections.
3	November 2023	Updated to address BOEM and USCG Round 3 Comments (dated August 8, 2023) and Round 4 Comments (dated September 29, 2023), revised the onshore Project Design Envelope, and revised the maximum monopile diameter to 14 m (46 ft). Made other minor revisions.
4	March 2024	Made minor revisions.

Executive Summary

ES-1 Overview of Vineyard Northeast

Vineyard Northeast LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast."

Vineyard Northeast includes 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. Up to three of those positions will be occupied by ESPs[1] and the remaining positions will be occupied by WTGs. As proposed, the WTGs and ESP(s) will be oriented in fixed east-to-west rows and north-to-south columns with 1 nautical mile (NM) (1.9 kilometer [km]) spacing between positions. The WTGs and ESP(s) will be supported by monopiles or piled jacket foundations. The base of the foundations may be surrounded by scour protection. Submarine inter-array cables will transmit power from groups of WTGs to the ESP(s). If two or three ESPs are used, they may be connected with inter-link cables. Offshore export cables will then transmit the electricity collected at the ESP(s) to shore.

The WTGs, ESP(s), and their foundations as well as the inter-array cables, inter-link cables (if used), and a portion of the offshore export cables will be located in Lease Area OCS-A 0522. The Lease Area is within the Massachusetts Wind Energy Area (MA WEA) identified by BOEM, following a public process and environmental review, as suitable for offshore wind energy development. At its closest point, the 536 square kilometer (km^2) (132,370 acre) Lease Area is approximately 46 km (29 miles [mi]) from Nantucket. Between the Lease Area and shore, the offshore export cables will be installed within two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—that connect to onshore transmission systems in Massachusetts and Connecticut. Other potential offshore and onshore transmission systems, which would be developed as Phase 2 of Vineyard Northeast, are identified but not fully analyzed in this Construction and Operations Plan (COP) (see Section 3.13).

The Massachusetts OECC travels from the northernmost tip of the Lease Area along the northeastern edge of the MA WEA and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) and then heads across Buzzards Bay towards the Horseneck Beach Landfall Site in Westport, Massachusetts. Up to two high voltage direct current (HVDC) cable bundles or up to three high voltage alternating current (HVAC) cables may be installed within the Massachusetts OECC. If HVAC offshore export cables are used, the cables would connect to a booster station in the northwestern aliquot[2] of Lease Area OCS-A 0534 to boost the electricity's voltage level,

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1 If two or three ESPs are used, they may be located at separate positions or two of the ESPs may be co-located at the same grid position. Co-located ESPs would be smaller structures installed on monopile foundations.

2 An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

reduce transmission losses, and enhance grid capacity. From the Horseneck Beach Landfall Site, onshore export cables will connect to a new onshore substation in Westport, Fall River, or Somerset, Massachusetts. Grid interconnection cables will connect the onshore substation to one of three potential points of interconnection (POIs): the existing Pottersville Substation, a planned substation near Brayton Point, or the existing Bell Rock Substation.

Up to two HVDC offshore export cable bundles may be installed within the Connecticut OECC. The Connecticut OECC travels from the southwestern tip of the Lease Area along the southwestern edge of the MA WEA and then heads between Block Island and the tip of Long Island towards potential landfall sites near New London, Connecticut. As the Connecticut OECC approaches shore, it splits into three variations to connect to three potential landfall sites: the Ocean Beach Landfall Site, the Eastern Point Beach Landfall Site, and the Niantic Beach Landfall Site. Onshore export cables will connect one of the landfall sites to a new onshore substation in Montville, Connecticut, which will be connected to the POI at the existing Montville Substation by grid interconnection cables.

Vineyard Northeast is being developed and permitted using a Project Design Envelope (PDE) based on expected commercial and technological advancements. The PDE outlines a reasonable range of project design parameters (e.g., multiple foundation types) and installation techniques (e.g., use of various cable installation tools). The Proponent has developed the PDE and sited Vineyard Northeast's facilities based on feedback from multiple agencies and stakeholders. For example, the Proponent modified and refined the OECCs through numerous consultations with federal and state agencies as well as fishermen and, based on their feedback, consolidated the offshore export cables with other developers' proposed cables to the extent feasible. Key elements of Vineyard Northeast's PDE are summarized in Table ES-1.

Table ES-1 Summary of the Project Design Envelope

Parameter	Project Design Envelope
Maximum number of WTG/ESP positions	160
Wind Turbine Generators	
Maximum number of WTGs	160
Maximum rotor diameter	320 meters (m) (1,050 feet [ft])
Maximum tip height	400 m (1,312 ft)
Minimum tip clearance	27 m (89 ft)
Electrical Service Platforms and Booster Station	
Number of ESPs	0–3 (ESP equipment may be integrated onto WTG foundation[s])[1]
Maximum number of booster stations	1 (only for HVAC transmission)
Maximum topside height above Mean Lower Low Water[2]	70 m (230 ft)

Table ES-1 Summary of the Project Design Envelope (Continued)

Parameter	Project Design Envelope
Foundations and Scour Protection	
Maximum pile diameter	Monopiles: 14 m (46 ft) Piled jackets: 4.25 m (14 ft)
Maximum area of scour protection	monopiles: 7,238 square meters (m^2) (1.8 acres) WTG piled jackets: 11,660 m^2 (2.9 acres) ESP piled jackets: 32,577 m^2 (8.1 acres) Booster station piled jackets: 18,427 m^2 (4.6 acres)
Offshore Cables	
Maximum total inter-array cable length	356 km (192 NM)
Maximum total inter-link cable length	120 km (65 NM)
Maximum number of offshore export cables	Massachusetts OECC: 3 HVAC cables or 2 HVDC cable bundles Connecticut OECC: 2 HVDC cable bundles
Maximum total offshore export cable length[3]	Massachusetts OECC: 436 km (235 NM) Connecticut OECC: 421 km (227 NM)
Target burial depth beneath stable seafloor[4]	1.5–2.5 m (5–8 ft)
Onshore Facilities	
Massachusetts landfall site	Horseneck Beach Landfall Site
Connecticut landfall site	Ocean Beach Landfall Site, Eastern Point Beach Landfall Site, or Niantic Beach Landfall Site
Massachusetts onshore cable route	Horseneck Beach Eastern Onshore Cable Route or Horseneck Beach Western Onshore Cable Route (including variants)
Connecticut onshore cable route	Ocean Beach Onshore Cable Route, Eastern Point Beach Onshore Cable Route, or Niantic Beach Onshore Cable Route
Onshore substation site envelopes[5]	Massachusetts: [redacted] Connecticut: [redacted]
POIs	Massachusetts: Pottersville POI, Brayton Point POI, or Bell Rock POI Connecticut: Montville POI

Notes:

1. As described in Section 3.4, this concept entails placing ESP equipment on one or more expanded WTG foundation platforms rather than having a separate ESP situated on its own foundation.
2. Height includes helipad (if present) but may not include antennae and other appurtenances.
3. Includes the length of the offshore export cables within the Lease Area.
4. Unless the final Cable Burial Risk Assessment (CBRA) indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.
5. Since the Proponent has not yet secured site control for the onshore substation sites, the Proponent has identified one or more "onshore substation site envelopes" for each POI.

ES-2 Construction

Construction of Vineyard Northeast will likely start with the onshore cables and onshore substations. The onshore cables are expected to be installed primarily underground within public roadway layouts or within existing utility rights-of-way (ROWs) via open trenching. The onshore cables may be installed in a duct bank (i.e., an array of plastic conduits encased in concrete) or within directly buried conduit(s). In most instances, underground trenchless crossing methods are expected to be used where the onshore cables traverse unique features (e.g., busy roadways, railroads, wetlands, and waterbodies). However, the northern crossing of the Taunton River [redacted] may require a segment of overhead transmission lines.[3] Construction of the onshore substations is expected to involve site preparation (e.g., land clearing and grading), installation of the substation equipment and cables, commissioning, and site clean-up and restoration.

Offshore construction will likely begin with offshore export cable installation and/or foundation installation (including scour protection installation). Once the foundations are in place, the WTGs, ESP topside(s), and booster station topside can be installed. Inter-array cables may be installed before or after the WTGs are installed on their foundations. WTG commissioning is expected to take place after the inter-array cables are installed.

Prior to offshore cable installation, the cable alignments may require sand bedform dredging and boulder clearance. Following those activities, pre-lay grapnel runs and pre-lay surveys will be performed to confirm that the cable alignments are suitable for installation. The offshore cables will then be buried beneath the stable seafloor at a target depth of 1.5 to 2.5 meters (m) (5 to 8 feet [ft])[4] likely using jetting techniques or a mechanical plow. While every effort will be made to achieve sufficient burial, a limited portion of the offshore cables may require cable protection if a sufficient burial depth cannot be achieved. At the landfall sites, the offshore export cables are expected to transition onshore using horizontal directional drilling (HDD) to avoid or minimize impacts to the beach, intertidal zone, and nearshore areas. The offshore export cables will connect to the onshore export cables in underground transition vaults at the landfall sites.

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3 As described in Section 3.8.3.3, the need for overhead transmission lines at this Taunton River crossing depends on the final location of the onshore substation site and the transmission technology employed (HVAC or HVDC) and will be confirmed through further field data collection and detailed engineering.

4 Unless the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

The foundations, WTGs, ESP topside(s), and booster station topside (if used) may be staged at a United States (US) or Canadian port or delivered directly to the Lease Area. The Proponent has identified several potential staging ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Canada that may be used for frequent crew transfer and for offloading/loading, storing, and pre-assembling components, among other activities (see Section 3.10.1). The foundations, WTGs, and topside(s) will be installed by jack-up vessels or heavy lift vessels (HLVs) using dynamic positioning (DP) or anchors along with necessary support vessels (e.g., tugboats). Seabed preparation may be required prior to foundation installation. Scour protection, which would likely consist of loose rock material placed around the foundation, will likely be needed for monopiles, but may or may not be needed for the smaller diameter jacket pin piles. Once set onto the seabed by the crane of the main installation vessel(s), monopiles or jacket pin piles will be installed using impact pile driving,[5] which will begin with a soft-start (i.e., the impact hammer energy level will be gradually increased). Noise mitigation systems are expected to be applied during pile driving. If monopile foundations are used, a transition piece will be installed on top of the monopile using a vessel's crane (unless an extended monopile concept is employed). Once the foundations are installed, the WTGs, ESP topside(s), and booster station topside will be lifted and secured onto their foundations. Then, the WTGs, ESP(s), and booster station will be commissioned to confirm that they are functioning correctly and ready for energy production. To aid safe navigation, the WTGs, ESP(s), booster station, and their foundations will be equipped with marine navigation and aviation lighting, marking, and signaling in accordance with BOEM, US Coast Guard (USCG), and Federal Aviation Administration (FAA) guidance.

ES-3 Operations and Maintenance

Vineyard Northeast's facilities are expected to operate for approximately 30 years. During operations, the offshore and onshore facilities will be continuously remotely monitored from one or more control center(s) located at the Proponent's operations and maintenance (O&M) facilities and/or a third party's facilities.

The WTGs, ESP(s), and booster station will be designed to operate autonomously and will not be manned. The offshore facilities will be equipped with a supervisory control and data acquisition (SCADA) system. The SCADA system will notify operators of alarms or warnings and enable the operators to remotely interact with and control devices (e.g., sensors, valves, motors), override automatic functions, reset systems, and shut down equipment for maintenance or at the request of grid operators or agencies. The Proponent anticipates that

[5] Prior to impact pile driving, a vibratory hammer or other tool could be used to slowly lower the pile through the top layers of the seabed in a controlled fashion to avoid the potential for a "pile run" (see Section 3.3).

the offshore cables will include a monitoring system, such as distributed temperature sensing (DTS), online partial discharge (OLPD) monitoring, and/or distributed acoustic sensing (DAS), to continuously monitor the cables' status.

The Proponent will regularly conduct inspections and preventative maintenance, including foundation and scour protection inspections, offshore cable surveys, safety inspections and tests, electrical component service, and replacement of consumables, among other activities. Offshore, most scheduled maintenance activities will be performed using service operation vessels (SOVs), service accommodation and transfer vessels (SATVs), crew transfer vessels (CTVs), and/or helicopters. Unscheduled repairs or component replacement may also be necessary, which may require jack-up vessels or other larger vessels similar to those used during construction. The Proponent expects to use one or more onshore O&M facilities to support offshore operations. The O&M facilities, which could be located at or near any of the ports identified in Section 4.4.1, would likely be used for dispatching technicians and crew exchange, bunkering, and loading supplies and spare parts onto vessels. The Proponent may also lease space at an airport hangar for aircraft (e.g., helicopters) used to support operations. Onshore maintenance and repair activities are expected to require minimal use of worker vehicles and construction equipment.

ES-4 Decommissioning

Decommissioning of the offshore and onshore facilities at the end of their operational life is essentially the reverse of the construction process. The WTGs, ESP(s), and booster station (if used) will be disconnected from the offshore cables, disassembled, and removed from their foundations. The foundations will be cut and removed to a depth of 4.5 m (15 ft) below the mudline, unless otherwise authorized by the Bureau of Safety and Environmental Enforcement (BSEE). The removed WTG, ESP, booster station, and foundation components will be shipped to shore and properly disposed of or recycled. The offshore cables may be removed or retired in place (if authorized by BOEM and other appropriate agencies). Any scour protection or cable protection may be removed or left in place, depending on input from federal and state agencies and relevant stakeholders. The onshore facilities could be retired in place or retained for future use, subject to discussions with local agencies.

ES-5 Organization of the COP

This COP is being submitted to BOEM in accordance with 30 CFR Part 585, the stipulations in Lease OCS-A 0522, and applicable guidance. The Proponent is proposing to develop Vineyard Northeast in phases pursuant to 30 CFR § 585.238. Phase 1, which is fully described throughout this COP, includes the full buildout of the entire Lease Area, the Massachusetts OECC, the Connecticut OECC, and associated onshore transmission systems. Phase 2 includes other potential offshore and onshore transmission systems, which are described in Section 3.13. Following COP approval of Phase 1, the Proponent would submit a Phase 2 COP revision to incorporate the new offshore and onshore transmission systems per 30 CFR § 585.634.

The Vineyard Northeast COP is comprised of two volumes:

- Volume I describes Vineyard Northeast's offshore and onshore facilities and how the Proponent plans to construct, operate, and decommission those facilities. Volume I also discusses the Proponent's outreach efforts and commitment to health, safety, and environmental (HSE) protection. Volume I is accompanied by several related appendices.

- Volume II assesses the benefits and potential impacts of Vineyard Northeast to physical, biological, socioeconomic, visual, and cultural resources based on the "maximum design scenario" for each resource. Volume II also describes the Proponent's measures to avoid, minimize, and mitigate those potential impacts. Volume II is accompanied by numerous appendices containing detailed resource and site conditions assessments.

ES-6 Agency, Tribal, and Stakeholder Outreach

Vineyard Northeast LLC is committed to being a good neighbor both onshore and offshore. The Proponent began agency, tribal, and stakeholder outreach specific to Vineyard Northeast in fall 2021 well before the submission of this COP. The Proponent's frequent and early engagement with agencies, Native American tribes,[6] fishermen, local communities, and other stakeholders during the COP planning process enabled the Proponent to incorporate their feedback into the siting and design of the facilities, the methodologies for resources assessments, survey strategies, workforce initiatives and educational opportunities, and/or proposed avoidance, minimization, and mitigation measures. Throughout the development, construction, operational, and decommissioning periods, the Proponent will continue to actively engage with agencies, Native American tribes, fishermen, local communities, and other stakeholders to identify and discuss their interests and concerns regarding Vineyard Northeast.

ES-7 Benefits of Vineyard Northeast

Vineyard Northeast will generate clean, renewable electricity by as early as 2030 to assist Northeastern states and/or other offtake users in achieving their renewable energy and carbon emission reduction goals. The electricity generated by the WTGs will displace electricity from fossil fuel power plants, resulting in a significant net reduction in air emissions from the regional electric grid. Vineyard Northeast is expected to reduce carbon dioxide equivalent (CO_2e) emissions from the electric grid by approximately 4.9 million tons per year (tpy), or the equivalent of taking approximately 970,000 cars off the road.[7] This reduction in greenhouse

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[6] Throughout the COP, "Native American tribes" generally refers to both federally recognized Tribes/Tribal Nations and other Native American communities. Where appropriate, consultations or communications with federally recognized Tribes/Tribal Nations will be identified.

[7] Assuming the minimum nameplate capacity of Vineyard Northeast.

gas emissions will help mitigate additional effects of ongoing climate change (e.g., sea level rise and increased flooding, changes in agricultural productivity, shifts in species' distributions, and increases in energy system costs) that are impacting the environment and public health. Vineyard Northeast will also reduce regional emissions of air contaminants such as nitrogen oxides (NOx) and sulfur dioxide (SO_2), which contribute to acid rain, ocean acidification, and ground level ozone/smog and are linked to increased rates of early death, heart attacks, stroke, and respiratory disorders. Vineyard Northeast will also help diversify the states' electricity supply and increase the reliability of the electric grid.

Beyond these important environmental, public health, and energy reliability benefits, Vineyard Northeast is expected to result in significant long-term economic benefits, including considerable new employment opportunities. Vineyard Northeast is expected to support a minimum of 15,894 direct, indirect, and induced full-time equivalent (FTE) job-years[8] during pre-construction and construction. Construction of Vineyard Northeast is also estimated to generate at least ~$1.63 billion in total labor income and ~$4.65 billion in output.[9] The operation of Vineyard Northeast is projected to generate approximately 17,046 FTE job-years assuming a 30-year operational life (equivalent to 568 direct, indirect, and induced FTEs annually), as well as at least ~$1.19 billion in total annual labor income and ~$4.62 billion in output.

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[8] One FTE job-year is the equivalent of one person working full time for one year (2,080 hours).

[9] Output is the estimated value of all goods and services sold (i.e., expenditures other than payroll).

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

List of Appendices

List of Figures

List of Tables

List of Acronyms

ACP	American Clean Power Association
ADLS	Aircraft Detection Lighting System
AHTS	anchor handling tug supply
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practical
API	American Petroleum Institute
ATON	Aids to Navigation
BOEM	Bureau of Ocean Energy Management
BRI	Biodiversity Research Institute
BSEE	Bureau of Safety and Environmental Enforcement
CBRA	Cable Burial Risk Assessment
CECPN	Certificate of Environmental Compatibility and Public Need
CFR	Code of Federal Regulations
CIP	Copenhagen Infrastructure Partners
CMR	Code of Massachusetts Regulations
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COP	Construction and Operations Plan
CT DEEP	Connecticut Department of Energy and Environmental Protection
CT DOT	Connecticut Department of Transportation
CTV	crew transfer vessel
CVA	Certified Verification Agent
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DAS	distributed acoustic sensing
DCR	Massachusetts Department of Conservation and Recreation
DHS	Department of Homeland Security
DMF	Massachusetts Division of Marine Fisheries
DMM	discarded military munitions
DoD	Department of Defense
DP	dynamic positioning
DPU	Massachusetts Department of Public Utilities
DTS	distributed temperature sensing
EFSB	Energy Facilities Siting Board
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
ESA	Endangered Species Act
ESP	electrical service platform
FAA	Federal Aviation Administration
FAST-41	Title 41 of the Fixing America's Surface Transportation Act

List of Acronyms (Continued)

FCP	Fisheries Communication Plan
FDR	Facility Design Report
FIR	Fabrication and Installation Report
FL	Fisheries Liaison
FM	Fisheries Manager
FPISC	Federal Permitting Improvement Steering Council
FR	Fisheries Representative
ft	foot
ft^2	square foot
FTE	full-time equivalent
gal	gallon
GE	General Electric
GW	gigawatt
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HLV	heavy lift vessel
HSE	health, safety, and environmental
HTV	heavy transport vessel
HVAC	heating, ventilation, and air conditioning
HVAC	high voltage alternating current
HVDC	high voltage direct current
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ISO-NE	ISO New England
kJ	kilojoule
km	kilometer
km^2	square kilometer
L	liter
LID	low-impact development
LLC	Limited Liability Company
LNM	Local Notice to Mariner
LOA	Letter of Authorization
LWRD	Land and Water Resources Division
m	meter
m^2	square meter
m^3	cubic meter
MA CZM	Massachusetts Office of Coastal Zone Management
MA WEA	Massachusetts Wind Energy Area
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
MARPOL	International Convention for the Prevention of Pollution from Ships
MassCEC	Massachusetts Clean Energy Center

List of Acronyms (Continued)

MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MBUAR	Massachusetts Board of Underwater Archeological Resources
MEPA	Massachusetts Environmental Policy Act
MHC	Massachusetts Historical Commission
mi	mile (statute)
MLLW	Mean Lower Low Water
MRASS	Mariner Radio Activated Sound Signal
MSIR	Marine Site Investigation Report
MW	megawatt
NDDB	Natural Diversity Data Base
NEPA	National Environmental Policy Act
NHESP	Natural Heritage and Endangered Species Program
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NM	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSRA	Navigational Safety Risk Assessment
NTM	Notice to Mariners
NYSDOS	New York State Department of State
NYSDPS	New York State Department of Public Service
NYSERDA	New York State Energy Research and Development Authority
NYSOGS	New York State Office of General Services
NYSPSC	New York State Public Service Commission
OCS	Outer Continental Shelf
OECC	offshore export cable corridor
OEM	original equipment manufacturer
OFL	Onboard Fisheries Liaison
OLPD	online partial discharge
OSRP	Oil Spill Response Plan
O&M	operations and maintenance
PAL	Public Archeology Laboratory
PATON	Private Aid to Navigation
PDE	Project Design Envelope
POI	point of interconnection
PVC	polyvinyl chloride
RI CRMC	Rhode Island Coastal Resources Management Council

List of Acronyms (Continued)

RI/MA WEA	Rhode Island/Massachusetts Wind Energy Area
ROD	Record of Decision
ROTV	remotely operated towed vehicle
ROV	remotely operated vehicle
ROW	right-of-way
SAP	Site Assessment Plan
SATV	service accommodation and transfer vessel
SBMT	South Brooklyn Marine Terminal
SCADA	supervisory control and data acquisition
SF_6	sulfur hexafluoride
SMS	Safety Management System
SO_2	sulfur dioxide
SOV	service operation vessel
SPCC	Spill Prevention, Control, and Countermeasure
SPMT	self-propelled modular transporter
SSBMT	Sustainable South Brooklyn Marine Terminal
TBD	to be determined
TBF	to be filed
TETRA	TErrestrial Trunked RAdio
TMP	Traffic Management Plan
TP	transition piece
TSHD	trailing suction hopper dredge
TSS	traffic separation scheme
US	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnances
VHF	very high frequency
WTG	wind turbine generator
XLPE	cross-linked polyethylene
yd^3	cubic yard

Standard Terminology

Standard Term	Definition
Vineyard Northeast	Vineyard Northeast LLC's proposal to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 along with associated offshore and onshore transmission systems.
Vineyard Northeast LLC	The Proponent of Vineyard Northeast. Vineyard Northeast LLC is an affiliate of Vineyard Offshore and is owned by Copenhagen Infrastructure Partners (CIP).
Project Design Envelope (PDE)	The PDE outlines a reasonable range of project design parameters (e.g., multiple foundation types) and installation techniques (e.g., use of various cable installation tools). The use of a PDE allows analysis of the maximum impacts that could occur from Vineyard Northeast based on the "maximum design scenario" for each resource while providing the Proponent with the flexibility to optimize its project(s) within the approved PDE during later stages of the development process.
Offshore Geographical Terms	
Lease Area OCS-A 0522 (Lease Area)	The BOEM lease area held by Vineyard Northeast LLC that will be developed for Vineyard Northeast.
aliquot	An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.
offshore export cable corridors (OECCs)	The corridors identified for routing offshore export cables between the Lease Area and the landfall sites.
Massachusetts OECC	The corridor identified for routing offshore export cables between the Lease Area and a landfall site in Massachusetts.
Connecticut OECC	The corridor identified for routing offshore export cables between the Lease Area and a landfall site in Connecticut.
Offshore Development Area	The Offshore Development Area is comprised of Lease Area OCS-A 0522, two OECCs (the Massachusetts OECC and Connecticut OECC), and the broader region surrounding the offshore facilities that could be affected by Vineyard Northeast-related activities.
Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA)	The areas designated by BOEM for wind energy development offshore Massachusetts and Rhode Island.
Offshore Facilities	
offshore facilities	All of Vineyard Northeast's offshore infrastructure (wind turbine generators [WTGs], electrical service platforms [ESPs], etc.).
wind turbine generator (WTG)	An offshore wind turbine located in the Lease Area that will generate clean, renewable, electricity.

Standard Terminology (Continued)

Standard Term	Definition
Offshore Facilities (Continued)	
electrical service platform (ESP)	An offshore substation located in the Lease Area, which contains transformers and other electrical gear.
booster station	If Vineyard Northeast uses high voltage alternating current (HVAC) offshore export cables within the Massachusetts OECC, the cables may connect to a booster station in the northwestern aliquot of Lease Area OCS-A 0534. The booster station would manage the offshore export cables' reactive power (unusable electricity), increase the transmission system's operational efficiency, reduce conduction losses, and minimize excess heating.
foundation	A steel structure that is secured to the seabed and supports a WTG, ESP, or booster station. Vineyard Northeast's foundations may be monopiles or piled jackets.
monopile	A type of foundation consisting of a single, hollow cylindrical steel pile that is driven into the seabed.
transition piece (TP)	A part of the foundation structure that is installed between the monopile and WTG tower and contains ancillary structures such as boat landing(s), ladders, work platforms, electrical equipment, and various ancillary equipment (e.g., cranes).
piled jacket	A type of foundation comprised of several legs connected by welded tubular cross bracing, which is secured to the seafloor using pin piles.
scour protection	Rock or other protection placed around the base of a foundation to minimize sediment transport and erosion.
inter-array cables	Submarine transmission cables that connect groups of WTGs to an ESP.
inter-link cable	A submarine transmission cable that may be used to connect ESPs together.
offshore export cables	Submarine transmission cables that connect the ESP(s) to the landfall sites.
offshore cable system	All offshore transmission cables (inter-array cables, inter-link cables, and offshore export cables).
cable protection	Rock, rock bags, concrete mattresses, or half-shell pipes (or similar) placed over an offshore cable to prevent damage to the cable.
Onshore Geographical Terms	
landfall sites	The shoreline sites where the offshore export cables transition onshore.
onshore export cable routes	The onshore transmission routes that connect the landfall sites to the onshore substation sites. The onshore export cables will be installed within the onshore export cable routes.
grid interconnection routes	The onshore transmission routes that connect the onshore substation sites to the points of interconnection (POIs). The grid interconnection cables will be installed within the grid interconnection routes.
onshore cable routes	All onshore transmission routes (the onshore export cable routes and grid interconnection routes).

Standard Terminology (Continued)

Standard Term	Definition
Onshore Geographical Terms (Continued)	
onshore substation site	A parcel of land where an onshore substation will be located.
onshore substation site envelope	A region identified by the Proponent within which an onshore substation site may be located.
point of interconnection (POI)	Where the electricity from Vineyard Northeast will be delivered into the electric grid.
Onshore Development Area	The Onshore Development Area consists of the landfall sites, onshore cable routes, onshore substation sites, and POIs in Bristol County, Massachusetts and New London County, Connecticut, as well as the broader region surrounding the onshore facilities that could be affected by Vineyard Northeast-related activities.
Onshore Facilities	
onshore facilities	All of Vineyard Northeast's onshore infrastructure (i.e., transition vaults, splice vaults, duct bank, onshore export cables, grid interconnection cables, onshore substations).
transition vault	A type of splice vault where the offshore export cables are connected to the onshore export cables. The transition vaults are located underground at the landfall sites.
onshore export cables	Onshore transmission cables that connect the landfall sites to the onshore substations.
grid interconnection cables	Onshore transmission cables that connect the onshore substations to the POIs.
onshore cables	All onshore transmission cables (onshore export cables and grid interconnection cables).
duct bank	The underground structure that houses onshore cables and typically consists of plastic pipes encased in concrete.
splice vault	Underground concrete chambers where segments of the onshore cables are spliced together.
onshore substation	A landside substation constructed for Vineyard Northeast that contains transformers and other electrical gear.
port facilities	Facilities and infrastructure located within/adjacent to a port that will be used during the construction and operation of Vineyard Northeast.
staging port	Specifically the port facilities that may be used for storage and pre-assembly of offshore components.
operations and maintenance (O&M) facilities	All onshore buildings and infrastructure used to support O&M activities.

Standard Terminology (Continued)

Standard Term	Definition
Onshore Facilities (Continued)	
construction staging area	An onshore area used for equipment laydown and storage during onshore construction activities.
horizontal directional drilling (HDD) staging area	Specifically the construction staging area at the landfall site used to support HDD activities.

1 Vineyard Northeast Overview

1.1 Introduction

Vineyard Northeast LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast." Vineyard Northeast includes 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. Up to three of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut. Other potential offshore and onshore transmission systems, which would be developed as Phase 2 of Vineyard Northeast, are identified but not fully analyzed in this Construction and Operations Plan (COP) (see Section 3.13). Figure 1.1-1 provides an overview of Vineyard Northeast.

1.2 Applicant's Purpose and Need

The purpose of Vineyard Northeast is to generate competitively-priced clean, renewable electricity from Lease Area OCS-A 0522 by as early as 2030 to meet the demand expressed by Northeastern states and/or other offtake users to achieve their renewable energy and carbon emission reduction goals. Vineyard Northeast will help diversify the states' electricity supply, increase energy reliability, and reduce regional greenhouse gas emissions. In addition to supporting these clean energy goals, Vineyard Northeast will provide substantial environmental, health, community, and economic benefits, including considerable new employment opportunities.

The combined offshore wind energy targets of the Northeastern states currently exceed 29 gigawatts (GW), with projected available supply falling short of expected demand. Vineyard Northeast's ability to deliver over 3 GW of power is therefore needed to meet these critical clean energy objectives. Vineyard Northeast is competing and will continue to compete in competitive offtake solicitations during the development of BOEM's Environmental Impact Statement. Depending on the solicitation, the minimum nameplate capacity required for Vineyard Northeast to remain technically and economically practicable or feasible is 2,600 megawatts (MW).

Vineyard Northeast is also consistent with Presidential Executive Order 14008 (Tackling the Climate Crisis at Home and Abroad), dated January 27, 2021, which directs the Secretary of the Interior, in consultation with other federal agencies, to review siting and permitting

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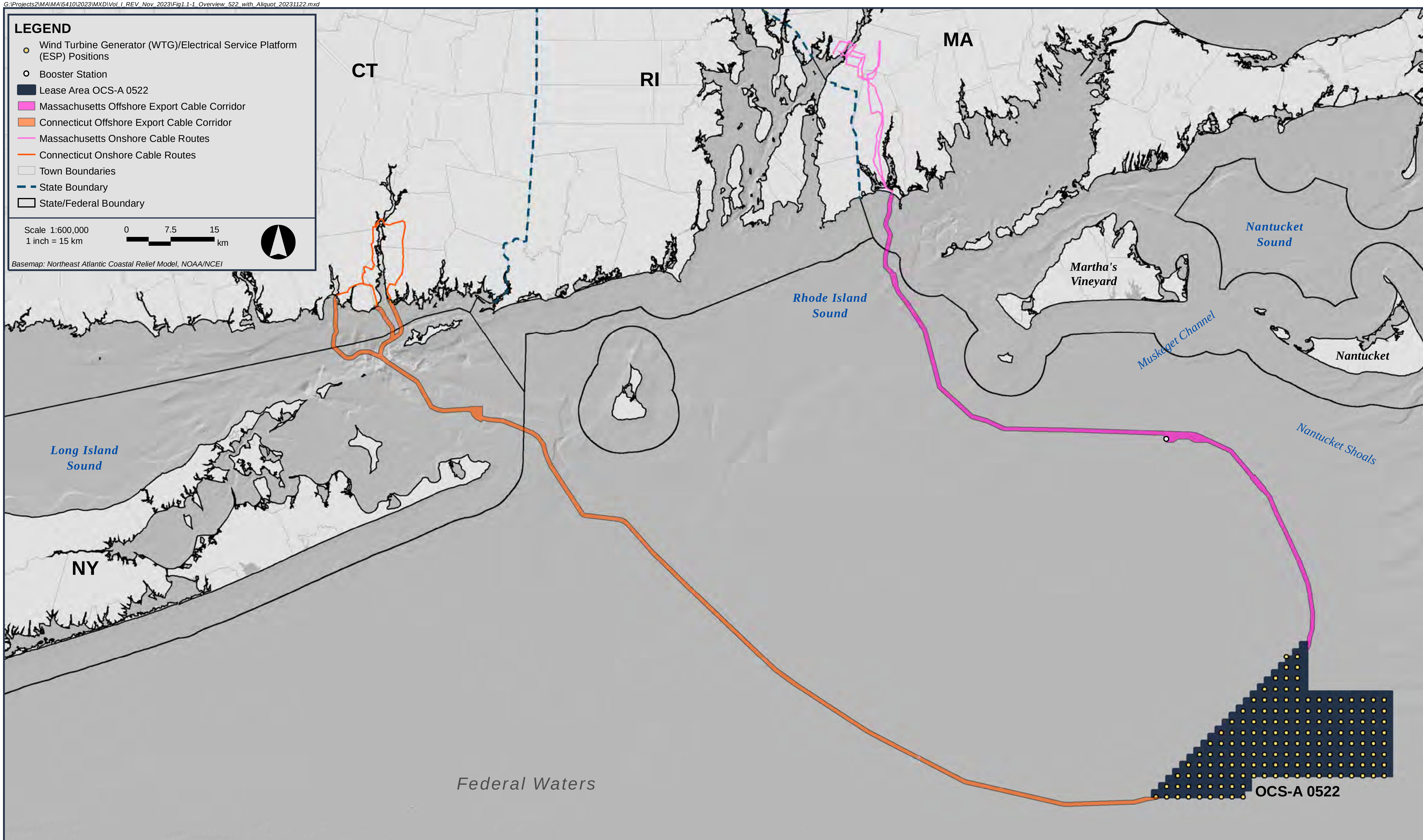

Figure 1.1-1
Overview of Vineyard Northeast

VINEYARD NORTHEAST
VINEYARD OFFSHORE

processes to identify steps to double offshore wind energy production by 2030, as well as the policy of the United States (US) to make Outer Continental Shelf (OCS) energy resources available for expeditious and orderly development, subject to environmental safeguards (see 43 U.S.C. 1332(3)).

1.3 Regulatory Overview and Organization of the COP

This Vineyard Northeast Construction and Operations Plan (COP) is being submitted to BOEM for the development of the entire Lease Area OCS-A 0522. The Proponent is proposing to develop Vineyard Northeast in phases pursuant to 30 CFR § 585.238:

- **Phase 1:** Phase 1, which is fully described throughout this COP, includes the full buildout of the entire Lease Area, the Massachusetts OECC, the Connecticut OECC, and associated onshore transmission systems.
- **Phase 2**: Phase 2 could include a New York OECC and associated onshore transmission system, additional points of interconnection (POIs) and associated routing variants in Southeastern Massachusetts, and additional POIs and associated routing variants in Southeastern Connecticut (see Section 3.13). Following COP approval of Phase 1, the Proponent would submit a Phase 2 COP revision per 30 CFR § 585.634 that provides the information required for BOEM to conduct its review of the new offshore and onshore transmission systems, as well as any necessary state or federal permits.

The purpose of the COP is to provide information about Vineyard Northeast's design and activities to BOEM, other federal and state agencies, Native American tribes, and stakeholders. The COP also contains a detailed assessment of Vineyard Northeast's potential benefits and impacts to assist BOEM in complying with its obligations under the National Environmental Policy Act (NEPA) and other relevant laws. The COP demonstrates that Vineyard Northeast is safe, conforms to applicable regulations, does not unreasonably interfere with other uses of the OCS, does not cause undue harm or damage to the environment or cultural resources, and will use the best available technology.

The Vineyard Northeast COP is comprised of two volumes:

- Volume I describes Vineyard Northeast's offshore and onshore facilities and how the Proponent plans to construct, operate, and decommission those facilities. Volume I also discusses the Proponent's outreach efforts and commitment to health, safety, and environmental (HSE) protection. Volume I is accompanied by several related appendices.
- Volume II assesses the benefits and potential impacts of Vineyard Northeast to physical, biological, socioeconomic, visual, and cultural resources based on the "maximum design scenario" for each resource. Volume II also describes the Proponent's measures to avoid, minimize, and mitigate those potential impacts. Volume II is accompanied by numerous appendices containing detailed resource and site conditions assessments.

This COP has been developed in accordance with 30 CFR Part 585, the stipulations in Lease OCS-A 0522, BOEM's (2020) *Information Guidelines for a Renewable Energy Construction and Operations Plan (COP)*, BOEM's (2023) *FINAL Information Needed for Issuance of a Notice of Intent (NOI) Under the National Environmental Policy Act (NEPA) for a Construction and Operations Plan (COP)*, and other relevant guidance. Section 7.2 demonstrates the Proponent's compliance with the stipulations in Lease OCS-A 0522. Section 7.3 lists BOEM's regulatory requirements for a COP and identifies where the corresponding information can be found in this COP.

1.4 Company Overview

Vineyard Northeast LLC (the "Proponent") is the current lease holder of Lease Area OCS-A 0522. The Proponent acquired the rights to Lease Area OCS-A 0522 from Vineyard Wind LLC in late 2021.[10]

Vineyard Northeast LLC is an affiliate of Vineyard Offshore and is owned by Copenhagen Infrastructure Partners (CIP). Vineyard Offshore is an offshore wind development company that develops US projects on behalf of CIP, including Vineyard Northeast (Lease Area OCS-A 0522), Vineyard Mid-Atlantic (Lease Area OCS-A 0544), and Lease Area OCS-P 0562. CIP is a fund management company focused on energy infrastructure including offshore wind, onshore wind, solar photovoltaics, biomass and energy from waste, transmission and distribution, and reserve capacity and storage. CIP has projects in development on four continents (North America, Europe, Asia, and Australia), which include Vineyard Wind 1 (a joint venture of CIP and Avangrid Renewables).

Vineyard Offshore's specialized team of over 100 personnel brings industry-leading experience to every phase of offshore wind project development, from conception and design to permitting, financing, and construction. Vineyard Offshore was established in 2022 by the same team that developed Vineyard Wind 1 (Lease Area OCS-A 0501), the nation's first commercial-scale offshore wind project to obtain permitting approval at the federal and state levels, conclude procurement and contracting for all major contract packages, and begin construction. The team's experience with the offshore wind permitting process for Vineyard Wind 1, at both the federal level and in Massachusetts, serves as a solid foundation for the development of Vineyard Northeast.

Lastly, the Proponent is supported by numerous expert consultants and partners to ensure a well-rounded team with the skillsets required to develop and operate offshore wind projects in the US. Epsilon Associates, Inc. is the lead environmental consultant for the federal permitting of Vineyard Northeast, including the development of this COP. Other key partners

[10] At the time, the Proponent was named OCS-A 0522 LLC.

and consultants supporting the development of the COP include Baird, Biodiversity Research Institute (BRI), Capitol Airspace Group, Geo SubSea LLC, Gradient, JASCO Applied Sciences, King and Associates, LGL, Public Archaeology Laboratory (PAL), R.C. Goodwin & Associates, RPS, Saratoga Associates, Westslope Consulting, and Wood Thilsted.

1.4.1 Contact Information

The point of contact for Vineyard Northeast is Rachel Pachter. Her contact information is provided below:

Rachel Pachter
Chief Development Officer, Vineyard Offshore
200 Clarendon Street, 18th floor
Boston, MA 02116
(508) 717-8964
rpachter@vineyardoffshore.com

1.4.2 Designation of Operator

Vineyard Northeast LLC will be the operator of Vineyard Northeast's facilities.

2 Project Siting and Design

This section describes how the Proponent considered technical feasibility, economic viability, avoidance and minimization of environmental impacts, agency input, and stakeholder concerns to site Vineyard Northeast's facilities and develop the Project Design Envelope (PDE). Sections 2.1 and 2.2 provide an overview of the proposed PDE and the location of the offshore and onshore facilities. Sections 2.3 through 2.8 describe how the Proponent evaluated the feasibility of various design alternatives to select the PDE and site the facilities. The design of Vineyard Northeast's offshore and onshore facilities is more fully described in Section 3.

2.1 Overview of the PDE

Offshore wind technologies, particularly the size of commercially available wind turbine generators (WTGs) (in terms of both power and physical dimensions), are advancing at a significant pace (see Section 2.4). Given that offshore wind technologies are rapidly evolving, Vineyard Northeast is being developed and permitted using a PDE based on expected commercial and technological advancements. The PDE outlines a reasonable range of project design parameters (e.g., multiple foundation types) and installation techniques (e.g., use of various cable installation tools). The use of a PDE allows analysis of the maximum impacts that could occur from Vineyard Northeast based on the "maximum design scenario" for each resource while providing the Proponent with the flexibility to optimize its project(s) within the approved PDE during later stages of the development process. This flexible approach is particularly important to ensure that the Proponent can take advantage of the best available technology, maximize renewable energy production, address stakeholder concerns, minimize adverse effects, and minimize costs for ratepayers.

The Proponent has developed the PDE and sited Vineyard Northeast's facilities based on feedback from multiple agencies and stakeholders. Key elements of Vineyard Northeast's PDE are summarized in Table 2.1-1 below. Section 3 provides a more detailed description of each component of Vineyard Northeast.

Table 2.1-1 Summary of the Project Design Envelope

Parameter	Project Design Envelope
Maximum number of WTG/electrical service platform (ESP) positions	160
Wind Turbine Generators	
Maximum number of WTGs	160
Maximum rotor diameter	320 meters (m) (1,050 feet [ft])
Maximum tip height	400 m (1,312 ft)
Minimum tip clearance	27 m (89 ft)

Table 2.1-1 Summary of the Project Design Envelope (Continued)

Parameter	Project Design Envelope
Electrical Service Platforms and Booster Station	
Number of ESPs	0–3 (ESP equipment may be integrated onto WTG foundation[s])[1]
Maximum number of booster stations	1 (only for high voltage alternating current [HVAC] transmission)
Maximum topside height above Mean Lower Low Water[2]	70 m (230 ft)
Foundations and Scour Protection	
Maximum pile diameter	Monopiles: 14 m (46 ft) Piled jackets: 4.25 m (14 ft)
Maximum area of scour protection	monopiles: 7,238 square meters (m^2) (1.8 acres) WTG piled jackets: 11,660 m^2 (2.9 acres) ESP piled jackets: 32,577 m^2 (8.1 acres) Booster station piled jackets: 18,427 m^2 (4.6 acres)
Offshore Cables	
Maximum total inter-array cable length	356 kilometers (km) (192 nautical miles [NM])
Maximum total inter-link cable length	120 km (65 NM)
Maximum number of offshore export cables	Massachusetts Offshore Export Cable Corridor (OECC): 3 HVAC cables or 2 high voltage direct current (HVDC) cable bundles Connecticut OECC: 2 HVDC cable bundles
Maximum total offshore export cable length[3]	Massachusetts OECC: 436 km (235 NM) Connecticut OECC: 421 km (227 NM)
Target burial depth beneath stable seafloor[4]	1.5–2.5 m (5–8 ft)
Onshore Facilities	
Massachusetts landfall site	Horseneck Beach Landfall Site
Connecticut landfall site	Ocean Beach Landfall Site, Eastern Point Beach Landfall Site, or Niantic Beach Landfall Site
Massachusetts onshore cable route	Horseneck Beach Eastern Onshore Cable Route or Horseneck Beach Western Onshore Cable Route (including variants)
Connecticut onshore cable route	Ocean Beach Onshore Cable Route, Eastern Point Beach Onshore Cable Route, or Niantic Beach Onshore Cable Route

Table 2.1-1 Summary of the Project Design Envelope (Continued)

Parameter	Project Design Envelope
Onshore Facilities (Continued)	
Onshore substation site envelopes[5]	Massachusetts: [redacted] Connecticut: [redacted]
Points of interconnection (POIs)	Massachusetts: Pottersville POI, Brayton Point POI, or Bell Rock POI Connecticut: Montville POI

Notes:

1. As described in Section 3.4, this concept entails placing ESP equipment on one or more expanded WTG foundation platforms rather than having a separate ESP situated on its own foundation.
2. Height includes helipad (if present) but may not include antennae and other appurtenances.
3. Includes the length of the offshore export cables within the Lease Area.
4. Unless the final Cable Burial Risk Assessment (CBRA) indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.
5. Since the Proponent has not yet secured site control for the onshore substation sites, the Proponent has identified one or more "onshore substation site envelopes" for each POI.

2.2 Location Overview

The WTGs, electrical service platform(s) (ESP[s]), and their foundations as well as the inter-array cables, inter-link cables (if used), and a portion of the offshore export cables will be located in Lease Area OCS-A 0522. The Lease Area is 536 square kilometers (km^2) (132,370 acres) in size and is located entirely in federal waters. At its closest point, the Lease Area is approximately 46 km (29 miles [mi]) from Nantucket.[11] Water depths in the Lease Area range from approximately 32 to 64 meters (m) (105 to 210 feet [ft]).

Lease Area OCS-A 0522 is within the Massachusetts Wind Energy Area (MA WEA) identified by the Bureau of Ocean Energy Management (BOEM), following a public process and environmental review, as suitable for wind energy development (see Figure 2.2-1). During this multi-step, six-year process, BOEM extensively reduced the areas under consideration for offshore wind energy development to address environmental and stakeholder concerns based on feedback from agencies and the public. For example, BOEM excluded Outer Continental Shelf (OCS) Lease Blocks east of the 70° longitude line to protect valuable fisheries resources, areas within 1.9 km (1 nautical mile [NM]) of traffic separation schemes to address navigational concerns, and areas of biologically-important habitat, including an area of high sea duck concentration (77 FR 5820, BOEM 2012). Thus, BOEM took significant steps to reduce user conflicts and minimize environmental impacts when siting Lease Area OCS-A 0522.

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11 The closest WTG/ESP position is ~49 km (31 mi) from Nantucket and ~63 km (39 mi) from Martha's Vineyard.

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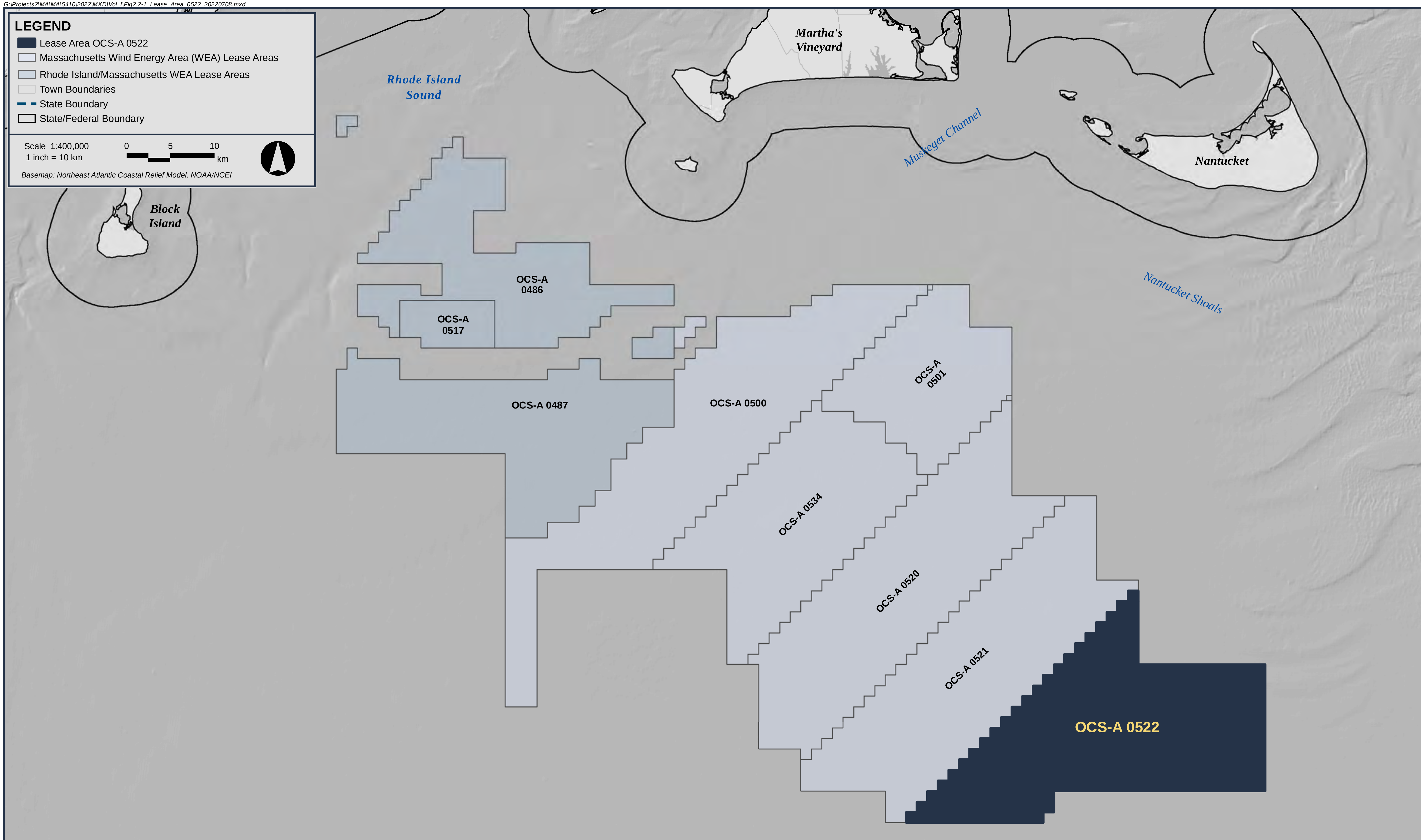

Figure 2.2-1
Lease Area OCS-A 0522

VINEYARD NORTHEAST
VINEYARD OFFSHORE

Between the Lease Area and shore, the offshore export cables will be installed within two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—that connect to onshore transmission systems in Bristol County, Massachusetts and New London County, Connecticut. The OECCs, which traverse federal and state waters, were developed in consultation with numerous federal and state agencies as well as stakeholders (see Section 2.8). The Massachusetts OECC travels from the northernmost tip of the Lease Area along the northeastern edge of the MA WEA and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) and then heads across Buzzards Bay towards the Horseneck Beach Landfall Site in Westport, Massachusetts. If high voltage alternating current (HVAC) offshore export cables are installed within the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[12] of Lease Area OCS-A 0534 to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity. From the Horseneck Beach Landfall Site, onshore export cables will connect to a new onshore substation in Westport, Fall River, or Somerset, Massachusetts. Grid interconnection cables will connect the onshore substation to one of three potential points of interconnection (POIs): the existing Pottersville Substation, a planned substation near Brayton Point, or the existing Bell Rock Substation.

The Connecticut OECC travels from the southwestern tip of the Lease Area along the southwestern edge of the MA WEA and then heads between Block Island and the tip of Long Island towards potential landfall sites near New London, Connecticut. As the Connecticut OECC approaches shore, it splits into three variations to connect to three potential landfall sites: the Ocean Beach Landfall Site, the Eastern Point Beach Landfall Site, and the Niantic Beach Landfall Site. Onshore export cables will connect one of the landfall sites to a new onshore substation in Montville, Connecticut, which will be connected to the POI at the existing Montville Substation by grid interconnection cables.

Vineyard Northeast's offshore facilities are shown on Figure 2.2-2. The potential locations of Vineyard Northeast's onshore facilities in Massachusetts and Connecticut are depicted on Figure 2.2-3. The location of Vineyard Northeast's offshore and onshore facilities is more fully described in Section 3.

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[12] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

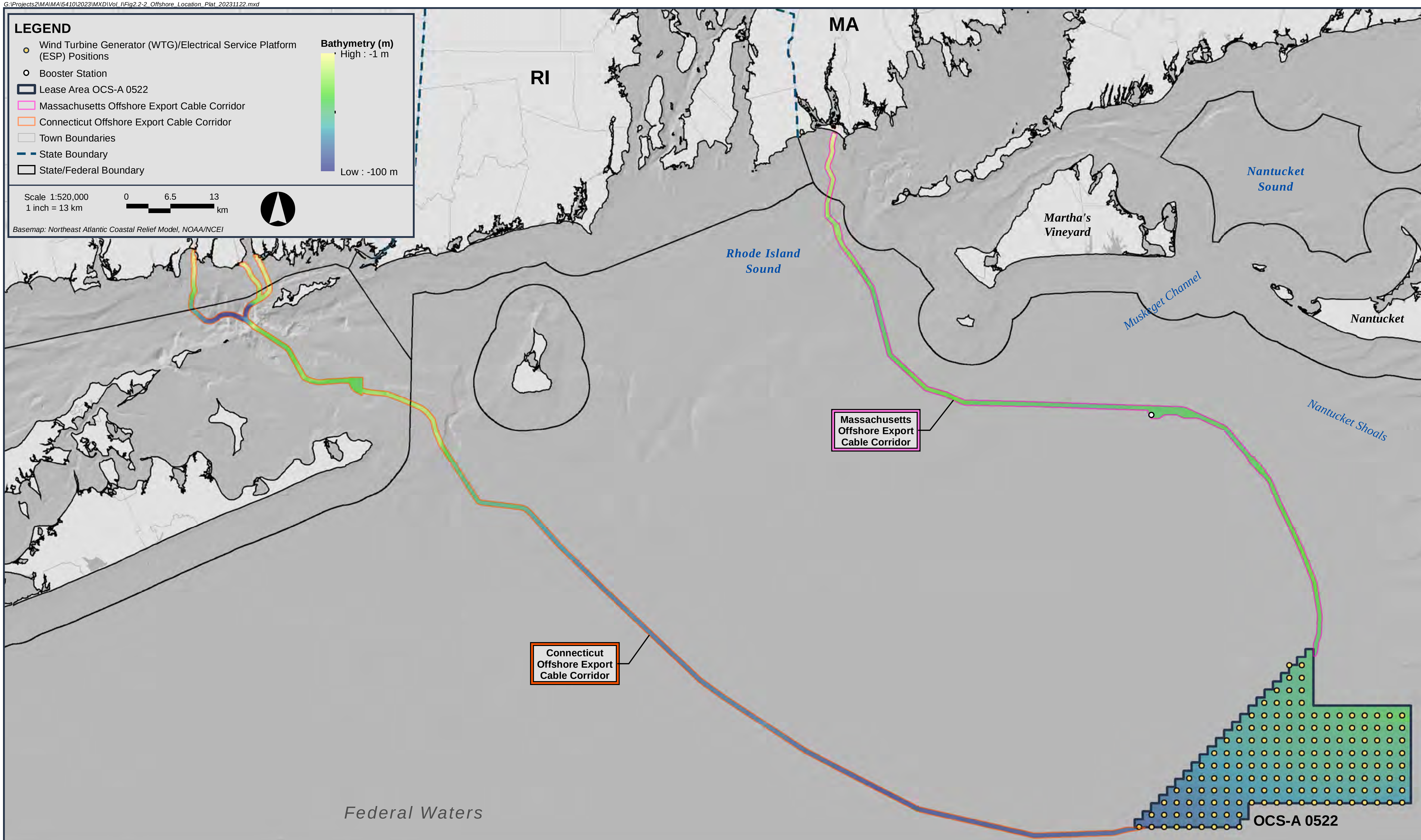

Figure 2.2-2

Vineyard Northeast Offshore Location Plat

VINEYARD NORTHEAST
VINEYARD OFFSHORE

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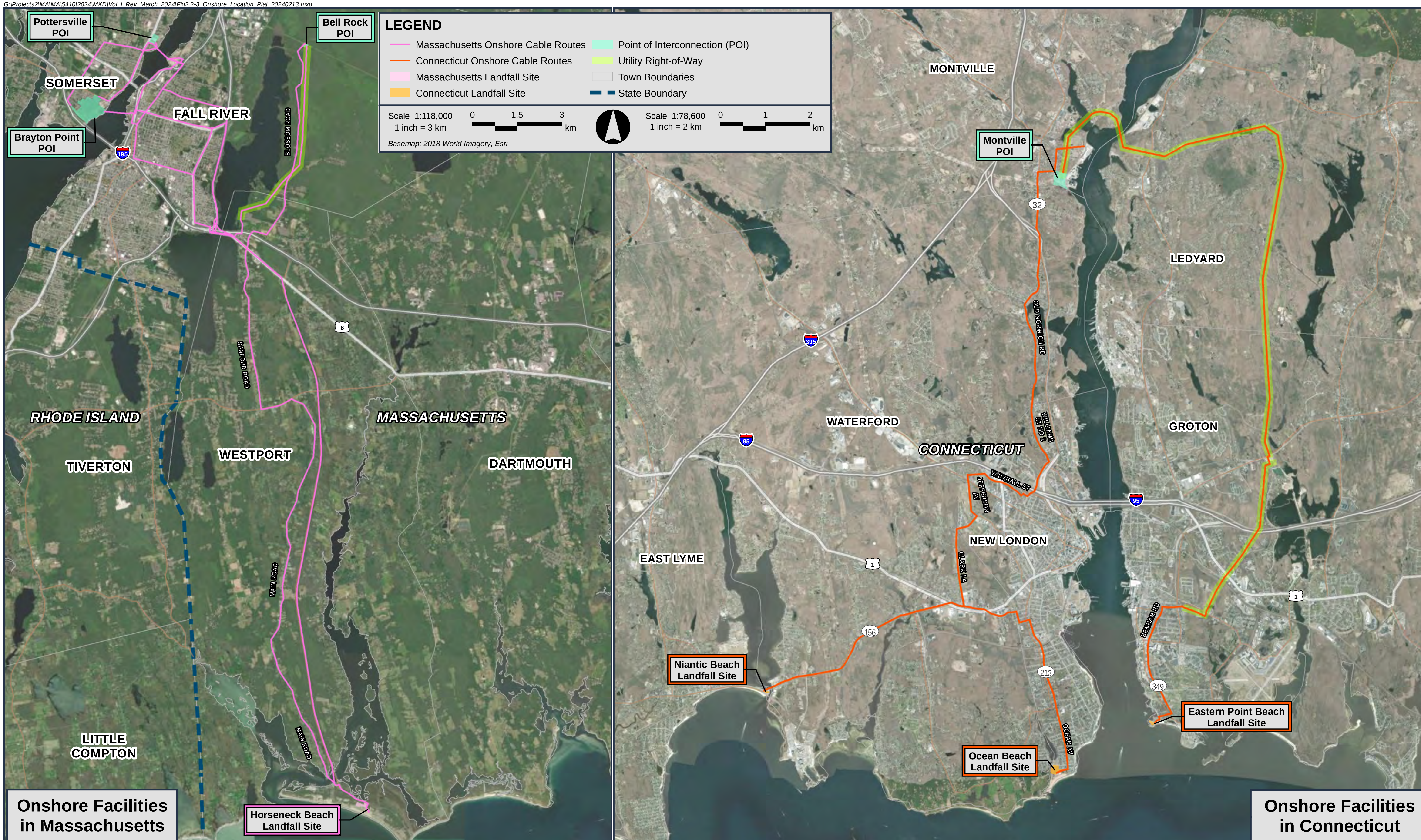

Figure 2.2-3
Vineyard Northeast Onshore Location Plat

VINEYARD NORTHEAST
VINEYARD OFFSHORE

2.3 Development of the Layout

The Lease Area includes 160 WTG/ESP positions.[13] As proposed, the WTGs and ESP(s) will be oriented in fixed east-to-west rows and north-to-south columns with 1 NM (1.9 km) spacing between positions (see Figure 2.3-1).[14] This 1 x 1 NM WTG/ESP layout is consistent with the layout adopted by other developers throughout the MA WEA and RI/MA WEA (collectively, "the WEAs").

In general, the most optimal WTG layout for wind energy production is a non-grid layout with closer turbine spacing and a higher density of WTGs around the edges of the wind farm; this edge-weighted design maximizes the number of WTGs per area while minimizing wake effects that impact the efficiency of downwind WTGs. However, as permitting of the first offshore wind projects within the WEAs progressed, other users of the OCS expressed the need for more uniform turbine layouts to accommodate vessel transits, fishing, and other uses of the WEAs. In response, the United States Coast Guard (USCG) initiated the Massachusetts and Rhode Island Port Access Route Study (MARIPARS) on March 26, 2019 to evaluate the need for vessel routing measures, including regional transit lanes, within the WEAs (USCG-2019-0131). The study solicited several rounds of public input from maritime community representatives, fishing industry representatives, developers, environmental groups, and other interested stakeholders.

On May 27, 2020, USCG published the final MARIPARS, which found that, "After considering all options and the vessel traffic patterns within the MA/RI WEA, a standard and uniform grid pattern with at least three lines of orientation throughout the MA/RI WEA would allow for safe navigation and continuity of USCG missions through seven adjacent wind farm lease areas over more than 1400 square miles of ocean." The USCG ultimately concluded that, "The adoption of a standard and uniform grid pattern through BOEM's approval process will likely eliminate the need for the USCG to pursue formal or informal routing measures within the MA/RI WEA at this time."

13 The Vineyard Northeast PDE includes the possibility of overplanting (i.e., installing more WTGs than needed to achieve the project[s]' ultimate nameplate capacity) to improve WTG availability during maintenance outages, to increase power production during periods of low wind speeds, and to compensate for transmission losses.

14 Where necessary, WTGs and ESP(s) may be micro-sited by a maximum of 152 m (500 ft) to avoid unfavorable seabed conditions, maintain facilities within the Lease Area boundaries, and/or for other unexpected circumstances.

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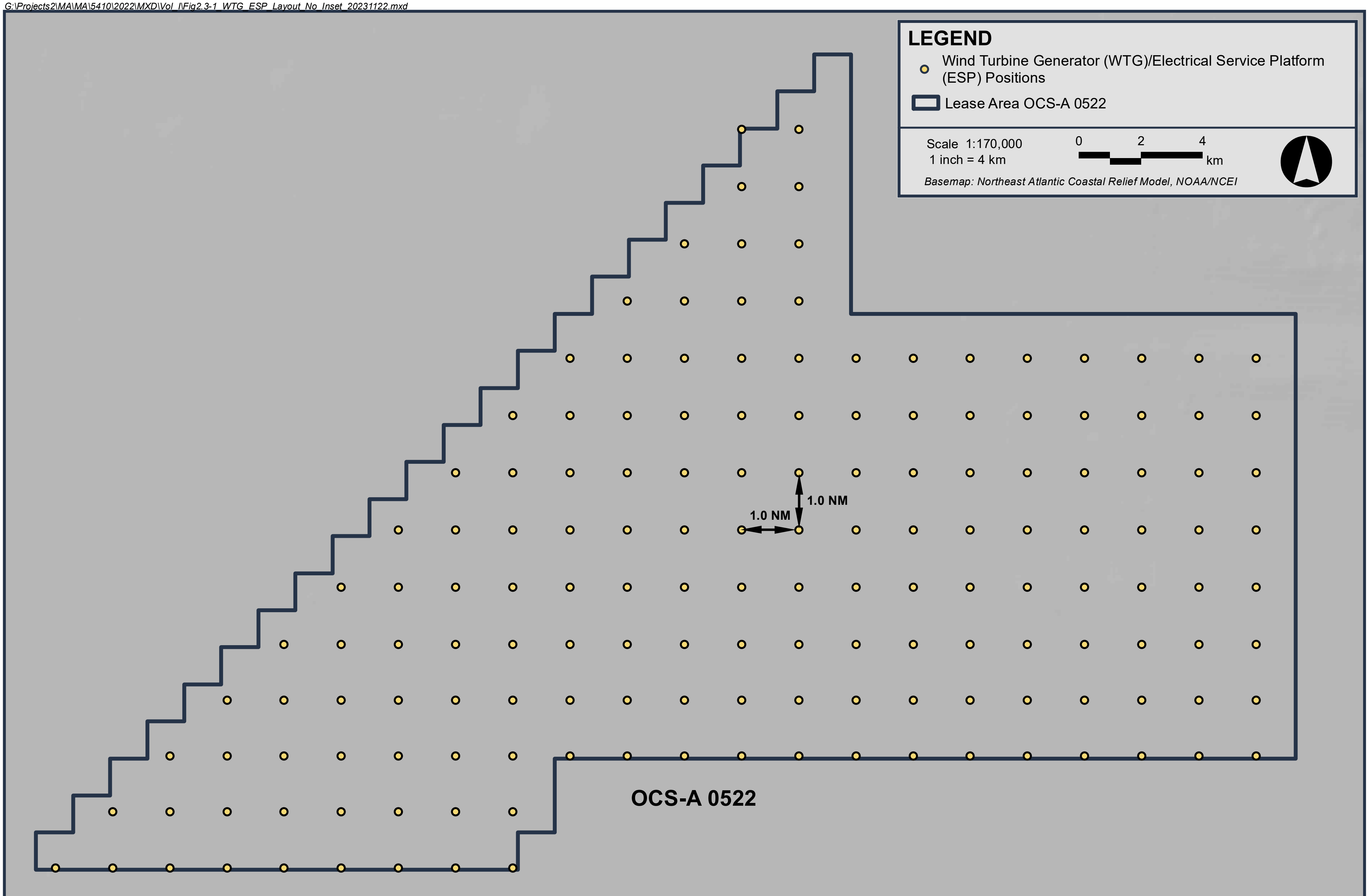

Figure 2.3-1
WTG/ESP Layout

VINEYARD NORTHEAST
VINEYARD OFFSHORE

The Proponent has sited the WTG/ESP positions within the Lease Area consistent with the recommendations of the MARIPARS.[15] In addition, as further discussed in Section 3.4, the Proponent may install a booster station in the northwestern aliquot of Lease Area OCS-A 0534, which would be aligned would with the 1 x 1 NM grid layout of the adjacent Vineyard Wind 1 project (see Figure 2.3-2).[16] The coordinates and water depths of all WTG/ESP positions and the booster station are provided in Appendix I-A1. Section 5.6 of COP Volume II and the Navigation Safety Risk Assessment (NSRA) provided as Appendix II-G further describe the layout and discuss marine navigation safety within the Offshore Development Area.

2.4 WTG Selection

Vineyard Northeast will use the latest generation of offshore WTGs that are commercially available at the time of procurement in order to maximize power production. The WTG parameters included in the PDE are the maximum dimensions of WTGs anticipated to be commercially available (see Section 2.1). These parameters were developed based on an analysis of historical offshore wind industry trends and feedback from original equipment manufacturers (OEMs) on future WTG development.

WTG capacities and physical dimensions are increasing significantly every few years (see Figure 2.4-1). The Block Island Wind Farm, which completed installation in 2016, includes six megawatt (MW) WTGs with rotor diameters of 150 m (492 ft) (Power Technology 2016). In 2023, the Vineyard Wind 1 project began the installation of 13 MW General Electric (GE) Haliade-X WTGs, which have rotor diameters of 220 m (722 ft) (Frangoul 2022; Storrow 2023).

GE's Haliade-X turbine has received a full type certificate to operate at up to 14.7 MW (Brown 2022). Siemens Gamesa has constructed a 15 MW WTG prototype with a 236 m (774 ft) rotor diameter and expects serial production of the model to begin in 2024 (Diaz 2023; Siemens Gamesa 2023). Vestas has also installed a prototype of its 15 MW WTG, which has a 236 m (774 ft) rotor diameter (Lewis 2023a). Vesta's V236-15.0 MW has been selected for the Empire Wind 1, Empire Wind 2, and Atlantic Shores Offshore Wind projects (Lewis 2023a; Vestas 2021, 2022).

China Three Gorges Corporation has begun constructing the second phase of the Zhangpu Liuao offshore wind project, which will feature 16 MW WTGs with a rotor diameter of 252 m (827 ft) (Lewis 2023b). MingYang Smart Energy installed a prototype of its 16 MW WTG (which has a 242 m [794 ft] rotor) in June 2023, with planned commercial availability in 2024 (DOE

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15 See the NSRA provided as Appendix II-G for additional discussion of how the layout is consistent with the recommendations of the MARIPARS.

16 If necessary, the booster station may be micro-sited by a maximum of 152 m (500 ft) to avoid unfavorable seabed conditions and/or for other unexpected circumstances.

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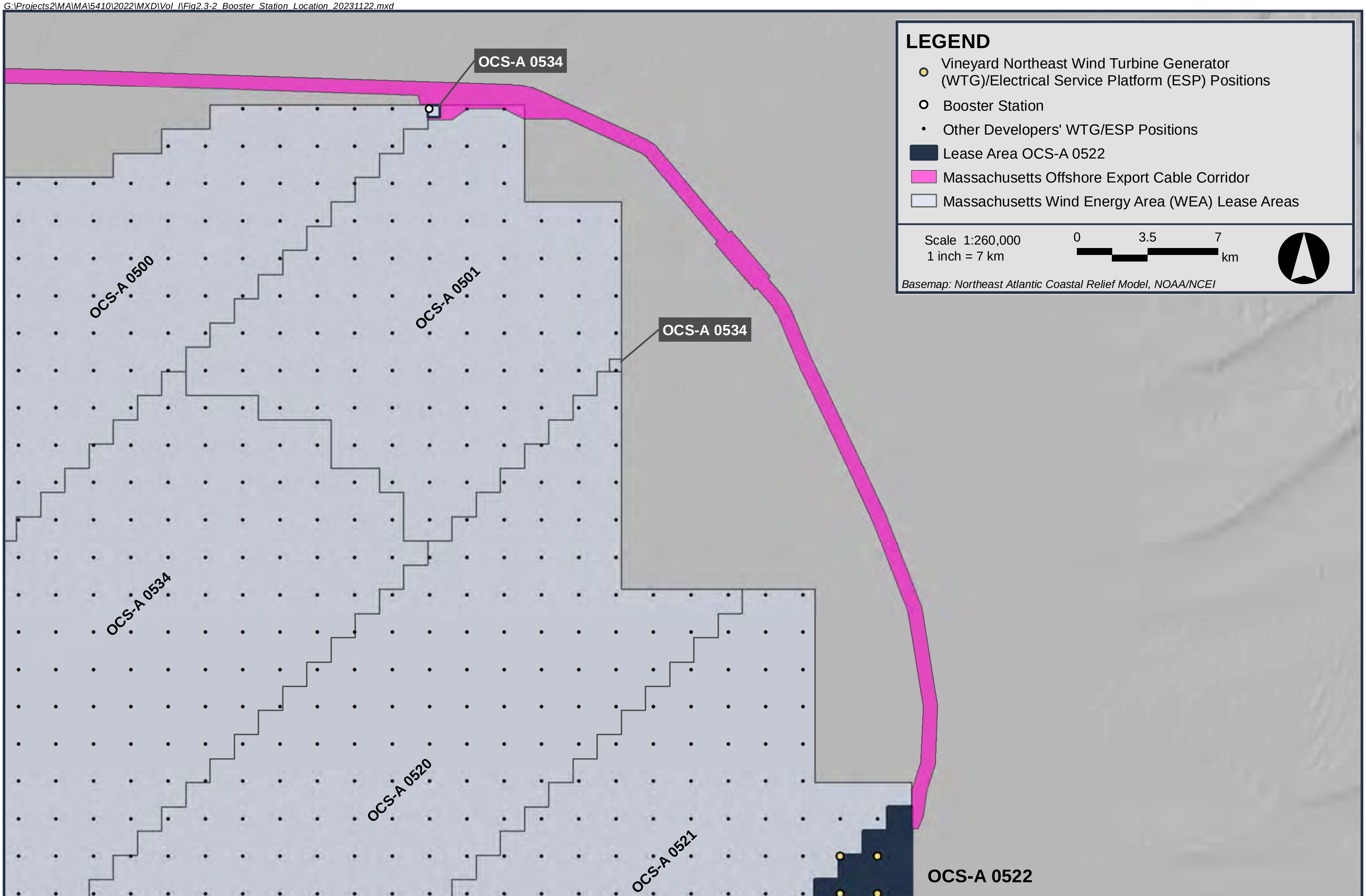

Figure 2.3-2
Booster Station Location

VINEYARD NORTHEAST
VINEYARD OFFSHORE

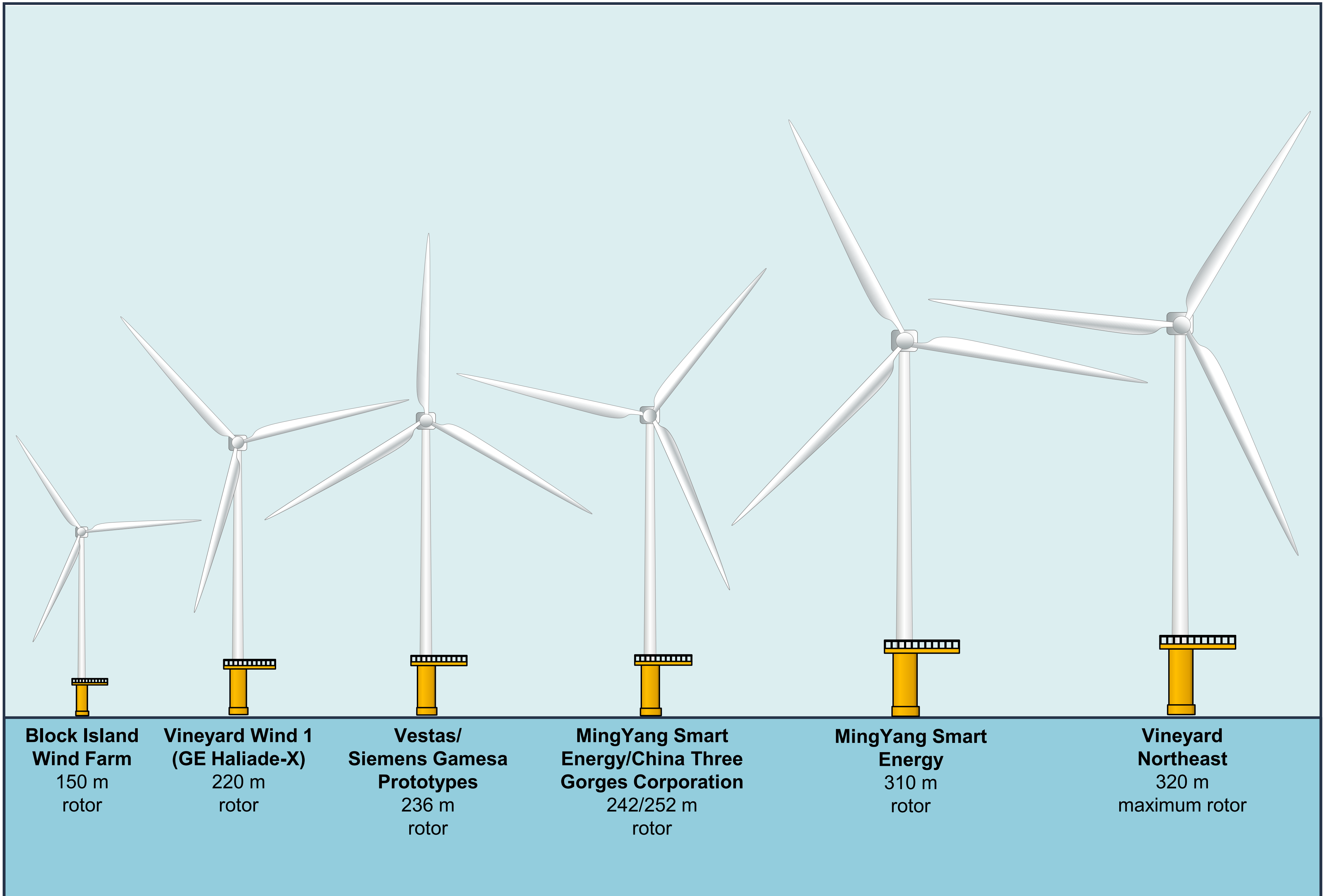

Figure 2.4-1

Trends in Offshore WTG Size

2023). MingYang Smart Energy also plans to deploy two 16.6 MW WTGs at the MingYang Yangjiang Qingzhou Four offshore wind farm in the South China Sea, which is expected to be operational in 2026 (Durakovic 2022). In 2023, MingYang Smart Energy unveiled plans for the MySE 18.X-28X, an 18 MW WTG with a rotor diameter greater than 280 m (919 ft) (Durakovic 2023). MingYang Smart Energy is also developing the MySE-22, a 22 MW WTG with a rotor diameter over 310 m (1,017 ft) (Blain 2023). The Chinese company CSSC Haizhuang has revealed plans for an 18 MW WTG with a 260 m (853 ft) rotor diameter (Proctor 2023). GE is also developing a 17–18 MW Haliade-X WTG (Buljan 2023).

Based on these trends in WTG development, WTGs with rotor diameters of up to 320 m (1,050 ft) are expected to be commercially available for Vineyard Northeast.

2.5 Foundation Type Selection

The Proponent assessed the feasibility of various foundation concepts based on numerous considerations:

- **Technical considerations:** The Proponent evaluated potential foundation types' ability to support the size of WTGs, ESP(s), and booster station under consideration based on site-specific geological, meteorological, and oceanographic conditions (including water depths).

- **Logistical considerations:** The Proponent assessed trends in vessel size and crane capacity. The Proponent also considered the availability of suitable ports within reasonable proximity to the Lease Area and the fabrication requirements for each foundation type.

- **Commercial considerations:** The Proponent assessed the commercial availability and cost of each potential foundation type as well as the maturity of the supply chain.

- **Environmental considerations:** The Proponent considered the potential environmental impacts (e.g., noise generated during installation, area of seafloor disturbance) and benefits associated with each foundation type.

Based on these considerations, the Proponent is including monopile and piled jacket foundations in the PDE (see Section 2.5.1). As discussed in Section 2.5.2, the Proponent critically evaluated suction bucket foundations and determined that, at present, they are neither commercially nor technically viable for Vineyard Northeast due to the lack of a robust global supply chain and because there is a lack of confidence in the feasibility of suction buckets for the size of WTGs expected to be commercially available at the time of development. Thus, suction bucket foundations are not included in the PDE. Gravity base foundations and floating foundations are similarly not under consideration for Vineyard Northeast (see Sections 2.5.3 and 2.5.4). Each foundation type is illustrated on Figure 2.5-1 and discussed further below.[17]

2.5.1 Piled Foundations

As further described in Section 3.3, a monopile is a single large steel pile that is driven into the seabed whereas a piled jacket consists of a steel jacket structure that is secured to the seafloor using multiple pin piles. Monopile and piled jacket foundations are proven WTG and ESP foundation technologies that are already being employed in offshore wind projects in the United States (US), including the Block Island Wind Farm, Coastal Virginia Offshore Wind pilot project, South Fork Wind Farm, and Vineyard Wind 1 (Buljan 2021; Dominion Energy 2021; Power Technology 2016; NYSERDA 2023).

Globally, monopiles are the dominant foundation type. Of the ~59 gigawatts (GW) of offshore wind capacity operating worldwide at the end of 2022, ~35.5 GW (over 60%) were installed on monopile foundations (DOE 2023). Jackets are the second most common foundation type, serving as the foundation type for approximately 10% of the global offshore wind capacity operating at the end of 2022 (DOE 2023). As such, the global offshore wind supply chain is largely geared towards monopiles and piled jackets. Since monopiles and piled jackets are a mature, commercially available technology and initial survey data collected for the Lease Area indicate that conditions are favorable for the installation of monopiles and piled jackets, the PDE includes both monopile and piled jacket foundations.

The maximum dimensions of monopile and piled jacket foundations included in the PDE are provided in Section 3.3.5 for the WTGs and Section 3.4.2 for the ESP(s) and booster station. The maximum WTG foundation dimensions are based on conceptual foundation designs to support the largest WTGs under consideration for Vineyard Northeast (see Section 2.4). The final dimensions of the foundations at each position will be determined using iterative modeling of environmental loads and loads from the candidate WTG designs based on detailed oceanographic, meteorological, geophysical, and geotechnical data for the Lease Area.

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[17] Bottom-frame foundations, also known as tripods, are triangular space-frame type structures that can be secured to the seafloor using driven piles, gravity pads, or suction buckets. Suction bucket and gravity pad bottom-frame foundations are not included in the PDE for the reasons described under Sections 2.5.2 and 2.5.3. Piled bottom-frame foundations are not included in the PDE due to the immaturity of the technology.

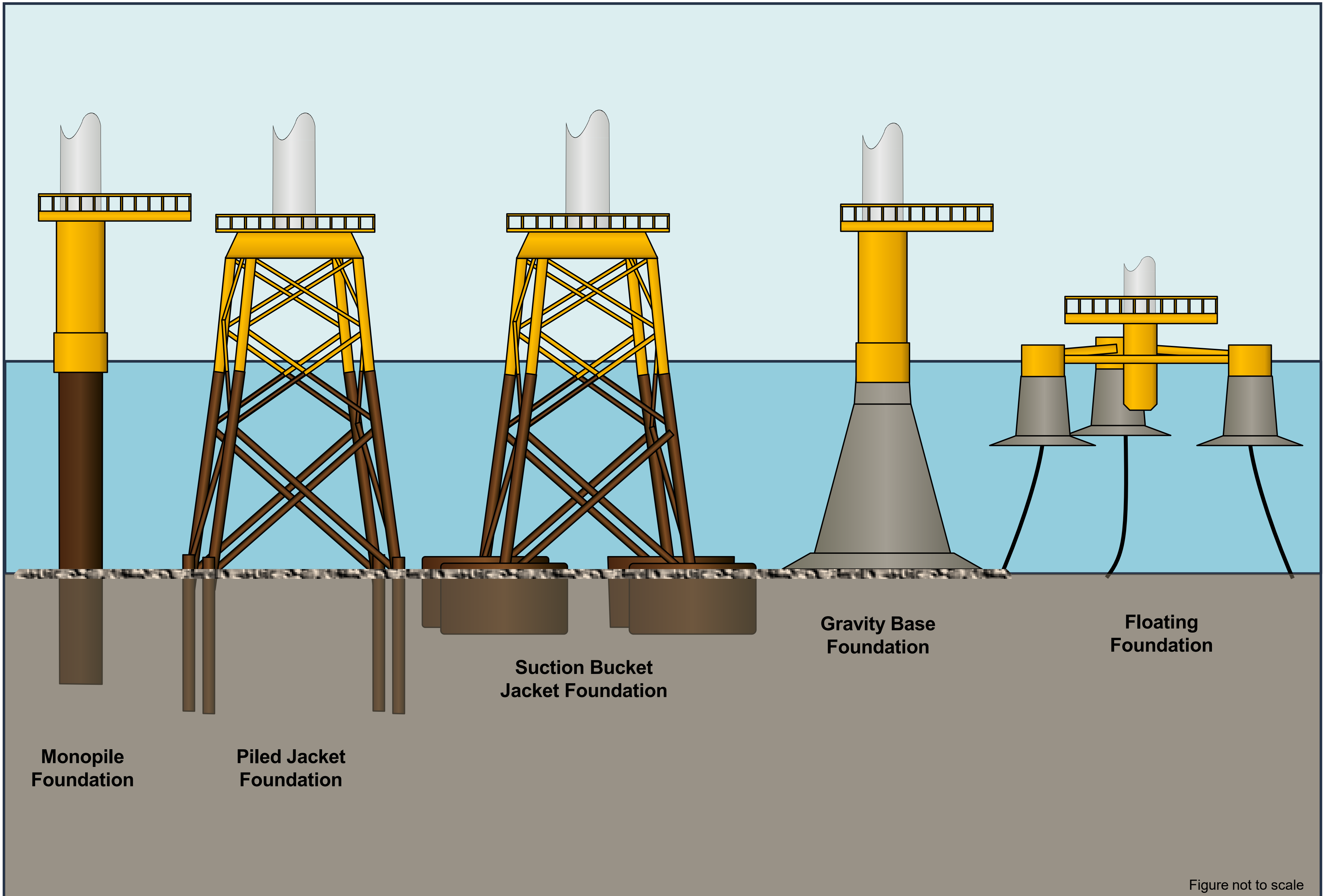

Figure 2.5-1
Potential Foundation Types Considered

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2.5.2 Suction Bucket Foundations

Suction bucket foundations were critically evaluated but are not included in the PDE for the reasons described below.

Suction bucket foundations are secured to the seafloor using suction buckets rather than driven piles. Suction buckets, also referred to as suction caissons, are large, inverted steel buckets located at the base of the foundation. During installation, pumps attached to the top of each bucket remove water from the bucket's interior, which reduces the pressure inside the bucket and creates a driving force that embeds the bucket into the seabed. The pumps can be installed on top of the suction bucket before it is lowered to the seabed or attached by a remotely operated vehicle (ROV) after the foundation is placed on the seabed. Once the buckets are fully embedded (when the pressure within the bucket equals the soil resistance), the pumps are removed. Any remaining interstitial space between the top of the bucket and seafloor may be filled with grout, sand, and/or concrete.

Relative to piled foundations, suction bucket foundations have less acoustic impacts during installation but typically occupy a larger footprint, require more seafloor preparation (i.e., dredging) and disturbance, and require a larger scour protection area. Suction bucket foundations are also more difficult to site because they are wider and require a large level seafloor surface with no boulders. The risk of encountering installation issues (e.g., hitting a boulder, encountering variable sediments) is also higher since the foundation is in contact with a greater volume of sediments.

Suction bucket foundations are a relatively immature technology and, at present, the use of suction buckets in offshore wind projects is limited. There have been a few small demonstration projects using suction bucket jackets in Europe: Ørsted's Borkum Riffgrund I (one position), Ørsted's Borkum Riffgrund II (20 positions), and Vattenfall's Aberdeen Offshore Wind Farm (11 positions) (Ørsted 2018). Although these demonstration projects were ultimately installed, they faced challenges, resulting in the cancellation of a planned deployment by Ørsted at the Hornsea One offshore wind farm. The installation of a suction bucket foundation (a mono-bucket) at the Deutsche Bucht offshore wind farm in the German North Sea was also abandoned due to technical issues during installation, which caused significant financial losses. More recently, in April 2023, the Seagreen offshore wind farm completed the installation of 114 suction bucket jackets in the North Sea (Offshore Engineer 2023). However, these foundations will support 10 MW WTGs, which are considerably smaller than the WTGs expected to be commercially available for Vineyard Northeast's expected development timeframe (see Section 2.4). Therefore, there is a lack of confidence in the feasibility of suction buckets for the size of WTGs under consideration for Vineyard Northeast.

Suction buckets are considerably more expensive than piled foundations due to the amount of steel required and the complexity of the fabrication process. Given suction buckets' limited track record and their significant cost, many manufacturers, developers, and financial institutions view suction buckets as riskier investments and are unwilling to spend money, time, and resources in further developing and improving the foundation technology or the required manufacturing facilities and staging areas. Consequently, the supply chain outlook for suction bucket foundations is highly uncertain and the Proponent cannot predict with any level of confidence whether suction buckets would be commercially available or economically feasible at the time of construction. Furthermore, it would be challenging to finance a project using suction bucket foundations because investors are less willing to support large-scale projects that use riskier, less proven technologies, when other investment opportunities using more reliable technology are available.

After careful consideration, the Proponent determined that suction bucket foundations are neither commercially nor technically viable for Vineyard Northeast.

2.5.3 Gravity Base Foundations

A gravity base foundation is a heavy foundation that sits directly on the seafloor. Gravity base foundations, which are typically much larger than piled or suction bucket foundations, are stable simply due to their weight and design and require no piles or suction buckets. The installation of gravity base foundations would require substantial dredging to remove soft sediments, which are prevalent throughout the Lease Area, followed by leveling and the installation of a large gravel bed to provide a strong flat surface to support and distribute the foundation's considerable weight. Relative to piled foundations, gravity base foundations have less acoustic impacts during installation but require more seafloor disturbance and a larger scour protection area. Like suction buckets, gravity base foundations are more difficult to site because they are wider and require a large and level seafloor surface.

Given their size and weight, gravity base foundations would likely need to be assembled at a US staging port and transported by barge or floated out to the Lease Area using tugboats. Once at the Lease Area, gravity base foundations would be ballasted into position. Staging gravity base foundations from a US port would require an extremely large laydown area proximate to the shoreline with sufficient load bearing capacity. Existing ports on the East Coast would likely require substantial upgrades to accommodate gravity base foundation staging. Floating gravity base foundations to the Lease Area using tugboats would also require staging areas with a deep quayside and access to the ocean via a wide and deep channel. Transporting gravity base foundations by barge would require the use of cranes with an extremely high lifting capacity. Without detailed engineering, it is uncertain whether even the largest cranes in existence today would be able to lift the size of gravity base foundations that would be required for Vineyard Northeast. Overall, there would be significant lead times and excessive costs to establish suitable port facilities and transport gravity base foundations to the Lease Area.

Gravity base foundations are not commercially feasible given their significant cost relative to other foundation types. At the same time, gravity base foundations have a very complex and globally untested logistics solution, especially when compared to monopiles. Of the ~59 GW of offshore wind capacity operating at the end of 2022, only ~816 MW (1.4% of the global capacity) were installed on gravity base foundations (DOE 2023). These gravity base foundations were primarily installed during the early years of the offshore wind energy industry to support relatively small WTGs at shallow sites in benign wave climates, particularly in the Baltic Sea. Since then, their use has become less frequent as the economic and practical benefits of other foundation types (particularly monopiles) have become more widely appreciated. As gravity base foundations have had limited application, particularly in recent years, supply chains are not readily available. Furthermore, gravity base foundations have only been used in water depths of up to approximately 30 m (98 ft) whereas the Lease Area is relatively deep, with water depths ranging from approximately 32 to 64 m (105 to 210 ft). For all these reasons, the Proponent concluded that gravity base foundations are neither technically nor commercially viable for Vineyard Northeast.

2.5.4 Floating Foundations

Floating foundations consist of a buoyant platform secured to the seafloor using mooring lines and anchors. Floating foundations are a relatively immature technology and have not been widely deployed for commercial-scale offshore wind projects. By the end of 2022, the global floating offshore wind energy capacity (~123 MW) only represented 0.2% of the ~59 GW of offshore wind projects installed worldwide (DOE 2023). The majority of floating WTG foundations installed thus far have been prototypes or pilot projects. These prototypes and pilot projects are being designed and tested primarily for water depths exceeding approximately 60 m (197 ft) where fixed foundation types (e.g., piled foundations, gravity base foundations) become less feasible due to their required weight and size. Floating foundations are significantly more expensive than fixed foundations. Since floating foundations are still in the early stages of development and because water depths at the Lease Area are too shallow to justify the additional engineering and costs associated with the foundation type, floating foundations are neither technically nor commercially viable for Vineyard Northeast.

2.6 Transmission Technology

The decision of whether to use high voltage direct current (HVDC) or HVAC transmission technology to deliver power from the offshore renewable wind energy facilities towards shore is primarily driven by the rated capacity of the facilities, the distance to the POI, supply chain constraints, and the potential for shared offshore transmission facilities.

HVAC transmission technology is a well-established and mature technology for transmitting bulk power from offshore wind projects located within approximately 100 km (60 mi) of the onshore substation. Most offshore wind projects constructed to date are located close enough to shore to use HVAC transmission systems. The primary advantage of HVAC export cables is that the associated ESP and onshore substation do not require additional converter equipment (to convert between alternating current and direct current) and are less expensive. However, as HVAC export cables increase in length, they produce larger amounts of capacitive reactive power (unusable electricity), which decreases the transmission capacity of the cables. Given the distance of the Lease Area from the POIs (see Section 2.7), HVAC export cables would exceed the "critical length" where there is little to no capacity left for active power transmission. Therefore, in order to use HVAC export cables, the Proponent would need to install a booster station midway along the offshore export cables to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity. The additional costs associated with the booster station reduce the economic advantages of using HVAC transmission technology.

HVAC export cables' transmission losses also increase exponentially with voltage. Additionally, HVAC export cables are typically more expensive and heavier than HVDC cables, which makes installation more challenging and decreases the length of cable that can be transported (resulting in more cable joints, slower installation, and higher risk of failure). For these reasons, as the rated capacity of a wind farm increases, which increases the number of cables and/or the cable voltage required to transmit an increasing amount of power to shore, HVDC transmission technology becomes more cost competitive. Multiple offshore and onshore HVDC transmission systems are successfully in operation worldwide.

Because the market is trending towards larger, higher capacity projects, the Proponent expects that the capacity of Vineyard Northeast will be large enough to justify the use of HVDC transmission technology. However, the Proponent is retaining the option to use HVAC export cables to deliver power to a POI in Massachusetts, via a booster station, should the Proponent develop a smaller capacity project. See Section 3.4 for further discussion of the booster station and Section 3.5 for additional description of HVDC and HVAC offshore export cables.

2.7 Identification of Potential POIs and Onshore Siting

There are a limited number of POIs near the coast that can accommodate the power generated by Vineyard Northeast, especially given the demand for interconnection points from other offshore wind developers and power producers. The Proponent performed a comprehensive screening analysis of potential POIs in the Northeast based on:

- the POIs' proximity to the Lease Area;
- the POIs' technical attributes, such as voltage, injection capability/headroom, existing transmission infrastructure, the extent of upgrades required to accommodate Vineyard Northeast's interconnection, and room at the site for potential expansion;
- upgrades planned and/or proposed by other entities (e.g., electric distribution companies) at the POIs and surrounding electric grid;
- the technical, commercial, and development risks associated with siting, permitting, and constructing the infrastructure necessary to access each POI;
- consideration of potential impacts and/or benefits to host community(ies);
- availability of substation property within reasonable proximity to the POIs or associated onshore cable routes;

- an evaluation of existing large generator interconnection requests filed in the Independent System Operator's queues at potential POIs; and

- upcoming offshore wind solicitations and anticipated market demand.

In Massachusetts, power from Vineyard Northeast will be delivered to one of three potential POIs: the existing 115 kV Pottersville Substation in Somerset, a planned 345 kV substation near Brayton Point in Somerset, or the existing 115 kV Bell Rock Substation in Fall River. The Proponent is retaining three potential Massachusetts POIs in the Construction and Operations Plan (COP) given the uncertainty regarding the timing and extent of planned/proposed upgrades to the Southern Massachusetts electric grid and because the Proponent's transmission studies and detailed electrical analyses are ongoing. At this time, the Pottersville POI is preferred because preliminary engineering studies indicate that it is technically feasible to deliver the desired capacity to the POI and there is greater certainty regarding the extent of upgrades required at the POI. Preliminary engineering studies have identified technical challenges with delivering a higher capacity project to the Bell Rock POI and the design of an interconnection at the Brayton Point POI depends on future upgrades to the regional electric grid, which is beyond the Proponent's control; for these reasons, the Bell Rock and Brayton Point POIs are less preferrable. In Connecticut, power from Vineyard Northeast will be delivered to the existing 345 kV Montville Substation in Montville. The proposed POIs are further described in Section 3.8.

After identifying the POIs, the Proponent identified potential landfall sites near the POIs based on the following criteria:

- **Cable route length:** The Proponent prioritized landfall sites that would allow for shorter onshore and offshore cable routes to minimize onshore traffic impacts, disturbance to nearby residences and businesses, seafloor disturbance, impacts to mariners and fisheries, installation and operational costs, and transmission line losses.

- **Sensitive habitats:** To the extent feasible, landfall sites were selected to avoid or minimize disturbance to sensitive habitats (onshore and nearshore), including mapped eelgrass habitat, wetlands, and wildlife management areas. The Proponent prioritized sites in previously disturbed areas (e.g., parking lots) to avoid disturbance to beach and dune habitat. To further avoid or minimize impacts to the beach, intertidal zone, and nearshore areas, the Proponent intends to use horizontal directional drilling (HDD) to bring the offshore export cables onshore at the landfall site (see Section 3.7.3). Therefore, the Proponent focused on identifying landfall sites that are suitable for HDD (see "onshore space constraints" below).

- **Onshore space constraints:** Landfall sites must be located sufficiently close to the shoreline so that they can be reasonably accessed by cable installation techniques and have sufficient open space to accommodate the installation of underground transition vault(s) (where the offshore cables connect to the onshore cables). Consequently, sites without existing aboveground structures or conflicting subsurface infrastructure are preferred. Because the Proponent intends to use HDD, the landfall sites require sufficient space to accommodate the HDD staging area (see Section 3.7.3). Landfall sites also require clear egress onto a road of sufficient width to accommodate the onshore cables' duct bank.

- **Nearshore water depths and geologic conditions:** Landfall sites with water depths that are deep enough to accommodate a cable laying vessel close to shore are preferred. Landfall sites with sediment types and shoreline geometry that are suitable for HDD are also preferred.

- **Surrounding uses:** The Proponent selected sites in public areas to minimize disturbance to residential areas. The Proponent also prioritized landfall sites in areas of seasonal use, rather than year-round use, to avoid and minimize temporary construction-period impacts to the public.

Once potential landfall sites were identified, the Proponent developed potential onshore cable routes to connect the landfall sites to the POIs. The onshore cable routes are sited primarily within public roadway layouts or existing utility rights-of-way (ROWs) (i.e., within previously disturbed areas) to minimize disturbance to terrestrial wildlife and habitat as well as cultural resources. To the extent practicable, the Proponent designed the onshore cable routes to minimize the route length and associated temporary construction impacts, avoid wetlands, enable technically feasible crossings of major roadways, railroads, and waterbodies, and reduce the number of sharp turns (which are more challenging and costly to construct). Areas of expected high underground utility congestion were avoided because they result in higher construction costs, an increased risk of damage to existing facilities during construction, and a higher risk of damage and localized overheating of the Proponent's cables. The specific landfall site and onshore route selection processes for Massachusetts and Connecticut are discussed in greater detail below.

2.7.1 Massachusetts Landfall Sites and Onshore Cable Routes

A landfall site at the Horseneck Beach State Reservation in Westport, Massachusetts, shown on Figure 2.2-3, provides the most direct onshore cable route to the potential Massachusetts POIs. Landfall sites west of Horseneck Beach were not considered because the corresponding onshore cable routes would be unnecessarily long to circumvent the West Branch of the Westport River and/or would cross into Rhode Island, adding additional permitting complexities. Landfall sites immediately to the east of Horseneck Beach would require the onshore cable routes to traverse Mass Audubon's Allens Ponds Pond Wildlife Sanctuary and/or require the offshore cables to cross Aquaculture Areas east of Gooseberry Island. Any other potential landfall sites farther east within Buzzards Bay would increase the length of the onshore cable routes and/or the length of the offshore cable routes. As such, landfall sites east of Horseneck Beach State Reservation were eliminated from consideration.

The Proponent first identified the two shortest onshore cable routes that are primarily within public roadway layouts and utility ROWs to connect the Horseneck Beach Landfall Site to the Bell Rock POI. The Proponent then identified several onshore cable route variants to facilitate interconnection at the Pottersville or Brayton Point POIs. The siting of these variants considered roadway layout space constraints, environmental resources (e.g., wetlands, rare species habitats), cultural resources, adjacent land uses, and the technical feasibility of the Taunton River, Interstate 195, and railroad crossings. The Proponent is including several potential Massachusetts onshore cable routes in the COP (see Figure 2.2-3) to provide flexibility should detailed engineering determine that one of the route segments is technically challenging, to allow for the analysis of alternatives during the permitting process, and because the Massachusetts POI has not been selected. The Horseneck Beach Landfall Site and the Massachusetts onshore cable routes are further described in Sections 3.7.1 and 3.8.1, respectively.

2.7.2 Connecticut Landfall Sites and Onshore Cable Routes

Based on the siting criteria described above, the Proponent initially identified several potentially suitable landfall sites in Connecticut (see Table 2.7-1 and Figure 2.7-1).

Table 2.7-1 Potential Connecticut Landfall Sites

Landfall Site	Location
Esker Point Beach Landfall Site	Groton, Connecticut
Bayberry Lane Landfall Site	Groton, Connecticut
Eastern Point Beach Landfall Site	Groton, Connecticut
Montville Landfall Site	Montville, Connecticut
Ocean Beach Landfall Site	New London, Connecticut
Millstone Landfall Site	Waterford, Connecticut
Niantic Beach Landfall Site	East Lyme, Connecticut

The Bayberry Lane Landfall Site is located at the Bayberry Lane Boat Launch near Baker Cove. At the site, shallow water depths persist for at least 2.4 km (1.5 mi) from shore, which would likely require the cable installation vessel to remain far offshore and the cables would either need to be brought towards shore by barge or floated in (although the distance may be too far to float the cables in). In addition, there is a large marina adjacent to the landfall site. Consultations with local officials highlighted potential issues with flooding at the boat launch's parking area. Long Island Sound Blue Plan mapping indicated significant areas of submerged aquatic vegetation and commercial aquaculture beds between Pine Island and the potential landfall site. Given those issues, the technical complexity of installing cables at the site, and the considerable level of vessel traffic associated with the marina (which also increases the risk of anchor damage to the offshore cables), the Bayberry Lane Landfall Site was removed from consideration.

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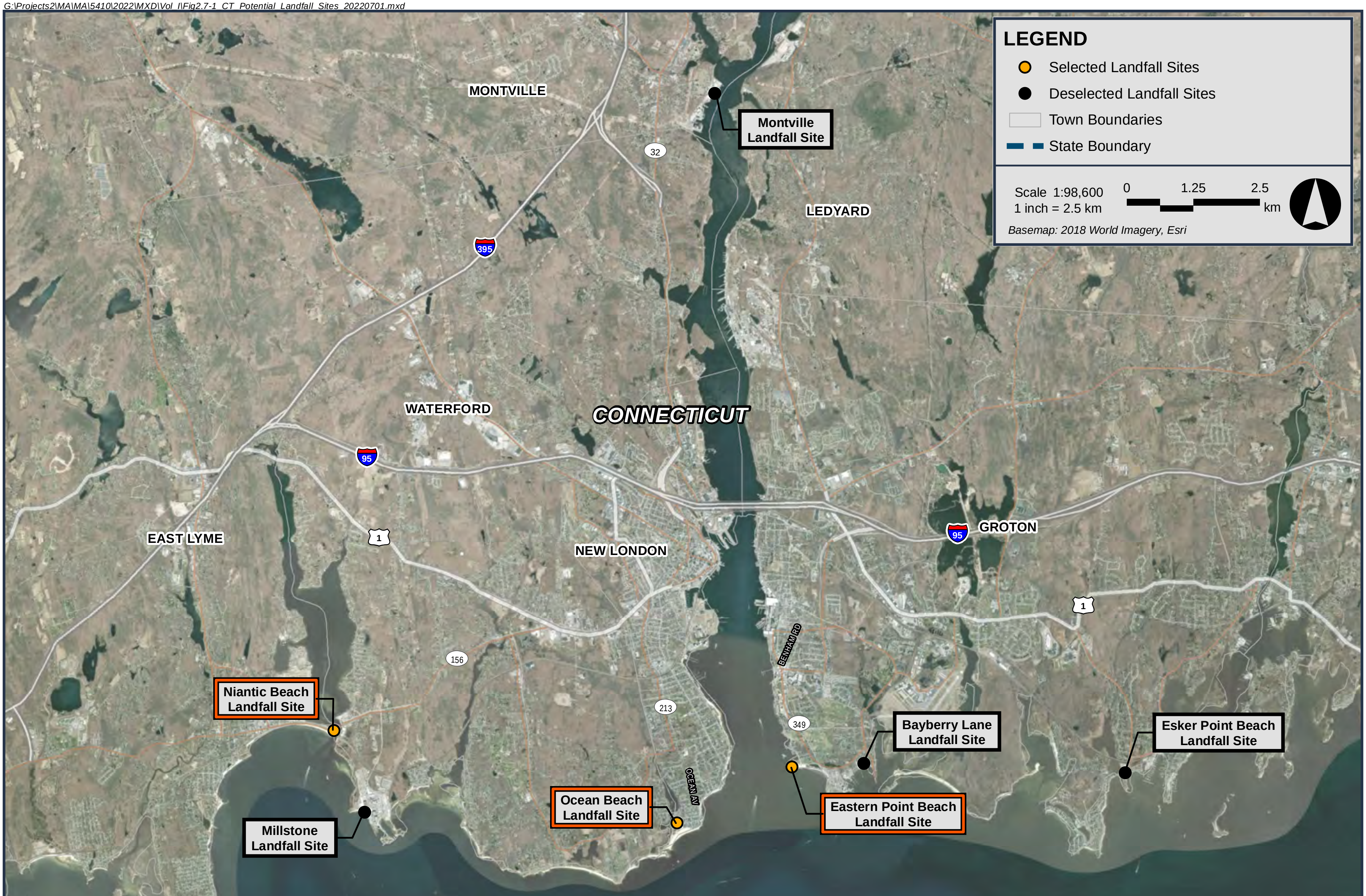

Figure 2.7-1
Potential Connecticut Landfall Sites

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The Proponent eliminated the Montville and Esker Point Beach Landfall Sites because the corresponding offshore cable routes were deselected, as further described in Section 2.8.2. The Montville Landfall Site would require the offshore export cables to be installed within the Thames River, which would be technically challenging given the level of vessel traffic, a railroad bridge in New London with limited clearance to the water, and the presence of multiple Department of Defense (DoD) and Department of Homeland Security (DHS) facilities, among other constraints. The Proponent eliminated the Esker Point Beach Landfall Site in part because the corresponding offshore cable routes would cross extensive areas of submerged aquatic vegetation and commercial aquaculture beds near the landfall site (between Ram Island and Groton Long Point). Furthermore, commercial fisheries representatives and National Marine Fisheries Service (NMFS) staff expressed broader concerns over offshore cable routing in Fishers Island Sound (see Section 2.8.2).

The Millstone Landfall Site, at the site of the Millstone Power Station, was eliminated due to permitting and logistical challenges associated with using a landfall site in close proximity to an active nuclear power plant with ongoing operational activities.

Given the complexity of routing the offshore export cables between the tip of Long Island and shore and because discussions with Connecticut agencies, municipalities, and stakeholders are ongoing, the Proponent is retaining the remaining three landfall sites (the Ocean Beach, Eastern Point Beach, and Niantic Beach Landfall Sites) in the COP. These landfall sites are further described in Section 3.7.2.

The Proponent then developed onshore cable routes for the three potential landfall sites. Although slightly less direct than an entirely in-road route, the Proponent sited the Eastern Point Beach Onshore Cable Route primarily within an existing utility ROW to consolidate infrastructure, minimize temporary onshore traffic impacts, and minimize disturbance to residences and businesses. The Ocean Beach Onshore Cable Route is designed to minimize the length of cables between the Ocean Beach Landfall Site and Montville POI, except where the route circumvents the densest parts of the City of New London. The Niantic Beach Onshore Cable Route is sited to largely follow the Ocean Beach Onshore Cable Route. An alternative onshore route from the Niantic Beach Landfall Site that followed an existing overhead transmission ROW (which originates at the Millstone Power Plant) was considered but eliminated based on consultations with ISO New England (ISO-NE) that identified potential electric grid reliability concerns stemming from siting significant additional transmission capacity in the heavily-used ROW. The Connecticut onshore cable routes are further described in Section 3.8.2.

2.8 Identification of Offshore Export Cable Corridors

To develop the OECC, the Proponent initially identified several offshore cable route concepts to connect the Lease Area to potential landfall sites in Massachusetts and Connecticut (see Section 2.7 for a description of potential landfall sites). Based on an extensive desktop assessment of publicly available data for the region surrounding the Lease Area and the coastline, the Proponent developed potential routes for further investigation via reconnaissance surveys. This desktop assessment considered mapped resources from the Massachusetts Ocean Management Plan, the Long Island Sound Blue Plan, the Northeast Ocean Data Portal, and the Mid-Atlantic Ocean Data Portal, among many other data sources. Data collected during the Proponent's reconnaissance surveys were then used to refine potential routes and delineate the Massachusetts OECC and Connecticut OECC.

The process of identifying and winnowing down potential offshore cable routes to develop the OECCs, which began in summer 2019 and lasted into spring 2022, considered numerous technical constraints and resources, including:

- **Offshore cable route length:** The Proponent prioritized shorter (i.e., more direct) routes to minimize seafloor disturbance, impacts to mariners and fisheries, installation and operational costs, and transmission line losses.

- **Water depths and geologic conditions:** Cable routes were designed to avoid deep water depths, high currents, steep seafloor slopes, and areas of coarse deposits and boulders, which make cable installation more challenging and increase the risk of cables becoming exposed over time.

- **Sensitive habitats:** To the extent feasible, routes were designed to avoid or minimize the length of cable through sensitive habitats, including mapped hard/complex bottom, whale core habitat, critical habitat for Endangered Species Act (ESA)-listed species, artificial reefs, cold water corals, and submerged aquatic vegetation and seagrass areas.

- **Existing and proposed offshore infrastructure:** The Proponent has consistently received feedback from numerous agencies and stakeholders, including fishermen, indicating that offshore wind developers should consolidate infrastructure to the extent feasible. To consolidate infrastructure, the cable routes were designed to follow other existing or proposed cables to the maximum extent possible. Routes were also designed to avoid or minimize cable and pipeline crossings, which are technically complex and likely require cable protection, and to avoid traversing other developers' lease areas.[18]

[18] The Massachusetts OECC overlaps with a small portion of Lease Areas OCS-A 0501 and OCS-A 0534 (see Section 3.5.2.1). The Proponent has a collaborative working relationship with the developers of Lease Areas OCS-A 0501 and OCS-A 0534 through Copenhagen Infrastructure Partners' joint venture with Avangrid Renewables on the Vineyard Wind 1 project.

- **Cultural resources:** The Proponent selected routes that avoid Traditional Cultural Properties. Known shipwrecks were also considered, although shipwrecks will primarily be avoided (by an appropriate buffer) through micro-siting the cables within the OECCs.

- **Socioeconomic resources:** Cable routes were sited to avoid or minimize potential impacts to areas of high commercial and recreational fishing density, aquaculture operations/shellfish beds, recreational diving areas, surfing areas, and sailing areas/races to the extent feasible.

- **Other constraints:** Cable routes were designed to avoid USCG vessel routing measures (e.g., traffic separation schemes [TSS], anchorage areas, safety fairways) or cross them perpendicularly. Federal Aids to Navigation (ATONs) were also considered, although ATONs will primarily be avoided through micro-siting the cables (within the OECC) around the ATONs in accordance with USCG's Minimum Safe Distance requirements. The routes were also sited to avoid US Army Corps of Engineers (USACE) borrow and active placement areas, dredged material disposal sites, dumping grounds, and known locations of unexploded ordnances (UXO) and/or discarded military munitions (DMM).

Although the Proponent endeavored to avoid or minimize potential impacts to the above resources to the extent possible, avoidance of all sensitive habitats and resources is not always possible.

Throughout the OECC routing process, the Proponent consulted with numerous federal and state agencies, including BOEM, NMFS (on several occasions), USACE, USCG, DHS, and the Connecticut Department of Energy and Environmental Protection (CT DEEP), as well as stakeholders (including fishermen). Agency and stakeholder outreach is further described in Section 8. The specific route selection processes for the Massachusetts OECC and Connecticut OECC are discussed in greater detail below.

2.8.1 Massachusetts OECC Routing

There are limited options for routing offshore cables between Lease Area OCS-A 0522 and the Horseneck Beach Landfall Site without crossing through several other developers' lease areas. The shortest route concept between the Lease Area and the Horseneck Beach Landfall Site travels from the northernmost corner of the Lease Area along the northeast boundary of the WEAs, south of Nomans Land, and across Buzzards Bay. Any alternative route concept, such as a route through Nantucket Sound and Vineyard Sound or a route from the southwest tip of the Lease Area to the west of the WEAs, would be prohibitively long. Routes between Martha's Vineyard and Nomans Land were not considered because they would pass through the Vineyard Sound and Moshup's Bridge Traditional Cultural Property.

The Proponent has consistently received feedback from numerous agencies and stakeholders, including fishermen, indicating that developers should consolidate infrastructure to the extent feasible. As such, the Proponent carefully studied the following initial route concepts shown on Figure 2.8-1:

- **A route east of New England Wind's South Coast Variant:** Relative to the two options below, a route paralleling New England Wind's South Coast Variant to the east would traverse through greater amounts hard bottom habitat south of Nomans Land and near the Elizabeth Islands, which would make cable installation more challenging and increase disturbance to sensitive habitats. The Proponent's outreach to fishermen indicated that this route is the least preferred option because it would pass through areas of higher commercial fishing density.

- **Routes between the South Coast Variant and SouthCoast Wind's cables:** Offshore cables must be spaced sufficiently far apart to provide flexibility for micrositing, installation tools, and future potential cable repairs. In many locations, it is technically infeasible to locate Vineyard Northeast's cables between New England Wind's South Coast Variant and SouthCoast Wind's cables given the limited distance between the other developers' cable routes. A route that is partially between New England Wind's South Coast Variant and SouthCoast Wind's cables (where there is sufficient space) would require several additional cable crossings.

- **A route west of SouthCoast Wind's cables:** A route paralleling SouthCoast Wind's cables to the west would require additional crossings of the SouthCoast Wind cables routed to Brayton Point, but would significantly reduce the length of cables through hard bottom habitat (particularly near Nomans Land and the Elizabeth Islands) and would avoid areas of higher commercial fishing density near Noman's Land. A route west of SouthCoast Wind's cables also avoids the congested area between SouthCoast Wind's cables, New England Wind's South Coast Variant, and Nomans Land and associated conflicts that could arise as those routes are refined and finalized.

As a result, the Proponent selected the route that parallels SouthCoast Wind's cable to the west for further study. The Proponent then refined the cable route by shifting the route farther west (away from Nantucket Shoals) to minimize potential temporary impacts to sea ducks during cable installation.

In spring 2022, the Proponent performed reconnaissance surveys to further refine the selected route into the Massachusetts OECC shown on Figure 2.8-1. Based on the reconnaissance surveys, an eastern route variant approximately 3 km (1.6 NM) south of the landfall site was eliminated due to its proximity to the South Coast Variant and less favorable seabed conditions (e.g., hard bottom). The Massachusetts OECC is further described in Section 3.5.2.1.

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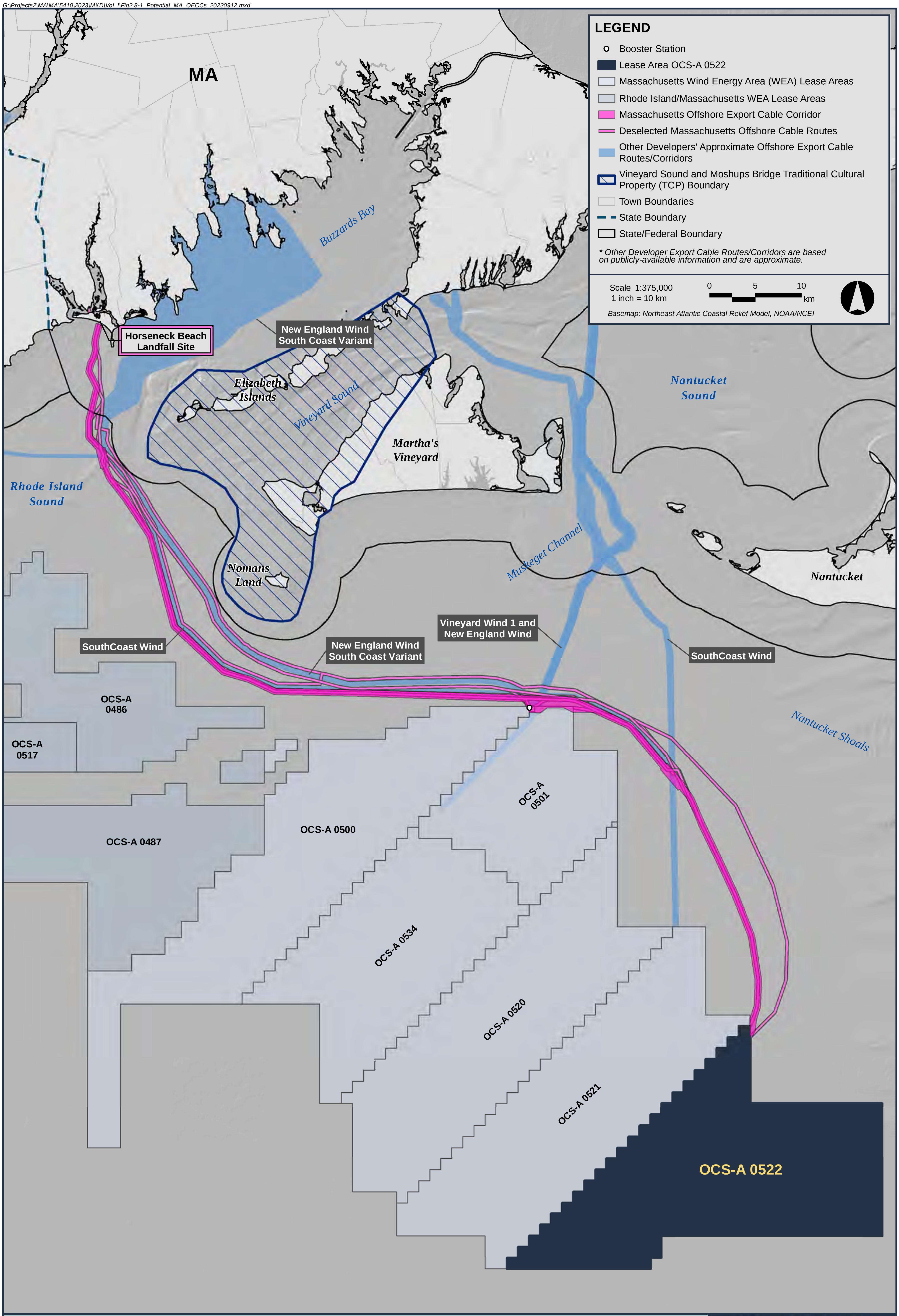

Figure 2.8-1
Potential Massachusetts Offshore Cable Routes and Selected OECC

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2.8.2 Connecticut OECC Routing

To develop initial offshore cable route concepts to Connecticut, the Proponent first identified the most direct routes between the southwest corner of the Lease Area and the potential Connecticut landfall sites, while avoiding crossing other developer's lease areas. As with the Massachusetts OECCs, the Proponent focused on consolidating its offshore export cables with the cables proposed by other offshore wind developers based on feedback from numerous agencies and stakeholders. Thus, the Proponent considered several initial route concepts that paralleled Beacon Wind's proposed cable routes between the Lease Area and the tip of Long Island (see Figure 2.8-2). Based on reconnaissance surveys for two potential routes following Beacon Wind's cables, the Proponent selected the westernmost route to minimize the length of cable through large sand bedforms, which would likely require dredging.

Between the tip of Long Island and shore, the Proponent considered numerous alternative routes into Long Island Sound and Fishers Island Sound as well as multiple options to candidate landfall sites (see Figure 2.8-2). These routing options were analyzed and refined through numerous consultations with federal and state agencies, including three consultations with NMFS and meetings with DHS, USACE, CT DEEP, University of Connecticut Avery Point staff, the Connecticut Siting Council, and the New York State Office of Parks, Recreation and Historic Preservation. Based on consultations with NMFS and their recommendations in spring 2022, the Proponent performed additional reconnaissance surveys to broaden the area of investigation to further assess routing alternatives at the entrance to Long Island Sound.

Potential cable routes between Orient Point and Plum Island (through Plum Gut) were eliminated because:

1. The high currents through Plum Gut would make cable installation extremely challenging and increase the likelihood of scour around the offshore export cables.
2. Relative to other route concepts, a route through Plum Gut is longer, crosses through greater amounts of sand bedforms and commercial fishing areas north of Gardiners Island, and would require additional crossings with other offshore wind developers' proposed cables. The route through Plum Gut would also require cable installation through a significant amount of hard bottom.
3. Based on discussions with DHS, the routes would require the crossing of surface-laid power cables (among other power and communications cables).
4. Plum Gut experiences heavy vessel traffic, particularly in the summer months, from fishing vessels, recreational boaters, and the Cross Sound Ferry between Orient Point and New London.

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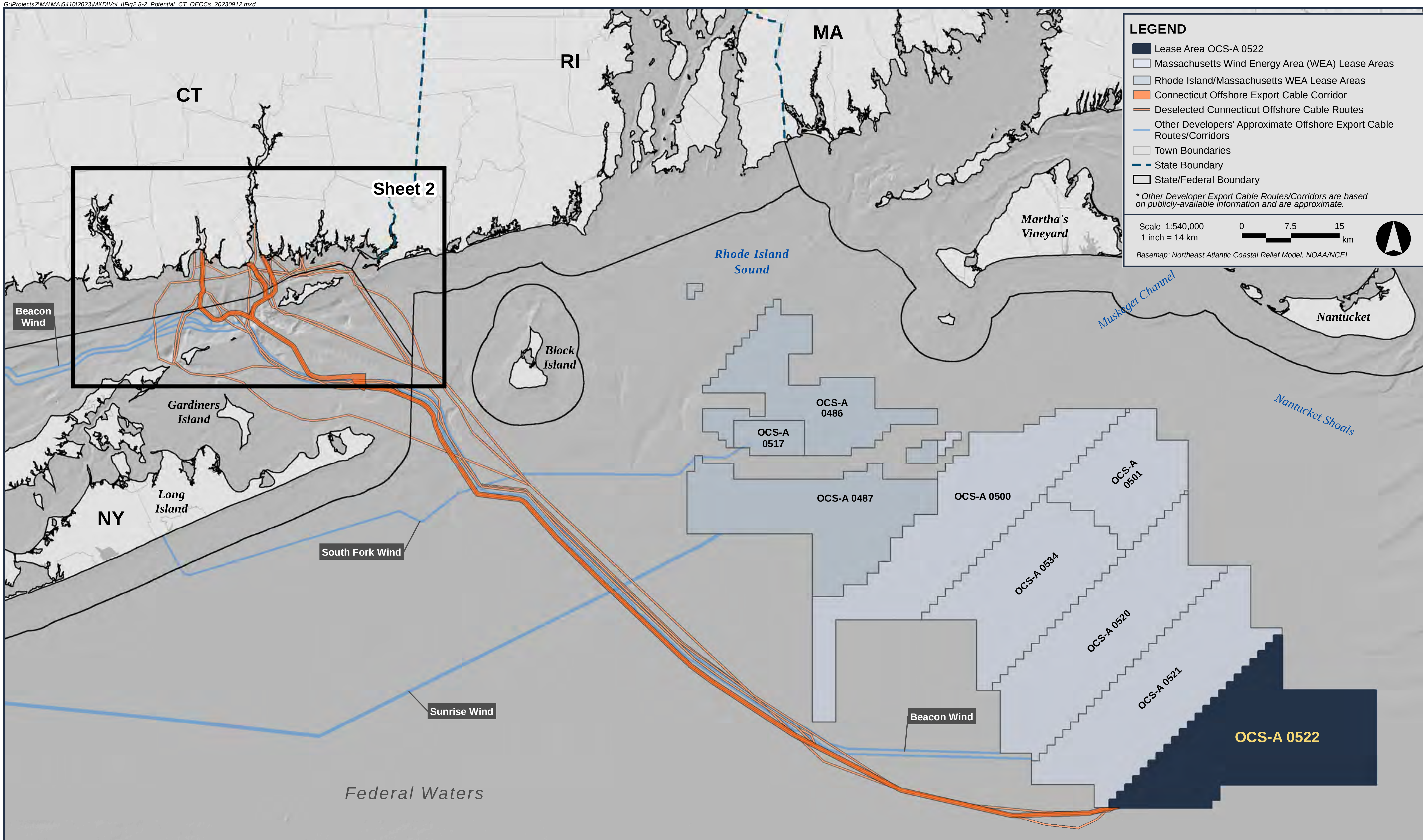

Figure 2.8-2, Sheet 1
Potential Connecticut Offshore Cable Routes and Selected OECC

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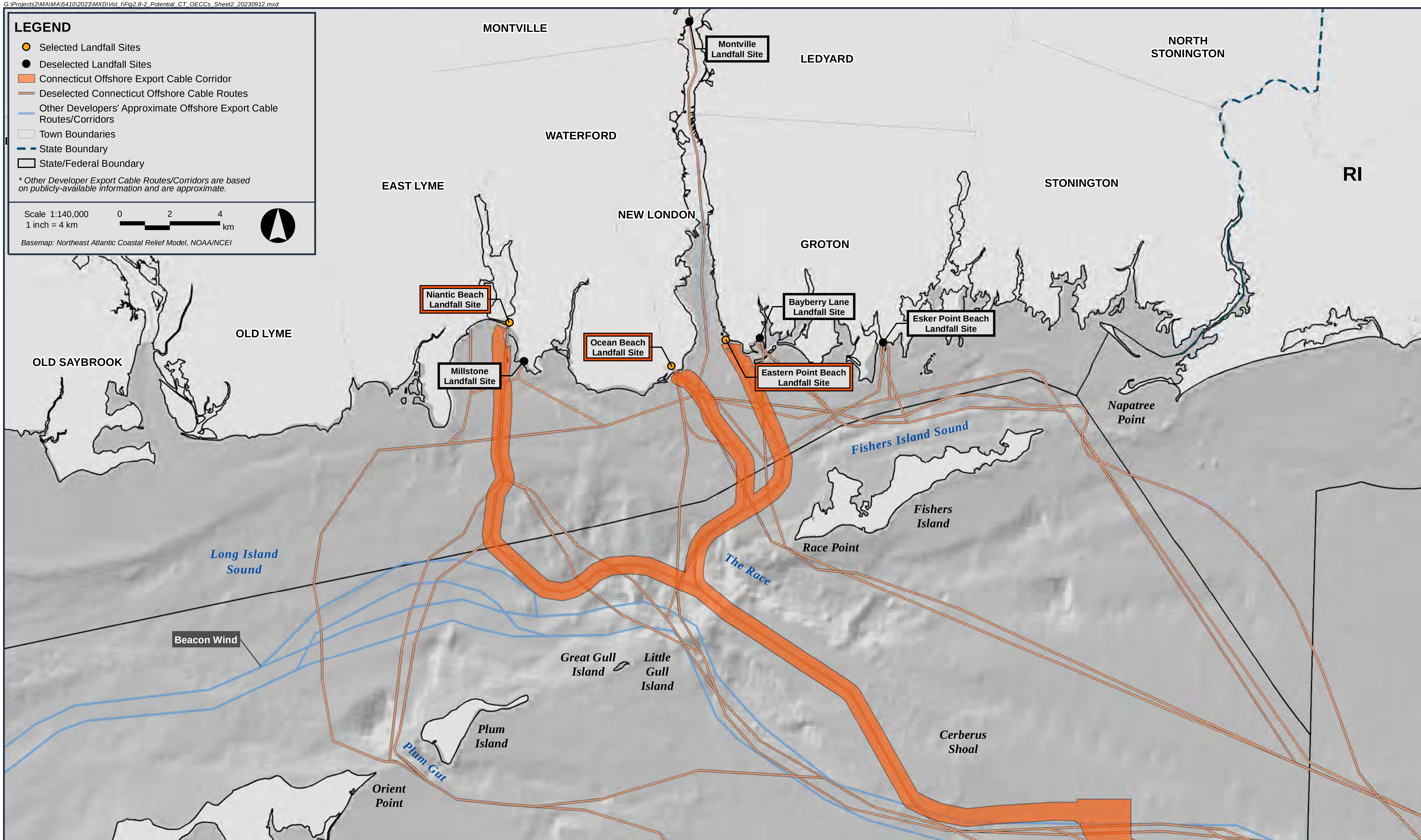

Figure 2.8-2, Sheet 2
Potential Connecticut Offshore Cable Routes and Selected OECC

Potential cable routes between Plum Island and Great Gull Island were not considered because the area identified as the Sluiceway (on National Oceanic and Atmospheric Administration [NOAA] charts) is very shallow with extensive hard bottom and rocky areas including Middle Shoal Rock, Old Silas Rock, and Beford Reef.

Potential cable routes east of Fishers Island (between the island and Napatree Point) and continuing through Fishers Island Sound were eliminated following consultations with NMFS and commercial fisheries representatives and based on further review of mapped resource data in the Long Island Sound Blue Plan. Specifically, Fishers Island Sound has extensive areas of hard/complex bottom, commercial fisheries and aquaculture, and crossings of power cables serving Fishers Island from Connecticut. In addition, the route east of Fishers Island was considered unnecessarily long given the elimination of the Esker Point Beach Landfall Site (see Section 2.7.2).

Several routing options were considered through the area centered on "the Race" (between Fishers Island and Little Gull Island). The route through the center of the Race was selected for the reasons outlined below:

- **Western side of the Race:** Potential routes on the western side of the Race (closest to Little Gull Island) were eliminated due to constraints from the proximity of an existing undersea communications cable and proposed offshore wind cable(s), steep slopes, water depths in excess of ~90 m (295 ft), and high currents, which would make cable installation extremely challenging and increase the risk of scour around the cable. Based on reconnaissance survey data, the western side of the Race also contains greater amounts of sensitive hard bottom habitat.

- **Eastern side of the Race:** Potential cable routes on the eastern side of the Race (closer to Fishers Island) and directly through the navigation channel (immediately south of Race Rock Light) were eliminated because of shallow water depths near Race Point Ledge and Race Rock Light, and due to the presence of steep slopes and deep water depths (>90 m [295 ft] in locations) within the navigation channel that make installation extremely difficult and increase the risk of cable instability post-burial. Deploying cable protection in the deepest parts of the Race is challenging; for example, concrete mattresses installed on such steep slopes in high currents can potentially overturn, become damaged, or move. Installation in greater water depths could also result in higher cable tensions and be too deep for divers to safely assist with installation and/or cable repairs. The area near Race Point also is an important recreational/sport fishing area. Finally, the USCG expressed concerns over installation within the active navigation channel.

- **Center Race:** The cable route through the center of the Race was selected, in consultation with NMFS, because the route has suitable water depths for available cable installation vessels, provides workable slopes, and minimizes disturbance to hard bottom habitat.

Southeast of the Race, the cable route was designed to avoid Cerberus Shoal (a fishing hot spot) based on feedback from fishermen. North of the Race, the cable route approaching the Ocean Beach Landfall Site was shifted to avoid closed and future dredged material disposal sites based on consultations with the USACE. The closed New London disposal site contains capped mounds of dredged material, which cannot be disturbed.[19] A cable route through the Eastern Long Island Sound Disposal Site would reduce the site's capacity, as future disposal would not be allowed over any cables installed within the area. North of the disposal sites, the Ocean Beach Approach was sited to minimize disturbance to mapped and surveyed hard bottom. The route approaching the Niantic Beach Landfall Site was shifted west to avoid submerged aquatic vegetation near Waterford Island, sited to minimize disturbance to hard bottom, and designed to be closely aligned or within the Connecticut National Estuarine Research Reserve buffer south of the landfall site.

Lastly, the Proponent eliminated the route option that travelled approximately 13 km (7 NM) up the Thames River because installation of the offshore export cables within the river would be technically challenging due to the level of vessel traffic, a railroad bridge in New London with limited clearance to the water, and the presence of multiple DoD and DHS facilities. The US Navy's Naval Submarine Base New London, a USCG station, the USCG Academy, and Electric Boat's submarine construction facility are located on the shores of the Thames. In addition, a route up the Thames River would require crossing a US Navy submarine degaussing cable. The offshore export cables would need to avoid Navy confined aquatic disposal cells in the channel, which contain capped polluted sediments. The channel is also subject to periodic dredging by USACE to maintain access. Thus, the offshore export cables would need to be located outside the channel, likely pushing the cable route into shallower waters that would require specialized cable installation equipment. Lastly, bridges over the river would limit the types of cable installation vessels that could be used.

After a lengthy and rigorous routing process (which began in summer 2019 and lasted into spring 2022), and after reaching consensus with NMFS, the Proponent identified the Connecticut OECC with three variations to connect to three potential landfall sites. The Proponent is retaining these three variations because detailed engineering of the onshore cable routes, landfall sites, and offshore cable alignments is still in process, which may demonstrate that a route is technically infeasible, and because discussions with Connecticut agencies, municipalities, and stakeholders are ongoing. The Connecticut OECC is further described in Section 3.5.2.2.

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[19] The Ocean Beach Approach of the Connecticut OECC was routed around the discontinued disposal site to the extent possible, and the offshore export cables will be micro-sited to avoid the inactive disposal site. The Proponent will coordinate with the appropriate agencies on measures to avoid or minimize potential impacts to the discontinued disposal sites.

3 Facilities and Construction

3.1 Construction Process and Schedule

There are several potential buildout scenarios for the Lease Area. The Lease Area may be built out in one continuous construction campaign or developed in multiple construction campaigns separated by one or more years. Table 3.1-1 describes the anticipated order and approximate duration of construction activities for the buildout of the entire Lease Area. There may be considerable overlap in the timeframes of the activities listed below. A representative draft construction schedule for one potential buildout scenario is provided as Figure 3.1-1.

Table 3.1-1 Anticipated Order and Duration of Construction

Activity (Listed in Anticipated Order)	Expected Duration[1,2]
1. Onshore cable installation	22 months per onshore cable route
2. Onshore substation construction and commissioning	33 months per onshore substation
3. Offshore export cable installation[3]	18 months per OECC
4. Wind turbine generator (WTG) foundation installation (including scour protection)	18 months
5. Electrical service platform (ESP) and booster station (if used) installation and commissioning	20 months
6. Inter-array cable and inter-link cable (if used) installation[3,4]	12 months
7. WTG installation and commissioning	18 months

Notes:
1. The expected durations do not account for any time of year restrictions or gaps due to weather or other construction constraints.
2. For each activity, if two vessel spreads are used (e.g., if two main installation vessels are used for WTG installation), the duration would be shorter.
3. The duration excludes pre-installation activities (e.g., pre-lay grapnel runs, pre-lay surveys).
4. Inter-array and inter-link cable installation (Step 6) could occur during or after WTG installation (Step 7).

As shown in Table 3.1-1 construction of Vineyard Northeast will likely start with the onshore facilities (i.e., onshore cables and onshore substation) so that power from the electrical grid can be used to energize and commission the offshore facilities as soon as they are installed. The timing of onshore construction activities will be coordinated with state and local agencies to avoid seasons or times of peak usage and to align with planned public works projects, where feasible, to minimize traffic disruption. Onshore construction at the landfall sites is planned to occur outside of the period from Memorial Day to Labor Day.

Offshore construction, which may start while onshore construction is ongoing, will likely begin with offshore export cable installation and foundation installation (including scour protection installation). The installation of some or all offshore export cables is prioritized so that the

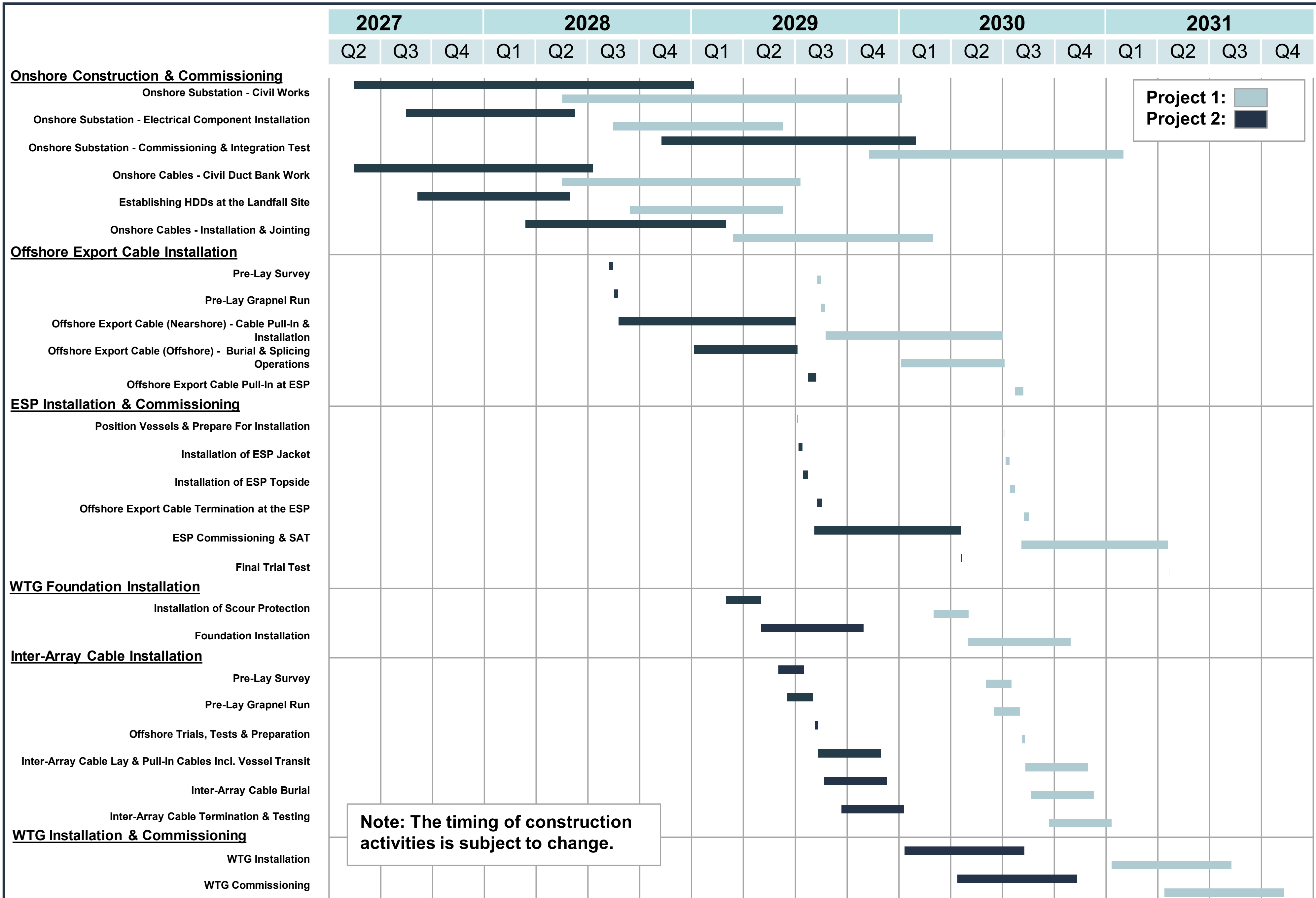

Figure 3.1-1

Representative Draft Construction Schedule

VINEYARD NORTHEAST

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electrical service platform(s) (ESP[s]) and booster station (if used) can be commissioned (a lengthy process) immediately upon installation. Once the foundations are in place, the wind turbine generators (WTGs), ESP topside(s), and booster station topside can be installed. Inter-array cables may be installed before or after the WTGs are installed on their foundations. WTG commissioning is expected to be completed after the inter-array cables are installed.

To protect North Atlantic right whale, pile driving of foundations will not occur from January 1 to April 30. The Proponent may identify additional time of year and/or time of day restrictions on certain construction activities (e.g., tree clearing, activities proximate to nesting bird habitat) in consultation with agencies and stakeholders during the permitting process.

3.2 Wind Turbine Generators

3.2.1 WTG Design

Vineyard Northeast will include up to 160 wind turbine generators (WTGs) that will generate clean, renewable electricity from offshore wind. As described in Section 2.3, the WTGs will be oriented in a grid layout with east-to-west rows and north-to-south columns with 1 nautical mile (NM) (1.9 kilometers [km]) spacing between positions (see Figure 2.3-1). The closest WTG/ESP position is approximately 49 km (31 miles [mi]) from Nantucket and approximately 63 km (39 mi) from Martha's Vineyard.

Each WTG will include three blades composed mostly of fiberglass[20] that are connected at the hub. Together, the blades and hub form the rotor. The rotor is connected to the nacelle, and the nacelle is mounted on top of the WTG tower (see Figure 3.2-1). The steel tower, which is typically constructed in two or more sections, is mounted on a foundation (see Section 3.3 for a description of WTG foundations).

Depending on the WTG type selected, the rotor may be connected to the electrical generator directly (i.e., a direct-drive system) or include a series of gears to increase the rotational speed of the generator (i.e., a gearbox). Wind sensors mounted on top of the nacelle automatically control the yaw and pitch systems. The yaw system turns the nacelle into the wind to maximize power production and out of the wind to maintain the WTG's safety in high winds. The blade pitch controllers adjust the angle of the blades to optimize power production while minimizing loads under existing weather conditions. Power produced by the WTG's generator is converted to match the inter-array cables' voltage by transformers, a power converter, and switchgear.

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[20] Recyclable blades are under development and may be used for Vineyard Northeast if such technologies are technically feasible and commercially viable at the time of procurement.

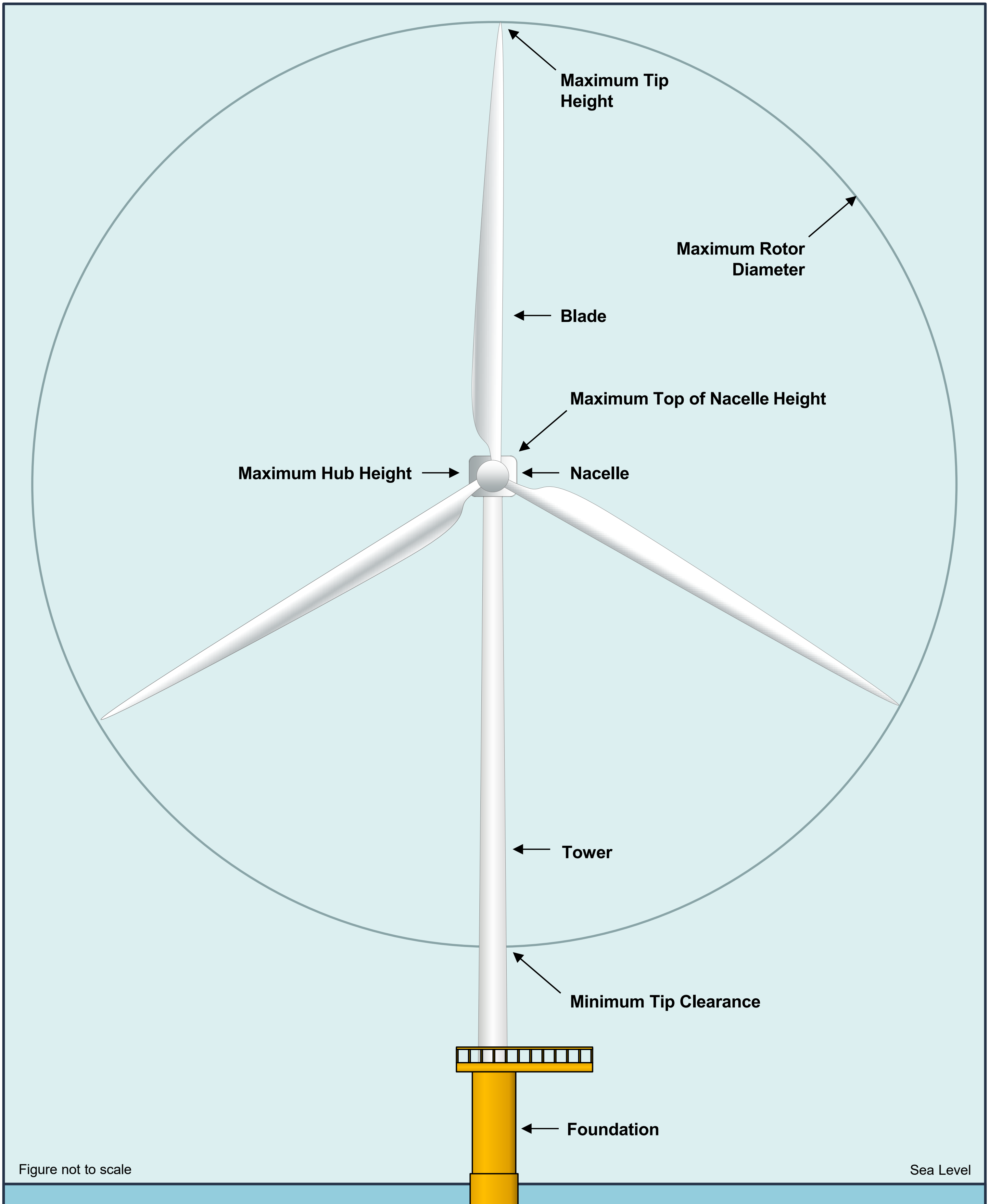

Figure 3.2-1
Wind Turbine Generator

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The electrical generator, drivetrain, brake, and motors that yaw and pitch the WTG are contained within the nacelle's housing, which provides protection from the weather (including lightning). The nacelle also contains a full array of instrumentation, controls, fire protection systems and other safety equipment, ventilation and cooling systems, an auxiliary crane, ancillary equipment, and workspace for technicians. The power converter, transformers, and switchgear may be located in the nacelle, inside the WTG tower, on top of the WTG foundation platform, or inside the WTG foundation. The WTGs will likely include batteries to provide standby/emergency power.

To facilitate the potential use of electric/hybrid vessels for construction and operations and maintenance (O&M) activities and reduce vessel emissions, the WTGs may be equipped with equipment to charge electric/hybrid vessels offshore. If employed, it is anticipated that technicians working at the WTG would lower a charging cable from the WTG's foundation platform to a vessel operating on dynamic positioning (DP). Once connected, the power from the cable would support the vessel's idling electrical load or charge the vessel's batteries. Once the charging cable is disconnected, it would be retracted back onto the WTG foundation platform.

During commissioning and maintenance, technicians will likely access the WTGs via a door at the base of the tower. An elevator designed to carry personnel, tools, small equipment, and small spare parts will serve as the main access route. Ladders will serve as a secondary access route. In addition, a helihoist platform may be located on top of the nacelle to allow technicians to access and evacuate the nacelle via helicopter.

The Project Design Envelope (PDE) for the WTGs is provided in the table below.

Table 3.2-1 PDE of WTG Dimensions

Dimension[1]	Project Design Envelope
Maximum rotor diameter	320 meters (m) (1,050 feet [ft])
Maximum tip height above Mean Lower Low Water (MLLW)	400 m (1,312 ft)
Maximum top of nacelle height above MLLW[2]	249 m (817 ft)
Maximum hub height above MLLW	240 m (787 ft)
Minimum tip clearance above MLLW	27 m (89 ft)
Maximum nacelle dimensions (length x width x height)	36 m x 17 m x 17 m (118 ft x 56 ft x 56 ft)
Maximum blade chord	10 m (33 ft)
Maximum tower diameter	11 m (36 ft)

Notes:
1. MLLW is the average height of the lowest tide recorded at a tide station each day during the recording period.
2. Height includes Federal Aviation Administration (FAA) lights and other appurtenances.

The WTGs will be designed in accordance with industry standards such as American Clean Power Association (ACP), International Electrotechnical Commission (IEC), American Petroleum Institute (API), International Organization for Standardization (ISO), and DNV standards (see Section 3.12.1). The WTG design will be reviewed by the third-party Certified Verification Agent (CVA) to verify that the design is able to withstand the site-specific conditions (e.g., sustained wind speeds and gusts) anticipated at the Lease Area (see Section 3.12.2). The WTGs will be designed to automatically stop power production (i.e., shut down) when wind speeds exceed a maximum value, after which the rotor will normally idle. The exact speed at which power production will cease depends on the manufacturer's specifications. Both the nacelle and tower will be coated to protect against corrosion in harsh marine environments.

To aid safe navigation within the Lease Area, the WTGs and their foundations will be lit and marked in accordance with Federal Aviation Administration (FAA), United States Coast Guard (USCG), and Bureau of Ocean Energy Management (BOEM) guidelines. The WTGs (blades, nacelle, and tower) will be no lighter than pure white (RAL 9010) and no darker than light grey (RAL 7035) in color; the Proponent expects that the WTGs will be off-white/light grey to reduce their visibility against the horizon. The WTG towers (and likely the tops of the nacelle) will contain alphanumeric identifiers following the *Rhode Island and Massachusetts Structure Labeling Plot* (see Appendix I-A1). The Proponent also expects to indicate the WTG's air draft restriction on the WTG tower and/or foundation. During construction, temporary red aviation obstruction lights will be installed on each WTG once the structure reaches a height of 61 meters (m) (200 feet [ft]). Permanent lighting and marking of the WTGs during the operational period are discussed in Section 4.1.5.

3.2.2 WTG Installation and Commissioning

The WTGs will be fabricated in the United States (US) [21] or internationally. Before installation begins, WTG components are expected to be transported from the manufacturing facility to a US or Canadian staging port(s) (see Section 3.10.1) using heavy transport vessels (HTVs), modified cargo vessels, and/or ocean-going barges. Alternatively, WTG components may be delivered directly from the manufacturing facility to the Lease Area.

At the staging port(s) (if used), WTG components will be offloaded and transported from the quayside to storage using cranes and/or other shore-based equipment (e.g., self-propelled modular transporters [SPMTs]). Stockpiling WTG components at the staging port(s)will enable the Proponent to maintain a steady pace of installation activities. Some preparatory work and pre-assembly of the WTG components may occur at the staging port(s). This could include partially assembling tower structures, installing internal electrical/mechanical components,

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[21] Only if US manufacturing facilities are a viable option at the time of procurement.

mounting minor equipment and external structures, pre-commissioning, and inspections. Once these preparatory activities are complete, the WTG components will be loaded onto feeder vessels or the main installation vessel for delivery to the Lease Area. The feeder vessels would likely be jack-up vessels or tugboats and barges.

At the Lease Area, the WTGs are expected to be installed by one or two main installation vessels, which may be a jack-up, anchored, or DP vessel. The WTG components will be lifted using the main installation vessel's crane and/or a "climbing crane" that crawls up the WTG tower (using the tower for support). The tower will be erected first, followed by the nacelle, and then the rotor (hub and blades). Alternatively, the nacelle and hub could be installed in a single operation followed by the installation of individual blades. If the tower consists of multiple sections, the sections will likely be joined with a bolted connection. A support vessel (e.g., tugboat) may remain at the Lease Area during the installation process to assist the main installation vessel. Figure 3.2-2 illustrates WTG installation using a jack-up main installation vessel.

After installation, the WTGs will be commissioned. During commissioning, the WTGs will be energized using power from the electrical grid or a temporary power supply (e.g., diesel generators) and prepared for operation. The purpose of commissioning is to test electrical connections, safety and control mechanisms, and communication systems to confirm that they are functioning correctly and that the WTG is ready for energy production. The WTG commissioning phase will likely occur in parallel with the WTG installation phase. The Proponent expects to use service operation vessels (SOVs), crew transfer vessels (CTVs), and/or helicopters to transport crew to and from the WTGs during commissioning.

The maximum potential seafloor disturbance from vessels used during WTG installation and commissioning is quantified in Table 3.2-2. Any anchoring or jacking-up during WTG installation and commissioning will occur within surveyed areas of the Lease Area.

Table 3.2-2 Seafloor Disturbance During WTG Installation and Commissioning

Activity	Temporary Seafloor Disturbance
Maximum distance of vessel work zone from WTG foundation center[1]	180 m (591 ft)
Maximum area of seafloor disturbance per vessel	1,200 square meters (m^2) (0.30 acres) per jack-up vessel or 784 m^2 (0.19 acres) per anchored vessel[2]
Maximum number of times vessels jack-up and/or anchor (per WTG)	4 total
Maximum area of temporary seafloor disturbance from vessels during WTG installation and commissioning (per WTG)	4,800 m^2 (1.2 acres)

Notes:

1. The maximum depth of disturbance from vessels used to install and commission the WTGs would not exceed the foundation penetration depth (see Section 3.3.5).
2. Excludes anchor sweep, which cannot be quantified at this early stage in the construction planning process.

Figure 3.2-2
Wind Turbine Generator Installation

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3.3 WTG Foundations

The WTG foundations will provide a stable, level base for the WTG towers. Two WTG foundation concepts are included in the PDE:

- Monopiles (with or without transition pieces)
- Piled jackets

The foundation design and installation process are described for monopiles in Section 3.3.1 and for piled jackets in Section 3.3.2. Both foundation types may require some seafloor preparation prior to installation and scour protection, which are described in Sections 3.3.3 and 3.3.4. The PDE of foundation dimensions and the maximum potential seafloor disturbance for each foundation type are provided in Section 3.3.5.

3.3.1 Monopile Design and Installation

A monopile is a single, hollow cylindrical steel pile that is driven into the seabed (see Figure 3.3-1). Monopiles usually consist of several rolled steel plates that are joined together by circumferential welds. Typically, a separate steel transition piece is installed on top of the monopile. Alternatively, the monopile length can be extended to the interface with the WTG tower, which is referred to as an "extended monopile" (see Figure 3.3-1).[22] The transition piece or top of the extended monopile contains a flange for connection to the WTG tower. Ancillary structures such as boat landing(s), ladders, work platforms, electrical equipment, and various ancillary equipment (e.g., cranes) will be located inside or outside of the transition piece or extended monopile. The base of the monopile will have j-shaped steel tubes (i.e., J-tubes) or an opening to allow the inter-array cables to enter and exit the foundation safely.[23] The foundation is expected to include an anode cage (a steel structure that has anodes attached to it) to provide corrosion protection. See Section 3.3.5 for the PDE of monopile dimensions.

The transition pieces or tops of the extended monopiles will be lit and marked in accordance with USCG and BOEM guidelines to aid marine navigation. Based on current guidance, the Proponent expects to paint each foundation (above sea level) in high visibility yellow paint. The foundations may also include alphanumeric identifiers and indicate the WTG's air draft restriction. During construction, the Proponent expects to install temporary yellow flashing

[22] This concept is also known as a "transition piece (TP)-less" monopile.

[23] If ESP equipment is integrated onto the WTG's expanded foundation platform (see Section 3.4), export cables may exit the base of the foundation.

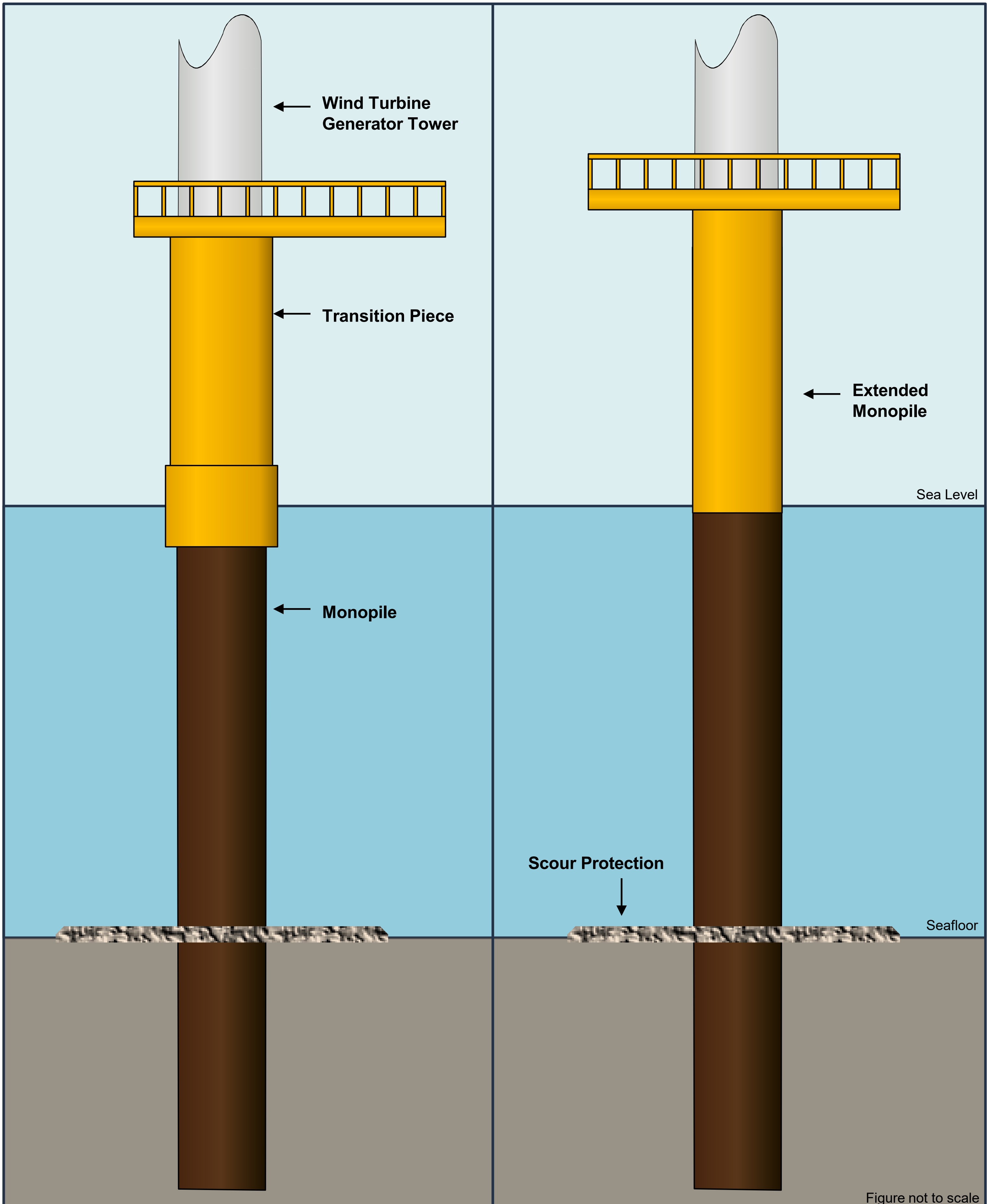

Figure 3.3-1
Monopile Foundation

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marine navigation lights near the tops of the foundations[24] that are visible in all directions at a distance of 5 NM (9.3 km). Permanent lighting and marking of the foundations are further described in Section 4.1.5.

Monopiles and transition pieces will be fabricated internationally or in the US.[25] After fabrication, the monopiles and transition pieces (if used) will be transported directly to the Lease Area or to US or Canadian staging port(s) (see Section 3.10.1) for final assembly and temporary storage. If monopiles and transition pieces are staged at US or Canadian port(s), equipment such as crawler cranes or SPMTs will be used to unload, transport, and load foundation components onto vessels. Depending on the location of fabrication and any subsequent staging activities, foundation components may be transported to the staging port(s) or the Lease Area by heavy lift vessels (HLVs), HTVs, ocean-going barges, modified cargo vessels, jack-up feeder vessels, and/or smaller feeder barges. The monopiles may also be floated out to the Lease Area using tugboats.

Seabed preparation may be required prior to monopile installation. Scour protection will likely be installed at the base of the monopile before and/or after the foundation is installed to minimize sediment transport and erosion. Seabed preparation and scour protection installation are discussed further in Sections 3.3.3 and 3.3.4, respectively.

The monopiles will be installed by one or two jack-up vessels or HLVs using DP or anchors. The main installation vessel(s) may remain at the Lease Area[26] while other vessels provide a continuous supply of foundations to the Lease Area. A tugboat may also remain at the Lease Area to assist transport vessels' approach to the main installation vessel. Alternatively, the foundation components could be picked up directly in a US port (if Jones Act compliant vessels are available) or Canadian port by the main installation vessel(s). The method of transporting and installing foundation components will be based on supply chain availability and final contracting.

At each foundation position, the main installation vessel will use a crane to upend and lower the monopile to the seabed (see Figure 3.3-2 for images of foundation installation). If a separate transport vessel is used, it is anticipated that the monopile will be lifted directly off the transport vessel, which could be moored to the main installation vessel. To stabilize the

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24 The maximum height of the foundation (including the transition piece) above water, which is the approximate maximum height of the marine navigation lights above water, is provided in Table 3.3-1.

25 Only if US manufacturing facilities are a viable option at the time of procurement.

26 In this scenario, the main installation vessels(s) would likely remain at the Lease Area for the duration of foundation installation, except to travel infrequently to a sheltered area to bunker fuel or seek shelter from weather (if needed).

Figure 3.3-2

Foundation Transportation and Installation

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monopile's vertical alignment before and during piling, a pile frame may be placed on the seabed (within the scour protection footprint)[27] or a pile gripper may extend from the side of the installation vessel. After the monopile is lowered to the seabed through the pile gripper/frame, the weight of the monopile will enable it to "self-penetrate" a fraction of the target penetration depth into the seafloor. The crane hook would then be released, and the impact pile driving hammer would be lifted and placed on top of the monopile.

Alternatively, a vibratory hammer or other tool could be used to install the monopile through surficial sediments in a controlled fashion to avoid the potential for a "pile run," where the pile could drop quickly through looser surficial sediments and destabilize the installation vessel. The extent to which a vibratory hammer may be used will continue to be evaluated based on site-specific data and the selected contractor's installation methodologies. Once the pile has penetrated the surficial sediments and is stable, an impact hammer would be used for the remainder of the installation.

Impact pile driving will begin with a soft-start, where initial sets of hammer strikes are delivered at a lower energy. A soft-start ensures that the monopile remains vertical and allows any motile marine life to leave the area before pile driving intensity is increased. The hammer energy will gradually be increased based on the resistance that is experienced from the sediments. The maximum hammer energy, anticipated duration of pile driving, and maximum number of monopiles that can be installed per day are provided in Section 3.3.5. Noise mitigation systems are expected to be applied during pile driving (see Sections 4.7 and 4.8 of COP Volume II).

Drilling could be required if pile driving encounters refusal (e.g., due to a large boulder or bedrock). If drilling is required, a rotary drilling unit would likely be installed on top of the monopile to remove obstructing material from the monopile's interior. The removed material would be deposited on the seabed adjacent to the scour protection material. Pile driving would then recommence. After pile installation is complete, the removed material may be re-deposited into the monopile to provide additional stability. Alternatively, the interior of the monopile may be filled with medium/coarse sand, grout, or concrete.

After the monopile is installed, the transition piece will be placed on top of the monopile using a vessel's crane (unless an extended monopile concept is used). The connection between the monopile and transition piece will be secured using grout, bolts, a slip joint or other mechanical joint, or a combination of these methods. Grout material, if used, would be mixed on the main installation vessel or on a separate grouting vessel and pumped through hoses into the transition piece. The grout level will be monitored to minimize overflow of grout outside the foundation.

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[27] The pile frame would be retrieved and relocated to each position (rather than left permanently on the seafloor).

If the time between monopile and transition piece installation lasts longer than a few days, the amount of marine growth will 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. Anti-fouling paint in contrasting colors may be used in select areas on the monopile (e.g., around apertures) to prevent the build-up of marine growth and increase visibility for remotely operated vehicles (ROVs) performing cable pull-in operations (see Section 3.6.4).

Any vessel anchoring, jacking-up, or other seafloor disturbance during WTG foundation installation will occur within surveyed areas of the Lease Area. The maximum potential seafloor disturbance from monopile installation is provided in Section 3.3.5.

3.3.2 Piled Jacket Design and Installation

A piled jacket foundation is a steel structure comprised of several legs connected by welded tubular cross bracing, which is secured to the seafloor using pin piles (see Figure 3.3-3). Pin piles are similar to monopiles (they are hollow steel cylinders that are driven into the seabed), but are much smaller in diameter. The jacket foundation will include a flange for mounting the WTG tower and ancillary structures such as cable tubes, boat landing(s), ladders, work platforms, electrical equipment, and various ancillary equipment (e.g., cranes). Like monopiles (see Section 3.3.1), the jacket will be equipped with a corrosion protection system and will contain marine navigation lighting and marking in accordance with USCG and BOEM guidelines. See Section 3.3.5 for the PDE of piled jacket dimensions.

The method of transporting and installing piled jacket foundations is similar to the method described above for monopiles (see Section 3.3.1). Jacket components may be fabricated at a steel manufacturing yard in the US or internationally. Once fabricated, the jacket components will be transported to a US or Canadian staging port(s) (see Section 3.10.1) for storage and pre-assembly or delivered directly to the Lease Area. Depending on the location of fabrication and any subsequent staging activities, foundation components may be transported to the staging port(s) or Lease Area by HLVs, HTVs, ocean-going barges, modified cargo vessels, jack-up feeder vessels, and/or smaller feeder barges (see Figure 3.3-2).

As with monopiles, seafloor preparation may be required prior to piled jacket installation (see Section 3.3.3). Scour protection may be installed at the base of the jacket (see Section 3.3.4).

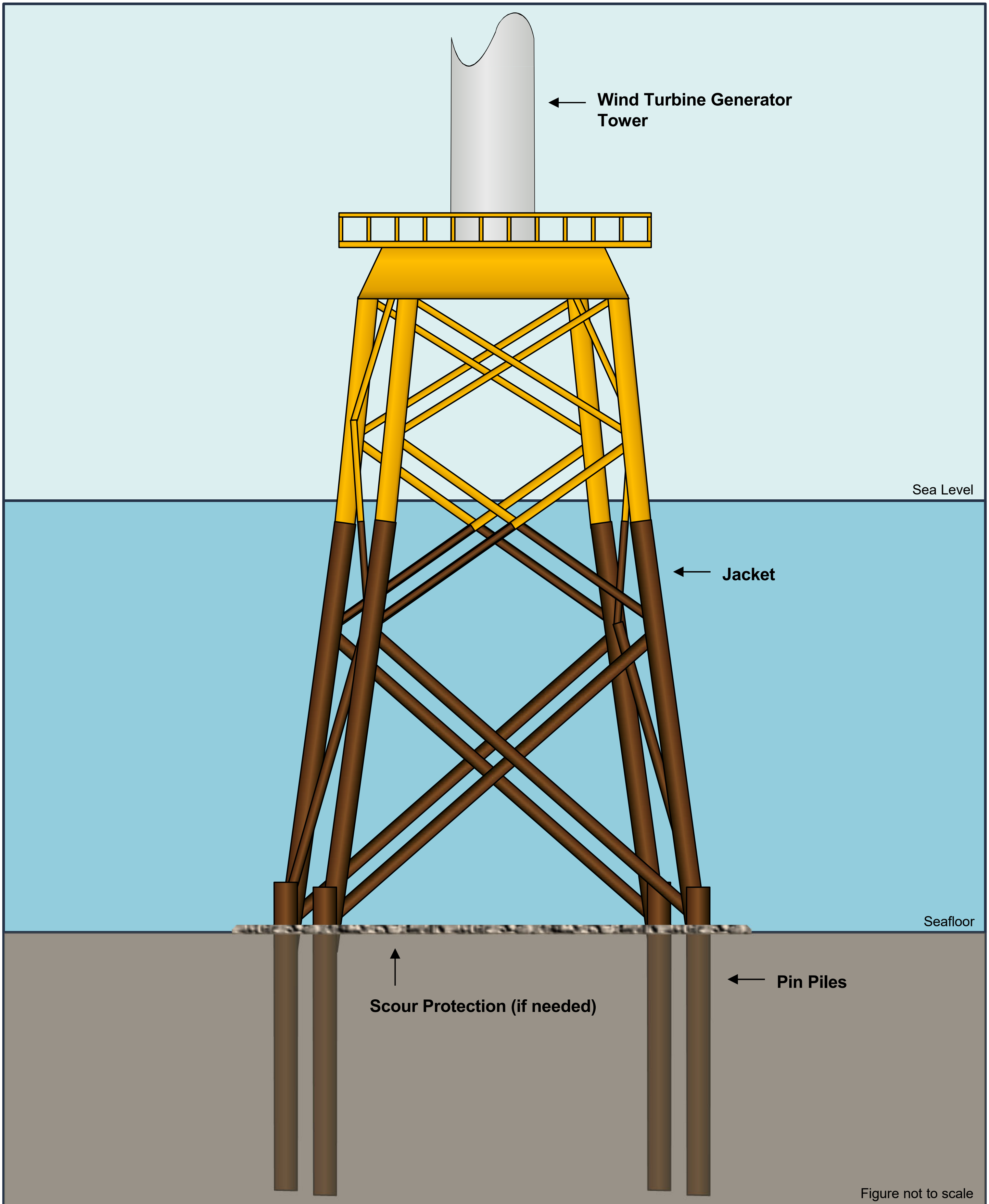

Figure 3.3-3
Piled Jacket Foundation

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Once delivered to the Lease Area, the jacket components will be installed by one or two DP, anchored, or jack-up vessels. The pin piles may be installed before or after the jacket structure.[28] If pre-piled (i.e., the pin piles are installed first), a frame would be used to orient the piles during pile driving. [29] The jacket structure would then be lifted by the installation vessel's crane directly onto the piles. If post-piled, the pin piles would be driven through pile "sleeves" or guides mounted to the base of each leg after the jacket structure is installed. These post-piled jacket structures may include mudmats at the base of each leg to distribute the jacket's weight and provide temporary support prior to pile driving.

After the main installation vessel's crane upends and lowers each pin pile to the seabed, the pile will "self-penetrate" a fraction of the target penetration depth into the seafloor. Alternatively, as described for monopiles, a vibratory hammer or other tool could be used to slowly lower the pile through the top layers of the seabed.[30] Once the pile has penetrated the surficial sediments and is stable, impact pile driving will commence with a soft-start. The maximum hammer energy, anticipated duration of pile driving, and maximum number of jacket pin piles that can be installed per day are provided in Section 3.3.5. Noise mitigation systems are expected to be applied during pile driving (see Sections 4.7 and 4.8 of COP Volume II). Drilling could be required if pile refusal is encountered. See Section 3.3.1 for additional description of pile installation.

After all pin piles are driven to their target depths and the jacket is installed, the jacket will be leveled and the piles will be affixed to the jacket, most likely by the use of grouting. If grout is used, the grout would be mixed on the installation vessel or on a separate grouting vessel and pumped through hoses to fill the annulus between the piles and jacket sleeves. The grout level will be monitored; when grout reaches the top of the sleeve, grouting will be halted.

Any vessel anchoring, jacking-up, or other seafloor disturbance during WTG foundation installation will occur within surveyed areas of the Lease Area. The maximum potential seafloor disturbance from piled jacket installation is provided in Section 3.3.5.

3.3.3 Seafloor Preparation

The Proponent anticipates that a pre-construction survey of bottom bathymetry will be conducted at each foundation position. Based on the results of the survey, seabed preparation may be required prior to scour protection or foundation installation. This could include

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28 The Proponent expects that piled jacket foundations for WTGs would be pre-piled, whereas piled jacket foundations for ESP(s) and the booster station (see Section 3.4.2) are more likely to be post-piled.

29 The pile frame, which would be placed on the seafloor within the scour protection footprint, would be retrieved and relocated to each position (rather than left permanently on the seafloor).

30 The extent to which a vibratory hammer may be used will continue to be evaluated based on site-specific data and the selected contractor's installation methodologies.

removing large obstructions (e.g., boulders, marine debris), leveling the seafloor's surface, and/or removing any surficial sediments that are too weak to support the foundation (if present). Seabed preparation (if needed) ensures that the foundation remains vertical and that its weight is uniformly distributed. Any seabed preparation is expected to occur within the maximum scour protection footprint provided in Section 3.3.5.

Seabed preparation could be accomplished using:

- **Trailing suction hopper dredge (TSHD):** A TSHD uses suction arms to collect sediment in the hopper of the vessel, thus leveling the seabed (see Section 3.5.3.2 for additional details).

- **Controlled flow excavation:** This method involves directing columns of water at the seabed to excavate sediments and push them aside (see Section 3.5.3.2 for additional details).

3.3.4 Scour Protection Installation

Scour protection may be installed at the base of each WTG foundation to minimize sediment transport and erosion (i.e., scour development) caused by water currents (see Figures 3.3-1 and 3.3-3). The need for scour protection is specific to the final design of the selected foundation concept(s) and will be further assessed upon detailed engineering of the foundations. It is anticipated that scour protection will be needed for the larger diameter monopiles, but may or may not be needed for the smaller diameter pin piles used for piled jacket foundations.

If used, scour protection would likely consist of loose rock material placed around the foundation in one or more layers. If installed in multiple layers, the lower layer(s) (i.e., the filter layer[s]) would consist of smaller sized rock followed by an upper armor layer consisting of larger rock. The rocks are expected to have a nominal rock diameter equivalent to that of a cube (D_{n50}) of approximately 25–500 millimeters (1–20 inches).[31] The rock material may be installed up to several months prior to the start of foundation installation (in which case, the foundations would be driven through the scour protection) and/or after foundation installation. The rock material will likely be sourced from within the US, Canada, or Europe.

There are several techniques for depositing rock scour protection, including fallpipes, side dumping, and placement using a crane/bucket. The Proponent expects to use a DP fallpipe vessel, which uses a pipe extending from the vessel's hopper to deposit rock in a controlled manner at the foundation position. An ROV located at the bottom of the fallpipe would likely be used to control the lateral movement of the fallpipe and monitor the installation process.

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31 Some rocks may be fragmented into smaller pieces during handling, transport, and installation.

Although freely-laid rock is the most widely used scour protection material in the offshore wind industry, scour protection may alternatively consist of rock bags or scour mats. Rock bags consist of rock encased in a durable net material (see Section 3.5.5 for additional description) whereas scour mats are expected to consist of plastic fronds. Both rock bags and scour mats would likely be deployed by a vessel's crane. The Proponent will also evaluate the feasibility of using nature-inclusive scour protection designs, which refers to options that can be integrated in or added to the design of scour protection to create suitable habitat for native species (see Section 3.5.5 for additional description of nature-inclusive designs).

The PDE of scour protection dimensions associated with each WTG foundation concept are provided in Section 3.3.5. The Proponent may install scour protection of any shape and size up to the maximum thickness and areas provided in Section 3.3.5 (including no scour protection).

Surveys may be conducted during scour protection installation to verify pre-installation site conditions, to determine if additional material is needed to provide the necessary coverage and thickness, and/or to collect as-built data. As discussed further in Section 4.2.2, the scour protection will be surveyed periodically throughout the operational period.

3.3.5 Maximum WTG Foundation Parameters

The PDE for the WTG foundations is provided in the table below.

Table 3.3-1 WTG Foundation Dimensions and Seafloor Disturbance

Parameter	Monopiles	Piled Jackets
Foundation Dimensions (per Foundation)		
Maximum number of legs	1	4
Maximum number of piles	1	4
Maximum total length (from interface with WTG to deepest point beneath the seafloor)	144 m (472 ft)	193 m (633 ft)
Maximum pile diameter	14 m (46 ft)	4.25 m (14 ft)
Maximum pile length	Extended monopile: 144 m (472 ft) With transition piece (TP): 110 m (361 ft)	99 m (325 ft)
Maximum pile seafloor penetration depth	45 m (148 ft)	94 m (308 ft)
Maximum diameter/dimensions of foundation at the seabed	14 m (46 ft)	51.5 m x 51.5 m (169 ft x 169 ft) On diagonal: 73 m (239 ft)
Maximum diameter/dimensions of foundation at the waterline[1]	12.5 m (41 ft)	51.5 m x 51.5 m (169 ft x 169 ft) On diagonal: 73 m (239 ft)

Table 3.3-1 WTG Foundation Dimensions and Seafloor Disturbance (Continued)

Parameter	Monopiles	Piled Jackets
Foundation Dimensions (per Foundation, Continued)		
Maximum height of foundation (including transition piece) above MLLW	35 m (115 ft)	35 m (115 ft)
Long-Term Seafloor Disturbance (per Foundation)		
Maximum thickness of scour protection	3 m (10 ft)	3 m (10 ft)
Approximate maximum size of scour protection[2]	Diameter of 96 m (315 ft)	112 m x 112 m (366 ft x 366 ft)
Maximum area of scour protection (includes footprint of foundation, mudmats [if used], and seafloor preparation)	7,238 m^2 (1.8 acres)	11,660 m^2 (2.9 acres)
Temporary Seafloor Disturbance (per Foundation)		
Maximum distance of vessel work zone from foundation center[3]	180 m (591 ft)	180 m (591 ft)
Maximum area of disturbance due to jack-up and/or anchored vessels[4]	3,600 m^2 (0.9 acres)	3,600 m^2 (0.9 acres)
Total Seafloor Disturbance (per Foundation)		
Maximum total area of seafloor disturbance (temporary and long-term disturbance)	10,838 m^2 (2.7 acres)	15,260 m^2 (3.8 acres)
Installation Parameters		
Maximum number of WTG/ESP piles installed per day	2 monopiles[5]	8 pin piles[6]
Maximum hammer energy	6,600-8,000 kilojoules (kJ)[7]	3,500 kJ

Notes:

1. The transition piece/extended monopile diameter at the waterline does not include any ancillary structures such as boat landing(s) and work platforms.
2. The approximate dimensions of scour protection are provided for informational purposes; however, the scour protection may not be the shape described (e.g., scour protection for a piled jacket may be a rounded triangle or donut-shaped). Regardless of the shape, the area of scour protection will fall within the maximum area of scour protection provided above.
3. The maximum depth of disturbance from vessels used to install the WTG foundations would not exceed the foundation penetration depth.
4. It is assumed that the vessels would jack-up and/or anchor up to three times at each WTG foundation. It is estimated that each jack-up vessel would impact approximately 1,200 m^2 (0.30 acres) of seafloor whereas each anchored vessel will disturb approximately 784 m^2 (0.19 acres), excluding anchor sweep (which cannot be quantified at this early stage in the construction planning process). Thus, the maximum area of disturbance due to jack-up and/or anchored vessels is calculated based on vessels jacking-up three times.
5. Impact pile driving for monopiles typically takes 2–4 hours. However, the time required to set up/prepare for pile driving varies significantly with weather and sea state conditions; therefore, the extent to which two monopiles could be driven per day would be limited based on those factors.
6. Impact pile driving for pin piles typically takes 2–6 hours. However, the time required to set up/prepare for pile driving varies significantly with weather and sea state conditions; therefore, the extent to which up to eight pin piles could be driven per day would be limited based on those factors.
7. Based on current site data and the preliminary pile drivability assessment (see Appendix II-B27), the expectation is that a maximum 6,600 kJ hammer would be used. However, the Proponent is continuing to collect geotechnical data and assess subsoil conditions. If the final pile drivability assessment determines that a larger (i.e., 8,000 kJ) hammer is needed, the hydroacoustic modeling will be updated.

3.4 Electrical Service Platforms and Booster Station

Vineyard Northeast will include up to three offshore electrical service platforms (ESPs), which will collect the power generated by the WTGs and transform it to a higher voltage for transmission to shore (see Figure 3.4-1). The power generated by the WTGs will be delivered to the ESP(s) via submarine inter-array cables (see Section 3.6). From the ESP(s), offshore export cables will transmit the electricity to shore (see Section 3.5).

Three ESP concepts are included in the PDE (a combination of these concepts may be employed):

- **High voltage direct current (HVDC) ESP:** If Vineyard Northeast employs HVDC offshore export cables and high voltage alternating current (HVAC) inter-array cables, the ESP(s) will convert the electricity delivered by the inter-array cables from alternating current to direct current and transform the voltage to match the offshore export cables' voltage. If HVDC inter-array cables are used (see Section 3.6.1), the ESP would simply collect and transform the voltage of the electricity.

- **High voltage alternating current ESP + booster station:** If Vineyard Northeast employs HVAC export cables to connect to a point of interconnection (POI) in Massachusetts, the ESP(s) would transform the voltage of electricity delivered by the inter-array cables to that of the offshore export cables. Because transmission losses in HVAC cables are greater than in HVDC cables, the Proponent would also need to install a booster station along the offshore export cables (between the ESP and shore) to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity.

- **Integrated ESP Equipment:** This concept entails placing ESP equipment on one or more expanded WTG foundation platforms rather than having a separate ESP situated on its own foundation (see Figure 3.4-2). With this concept, the ESP electrical equipment may be placed on numerous (i.e., more than three) WTG foundations (see Section 3.3).

Each ESP and booster station is comprised of two primary components: the topside, which contains the electrical equipment, and the foundation, which supports the topside (see Figure 3.4-1). The design, installation, and commissioning of the topsides are described in Section 3.4.1. The design and installation of the foundations and associated scour protection are described in Section 3.4.2.

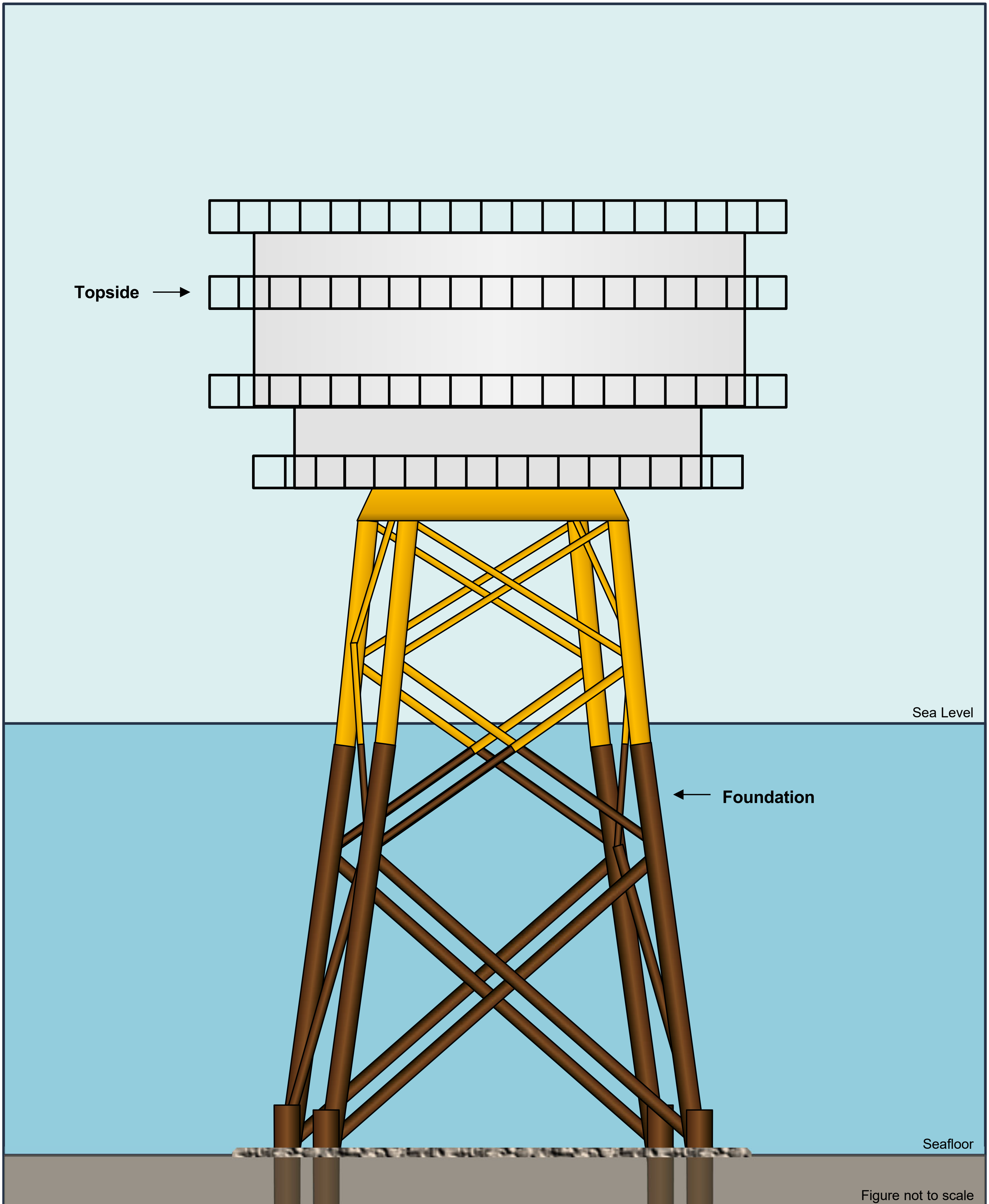

Figure 3.4-1
Electrical Service Platform/Booster Station

VINEYARD NORTHEAST
VINEYARD OFFSHORE

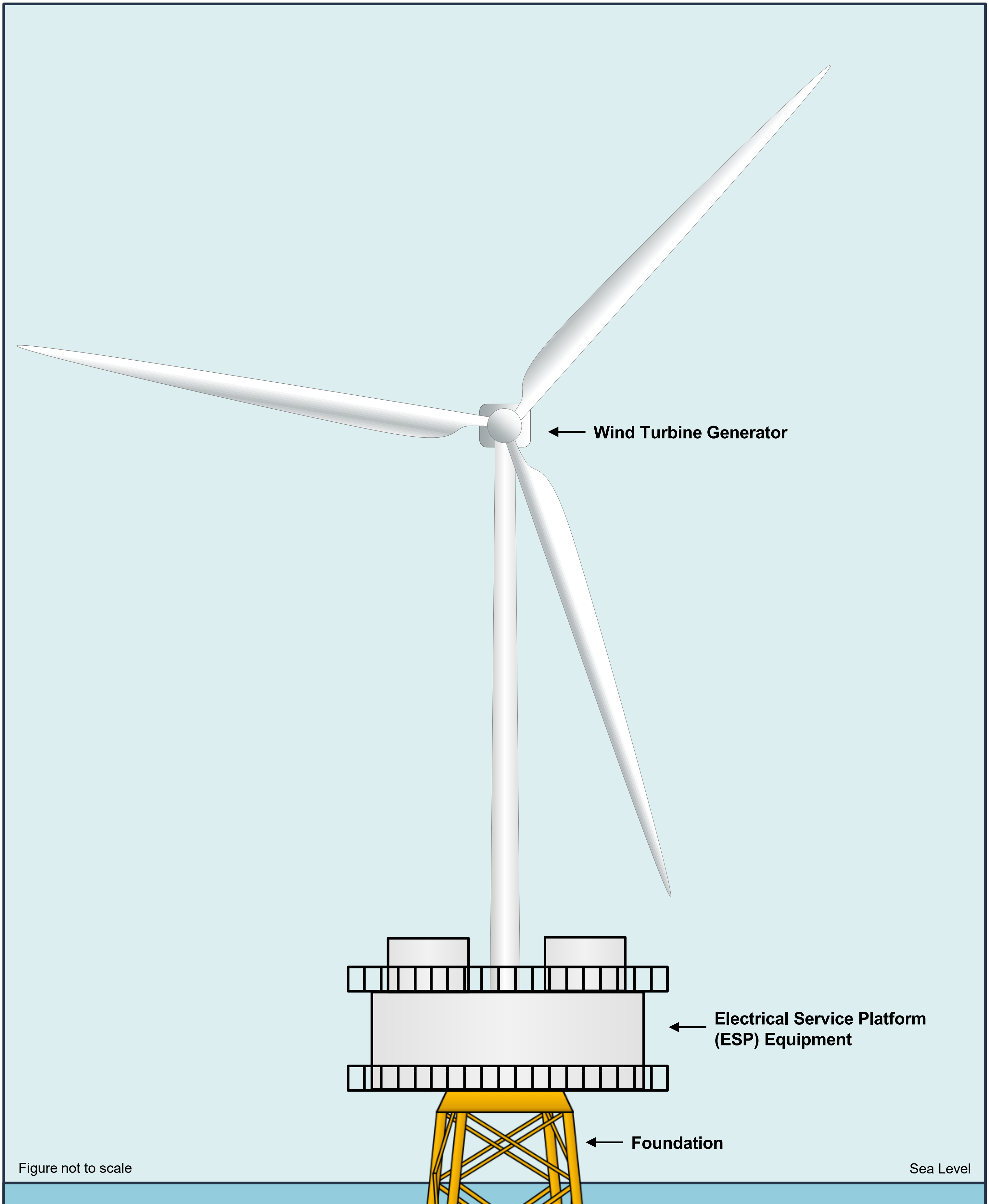

Figure 3.4-2
Integrated ESP Concept

VINEYARD NORTHEAST
VINEYARD OFFSHORE

The ESP(s) may be located at any WTG/ESP position (see Figure 2.3-1). If two or three ESPs are used, they may be located at separate positions or two of the ESPs may be co-located at one of the potential grid positions shown on Figure 2.3-1.[32] Co-located ESPs would be smaller structures installed on monopile foundations (see Figure 3.4-3).[33] If co-located ESPs are used, each ESP's monopile foundation would be within 76 m (250 ft) of the grid position's centroid (i.e., the monopiles would be separated by up to 152 m [500 ft]). While the use of co-located ESPs could result in a total of 161 monopile foundations within the Lease Area, the total number of WTG and ESP positions in the Lease Area will not exceed 160. The Proponent does not expect to use both co-located ESPs and integrated ESPs.

The booster station, if needed, would be located in the northwestern aliquot[34] of Lease Area OCS-A 0534 and would be aligned with the 1 x 1 NM grid layout of the Vineyard Wind 1 project (see Figure 2.3-2).[35] The booster station would be approximately 23 km (15 mi) from Martha's Vineyard and approximately 26 km (16 mi) from Nantucket.

3.4.1 Topside Design, Installation, and Commissioning

An ESP's electrical equipment is located in the topside. Within the topside, the inter-array cables will connect to switchgear and transformers, which will increase the electricity's voltage to match the offshore export cables' voltage. Assuming HVAC inter-array cables are used, the HVDC topside(s) will also include electrical equipment (e.g., converter transformers, reactors, and valve stacks) to convert the power from alternating current to direct current.

As mentioned above, a booster station may be installed if HVAC export cables are employed (see Section 3.5). As HVAC offshore export cables increase in length, they produce larger amounts of capacitive reactive power (unusable electricity), which can decrease the transmission capacity of the cables. A booster station located midway along the offshore export cables is used to manage the cables' reactive power, increase the transmission system's

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32 Co-located ESPs would be used to accommodate a "meshed-ready" ESP concept if such concept became technically and commercially feasible. "Meshed-ready" means that the ESP could accommodate an offshore transmission configuration in which multiple offshore wind projects' substations are electrically interconnected.

33 While the exact topside dimensions for a co-located ESP have not yet been determined, the Proponent expects that a co-located ESP topside would be approximately 10-15% smaller than the dimensions provided for a normal ESP topside.

34 An aliquot is 1/64th of a BOEM OCS Lease Block.

35 The Proponent has a collaborative working relationship with the developers of Lease Areas OCS-A 0501 and OCS-A 0534 through Copenhagen Infrastructure Partners' joint venture with Avangrid Renewables on the Vineyard Wind 1 project.

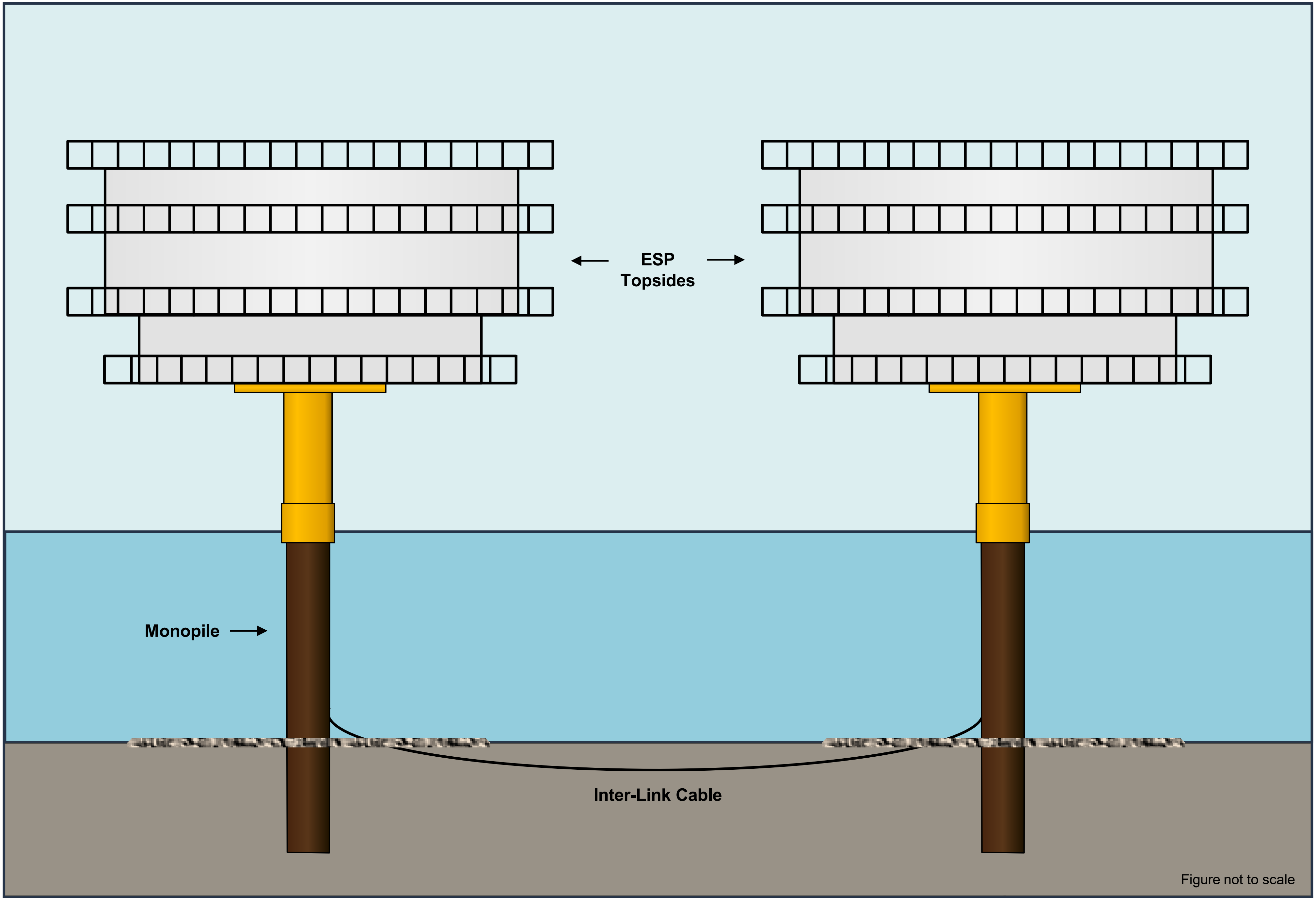

Figure 3.4-3
Co-Located Electrical Service Platforms

operational efficiency, reduce conduction losses, and minimize excess heating. As a result, adding a booster station enables HVAC offshore export cables to transmit wind power generated farther offshore. The booster station topside, which is similar in design to the ESP topside, contains switchgear, transformers, and other electrical equipment.

The PDE for the ESP and booster station topsides is provided in Table 3.4-1. Although the same PDE is provided for the HVDC and HVAC ESP topsides, the topsides for HVAC ESPs are expected to be smaller because they do not require electrical equipment to convert power from alternating current to direct current. The booster station requires even less electrical equipment and is therefore expected to be considerably smaller.

Table 3.4-1 ESP and Booster Station Topside Dimensions

Parameter	ESP	Booster Station
Number of ESPs/booster stations	0–3 (zero indicates the ESP equipment may be integrated onto WTG foundation[s])	0–1 (only needed for HVAC transmission)
Maximum topside width	85 m (279 ft)	60 m (197 ft)
Maximum topside length	170 m (558 ft)	100 m (328 ft)
Maximum topside height above foundation	45 m (148 ft)	38 m (125 ft)
Maximum height above MLLW[1]	70 m (230 ft)	70 m (230 ft)

Note:
1. Height includes helipad (if present) but may not include antennae and other appurtenances.

The electrical equipment in the ESP and booster station topsides require cooling. HVAC equipment can be air cooled, whereas HVDC equipment requires water cooling. For HVDC ESP(s), the Proponent anticipates that seawater will be withdrawn through pipes that are attached to the foundation and pumped to heat exchangers located in the topside. Anti-biofouling additives (e.g., sodium hypochlorite) may be injected near the intake to prevent marine growth within the cooling system. Before entering the heat exchangers, the seawater will likely be passed through filters. After leaving the heat exchangers, the warmed seawater will be discharged below the water's surface through pipes that are attached to the foundation. See Table 3.4-2 for the maximum anticipated withdrawal rate and temperature increase of the HVDC cooling water. Alternatively, HVDC ESP(s) could potentially use closed loop water cooling (where no water is withdrawn from or discharged to the sea) if such technology becomes technically and commercially feasible.[36]

[36] Although this technology is not currently available in the offshore wind market (BOEM 2022), the Proponent is aware of a number of firms that are working to develop and test closed loop cooling systems for use in offshore wind HVDC ESPs.

Table 3.4-2 HVDC ESP Seawater Cooling Parameters

Parameter	Expected Value
Maximum cooling water withdrawal and discharge rate	1,380,000 liters per hour (365,000 gallons per hour)
Expected temperature increase (inlet vs. outlet)	8.5 °C (15.3 °F)

Subject to final design, the ESP and booster station topsides may also include:

- shunt reactors and auxiliary electrical equipment
- control and communications equipment
- cranes
- a heating, ventilation, and air conditioning system to regulate equipment temperatures
- staff facilities (e.g., break room, storage facilities, restrooms,[37] etc.)
- a clean water wash system, freshwater storage, and associated utility pumps
- a backup battery system and/or diesel generator(s), diesel fuel storage, and associated utility pumps
- an oil/water separator, spill containment, and other spill prevention equipment
- safety equipment (e.g., life rafts or boats, lifejackets), fire detection, and firefighting equipment (e.g., inert gas, water/foam systems)
- lightning masts to protect electrical equipment and personnel
- equipment to facilitate the potential use of electric/hybrid vessels for construction and O&M of Vineyard Northeast (see the description of this concept in Section 3.2.1)
- a helipad

If the ESP(s) include a helipad, it would be designed to accommodate USCG search and rescue helicopters.

The ESP(s), booster station, and their foundations will be lit and marked in accordance with FAA, USCG, and BOEM guidelines to aid safe navigation within the Lease Area. The ESP and booster station topsides are expected to be light grey in color. The topsides will contain

[37] If restrooms are included in the topside, no wastewater would be discharged into the sea.

alphanumeric identifiers following the *Rhode Island and Massachusetts Structure Labeling Plot* (see Appendix I-A1) and yellow flashing lights[38] to aid maritime navigation. During construction, temporary red aviation obstruction lights may be installed on each topside, if they reach a height of 61 m (200 ft). Other lighting (e.g., helipad lights) may be utilized for safety purposes. Permanent lighting and marking of the ESP(s) and booster station during the operational period are discussed in Section 4.1.5.

The ESP and booster station topsides will likely be transported directly from a US or international manufacturing facility to the Lease Area on HLVs, HTVs, and/or ocean-going barges. Although less likely, the topsides could be transported to a US or Canadian staging port (see Section 3.10.1) before being delivered to the Lease Area.

The ESP and booster station topsides will be installed after their foundations are installed (see Section 3.4.2). The topside installation vessel, which will likely be an anchored, DP, or jack-up vessel, may be the same vessel that installs the foundations. After the installation vessel positions itself next to the foundation, the vessel's crane will likely lift the topside from its deck or a separate transport vessel and place it on the foundation. Alternatively, the topside may be floated to the Lease Area using tugboats or transported on a semi-submersible vessel; after the topside is positioned over the jacket, it would be ballasted down onto the foundation. The topside and foundation will be connected using bolted connections and/or welding.

After mechanical installation of the topside is complete, the inter-array cables, offshore export cables, and/or inter-link cables (if used) will be pulled into place and terminated within the topside (see Sections 3.5.4.3 and 3.6.4). Then, the ESP(s) and booster station will be energized and commissioned. Commissioning, which entails conducting tests of the electrical infrastructure as well as safety, controls, and communication systems prior to commercial operations, may last several months. During the commissioning period, a jack-up vessel or floating vessel (e.g., SOV) may be positioned near the ESP(s) and booster station to provide accommodations for workers performing commissioning activities.

If an integrated ESP concept is used (i.e., where ESP equipment is placed on one or more expanded WTG foundation platforms), the ESP equipment is anticipated to be installed on the expanded foundation platform before or after the WTG is installed using a vessel similar to the foundation or WTG installation vessel (see Section 3.2.2). The ESP equipment would be commissioned at the same time the WTG is commissioned (see Section 3.2.2).

The maximum potential seafloor disturbance from vessels used during the installation and commissioning of ESP and booster station topsides is quantified in Table 3.4-3. Any vessel anchoring, jacking-up, or other seafloor disturbance during ESP and booster station installation will occur within surveyed areas of the Lease Area.

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[38] The lights may alternatively be located on the foundation.

Table 3.4-3 Seafloor Disturbance During Topside Installation and Commissioning

Activity	Temporary Seafloor Disturbance
Maximum distance of vessel work zone from foundation center[1]	180 m (591 ft)
Maximum area of seafloor disturbance per vessel	1,200 m^2 (0.30 acres) per jack-up vessel or 784 m^2 (0.19 acres) per anchored vessel[2]
Maximum number of times vessels jack-up and/or anchor during topside installation and commissioning (per topside)	5 total
Maximum area of temporary seafloor disturbance from vessels during topside installation and commissioning (per topside)	6,000 m^2 (1.5 acres)

Notes:

1. The maximum depth of disturbance from vessels used for topside installation and commissioning would not exceed the foundation penetration depth (see Section 3.4.2).
2. Excludes anchor sweep, which cannot be quantified at this early stage in the construction planning process.

3.4.2 Foundation Design and Installation

Each ESP and booster station topside will be supported by a monopile or a piled jacket foundation. The ESP and booster station foundation types are the same as those under consideration for the WTGs (see Section 3.3), but have different maximum dimensions. Table 3.4-4 provides the PDE for ESP and booster station foundations. If the ESP equipment is integrated onto the WTG foundations, the foundation dimensions would instead fall within the PDE for WTG foundations provided in Section 3.3.5.

Section 3.3 provides a detailed description of each foundation type as well as transportation and installation methodologies. As with WTG foundations, the ESP and booster station foundations may require seabed preparation (i.e., removing large obstructions, leveling the seafloor's surface, and/or removing weak surficial sediments). Seabed preparation methods are described in Section 3.3.3. Any seabed preparation for ESP and booster station foundations is expected to occur within the maximum scour protection footprint provided in Table 3.4-4.

Scour protection may be installed at the base of each ESP and booster station foundation to protect it from sediment transport and erosion caused by water currents. The types of scour protection and installation methods are described in Section 3.3.4. The PDE of scour protection dimensions for the ESP(s) and booster station is provided in Table 3.4-4.

Table 3.4-4 ESP and Booster Station Foundation Dimensions and Seafloor Disturbance

Parameter	ESP		Booster Station	
	Monopile	Piled Jacket	Monopile	Piled Jacket
Foundation Dimensions (per Foundation)				
Maximum number of legs	1	6	1	6
Maximum number of piles	1	18	1	18
Maximum total length (from interface with topside to deepest point beneath the seafloor)	144 m (472 ft)	193 m (633 ft)	144 m (472 ft)	193 m (633 ft)
Maximum pile diameter	14 m (46 ft)	4.25 m (14 ft)	14 m (46 ft)	4.25 m (14 ft)
Maximum pile length	Extended monopile: 144 m (472 ft) With TP: 110 m (361 ft)	99 m (325 ft)	Extended monopile: 144 m (472 ft) With TP: 110 m (361 ft)	99 m (325 ft)
Maximum pile seafloor penetration depth	45 m (148 ft)	94 m (308 ft)	45 m (148 ft)	94 m (308 ft)
Maximum diameter/dimensions of foundation at the seabed	14 m (46 ft)	170 m x 85 m (558 ft x 279 ft) On diagonal: 190 m (624 ft)	14 m (46 ft)	100 m x 60 m (328 ft x 197 ft) On diagonal: 117 m (383 ft)
Maximum diameter/dimensions of foundation at the waterline[1]	12.5 m (41 ft)	170 m x 85 m (558 ft x 279 ft) On diagonal: 190 m (624 ft)	12.5 m (41 ft)	100 m x 60 m (328 ft x 197 ft) On diagonal: 117 m (383 ft)
Maximum height of foundation above MLLW	35 m (115 ft)	35 m (115 ft)	35 m (115 ft)	35 m (115 ft)

Table 3.4-4 ESP and Booster Station Foundation Dimensions and Seafloor Disturbance (Continued)

Parameter	ESP		Booster Station	
	Monopile	Piled Jacket	Monopile	Piled Jacket
Long-Term Seafloor Disturbance (per Foundation)				
Maximum thickness of scour protection	3 m (10 ft)	3 m (10 ft)	3 m (10 ft)	3 m (10 ft)
Approximate maximum size of scour protection[2]	Diameter of 96 m (315 ft)	230 m x 145 m (755 ft x 476 ft)	Diameter of 96 m (315 ft)	160 m x 120 m (525 ft x 394 ft)
Maximum area of scour protection (includes footprint of foundation, mudmats [if used], and seafloor preparation)	7,238 m^2 (1.8 acres)	32,577 m^2 (8.1 acres)	7,238 m^2 (1.8 acres)	18,427 m^2 (4.6 acres)
Temporary Seafloor Disturbance (per Foundation)				
Maximum distance of vessel work zone from foundation center[3]	180 m (591 ft)	180 m (591 ft)	180 m (591 ft)	180 m (591 ft)
Maximum area of disturbance due to jack-up and/or anchored vessels[4]	3,600 m^2 (0.9 acres)	3,600 m^2 (0.9 acres)	3,600 m^2 (0.9 acres)	3,600 m^2 (0.9 acres)
Total Seafloor Disturbance (per Foundation)				
Maximum total area of seafloor disturbance (temporary and long-term disturbance)	10,838 m^2 (2.7 acres)	36,177 m^2 (8.9 acres)	10,838 m^2 (2.7 acres)	20,027 m^2 (5.4 acres)
Installation Parameters				
Maximum number of WTG/ESP piles installed per day	2 monopiles[5]	8 pin piles[6]	2 monopiles[5]	8 pin piles[6]
Maximum hammer energy	6,600-8,000 kJ[7]	3,500 kJ	6,600-8,000 kJ[7]	3,500 kJ

Table 3.4-4 ESP and Booster Station Foundation Dimensions and Seafloor Disturbance (Continued)

Notes:

1. The transition piece/extended monopile diameter at the waterline does not include any ancillary structures such as boat landing(s) and work platforms.
2. The approximate dimensions of scour protection are provided for informational purposes; however, the scour protection may not be the shape described (e.g., scour protection for a piled jacket may be a rounded triangle or donut-shaped). Regardless of the shape, the area of scour protection will fall within the maximum area of scour protection provided above.
3. The maximum depth of disturbance from vessels used to install the foundations would not exceed the foundation penetration depth.
4. It is assumed that the vessels would jack-up and/or anchor up to three times at each foundation. It is estimated that each jack-up vessel would impact approximately 1,200 m^2 (0.30 acres) of seafloor whereas each anchored vessel will disturb approximately 784 m^2 (0.19 acres), excluding anchor sweep (which cannot be quantified at this early stage in the construction planning process). Thus, the maximum area of disturbance due to jack-up and/or anchored vessels is calculated based on vessels jacking-up three times.
5. Impact pile driving for monopiles typically takes 2–4 hours. However, the time required to set up/prepare for pile driving varies significantly with weather and sea state conditions; therefore, the extent to which two monopiles could be driven per day would be limited based on those factors.
6. Impact pile driving for pin piles typically takes 2–6 hours. However, the time required to set up/prepare for pile driving varies significantly with weather and sea state conditions; therefore, the extent to which up to eight pin piles could be driven per day would be limited based on those factors.
7. Based on current site data and the preliminary pile drivability assessment (see Appendix II-B27), the expectation is that a maximum 6,600 kJ hammer would be used. However, the Proponent is continuing to collect geotechnical data and assess subsoil conditions. If the final pile drivability assessment determines that a larger (i.e., 8,000 kJ) hammer is needed, the hydroacoustic modeling will be updated.

3.5 Offshore Export Cables

Offshore export cables installed within two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will transmit electricity from the ESP(s) to landfall sites in Massachusetts and Connecticut (see Figure 2.2-2). The Massachusetts and Connecticut OECCs are described in Section 3.5.2.

The PDE includes two offshore transmission options:

- **All HVDC offshore export cables:** Under this concept, all Vineyard Northeast offshore export cables will use HVDC transmission technology. Up to two HVDC offshore export cable bundles will be installed within both the Massachusetts OECC and the Connecticut OECC, for a total of up to four HVDC cable bundles.

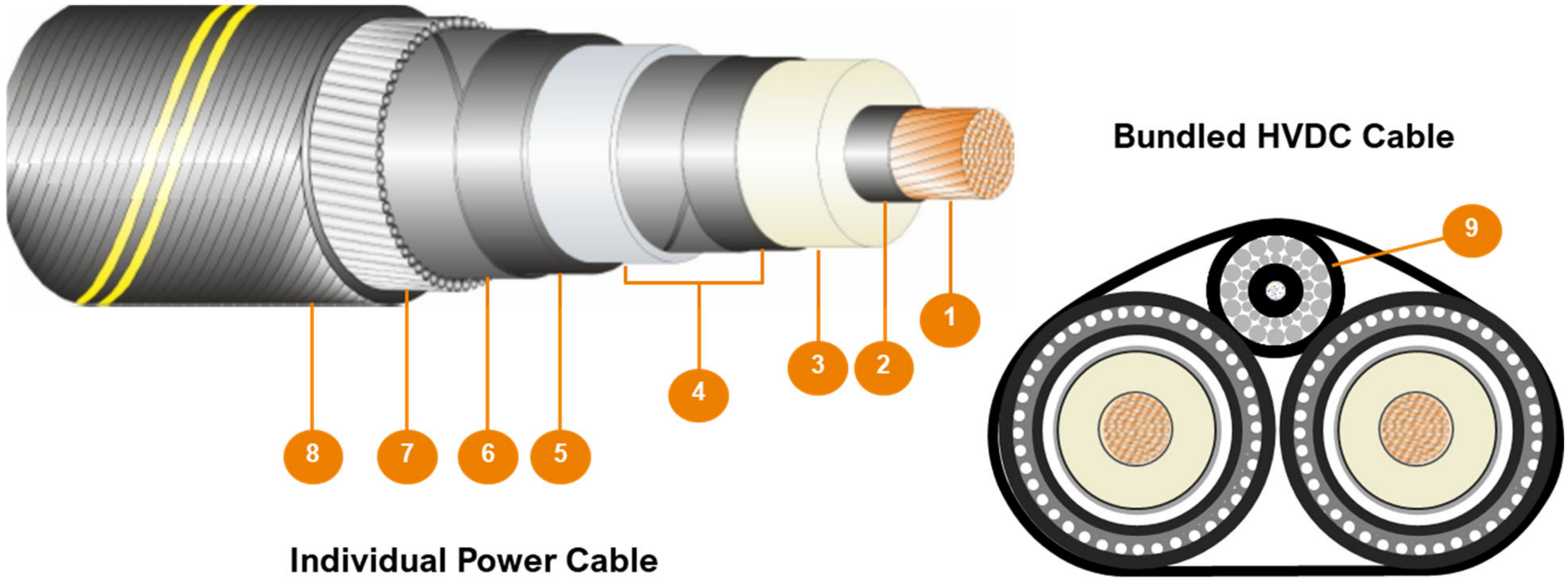
- **HVDC + HVAC offshore export cables:** The Proponent may employ HVAC transmission technology to transmit power to a POI in Massachusetts. In this scenario, up to three HVAC offshore export cables would be installed within the Massachusetts OECC and would connect to a booster station in Lease Area OCS-A 0534 (see Section 3.4). Additionally, up to two HVDC offshore export cable bundles could be installed within the Connecticut OECC, giving a total of up to five HVAC and bundled HVDC offshore export cables.

3.5.1 Offshore Export Cable Design

3.5.1.1 HVDC Offshore Export Cable Bundles

Each 320–525 kV high voltage direct current (HVDC) offshore export cable bundle will consist of two or three power cables[39] and one or more fiber optic cables (for communication and monitoring) that are bound together and installed simultaneously within a single trench. Each power cable is expected to contain a single aluminum or copper conductor that is encapsulated in cross-linked polyethylene (XLPE) insulation, water blocking layer(s), a metallic sheath, a core jacket, and a protective armor layer (see Figure 3.5-1). The armor layer, which will likely consist of steel armor wires that are wrapped in polypropylene yarn (referred to as "serving"), protects the cable from over-bending and damage during installation as well as minor impacts during its operational life. The cable bundle will likely include distributed temperature sensing (DTS), distributed acoustic sensing (DAS), online partial discharge (OLPD) monitoring, and/or a similar monitoring system to continuously monitor the status of the cables

[39] If the HVDC cable bundle includes three power cables, the third cable would be a neutral cable that provides redundancy.



Design:

1. Conductor (Al or Cu)
2. Inner semi-conducting layer
3. Insulation
4. Insulation shield and water barrier
5. Metallic sheath
6. Core jacket
7. Armor layer
8. Outer serving
9. Fiber optic cable

Figure 3.5-1
HVDC Offshore Export Cable Schematic

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and detect anomalous conditions, such as insufficient cable depth or possible cable damage (see Section 4.1.2 for additional details). The HVDC offshore export cable bundle is expected to have a maximum outer diameter of up to approximately 0.4 m (1.3 ft).

3.5.1.2 HVAC Offshore Export Cables

If high voltage alternating current (HVAC) cables are employed in the Massachusetts OECC, each 220–345 kV HVAC offshore export cable is expected to be comprised of three aluminum or copper conductors for power transmission and one or more fiber optic cables.[40] Each conductor will likely be encapsulated in XLPE insulation, water blocking layer(s), a metallic sheath, and an inner sheath; the three conductors are then contained within a single layer of protective steel armor (see Figure 3.5-2). The cables will likely include DTS, DAS, OLPD monitoring, and/or a similar monitoring system to continuously assess the status of the cables and detect anomalous conditions. The HVAC offshore export cables will have a maximum outer diameter of approximately 0.35 m (1.1 ft).

3.5.2 Offshore Export Cable Corridors

The Proponent has identified two offshore export cable corridors (OECCs) to connect the Lease Area to landfall sites in Massachusetts and Connecticut. To consolidate offshore infrastructure, the OECCs follow other developers' proposed offshore export cable routes to the extent feasible (see Section 2.8).

3.5.2.1 Massachusetts OECC

Up to two HVDC cable bundles or up to three HVAC cables may be installed within the Massachusetts OECC. The Massachusetts OECC travels from the northernmost tip of Lease Area OCS-A 0522 along the northeastern edge of the Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) and then heads across Buzzards Bay towards a landfall site in Westport, Massachusetts (see Figure 3.5-3). The Massachusetts OECC is typically 720 m (2,362 ft) wide.[41] Where the Massachusetts OECC approaches the northern border of Lease Area OCS-A 0501, it widens to approximately 1,891 m (6,204 ft) to enable HVAC offshore export cables (if used) to connect to a booster station in Lease Area OCS-A 0534 (see Section 3.4). The Massachusetts OECC is also wider at expected cable crossings to allow the cables to cross existing cables perpendicularly and to provide

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40 Fiber optic cables are typically integrated into the offshore export cable but may be bundled externally to the export cable. In either scenario, the fiber optic and export cables would be installed simultaneously.

41 At this time, the Proponent is requesting an easement for the full width of the Massachusetts OECC (see Appendix I-A2) but expects to further refine the width of the requested easement prior to BOEM's Record of Decision.

Design:

1 Conductor (Al or Cu)
2 Inner semi-conducting layer
3 Insulation
4 Outer semi-conducting layer
5 Water barrier
6 Metallic sheath
7 Inner sheath
8 Fiber optic cable
9 Fillers
10 Armor bedding
11 Armor layer
12 Outer serving

Figure 3.5-2
HVAC Offshore Export Cable Schematic

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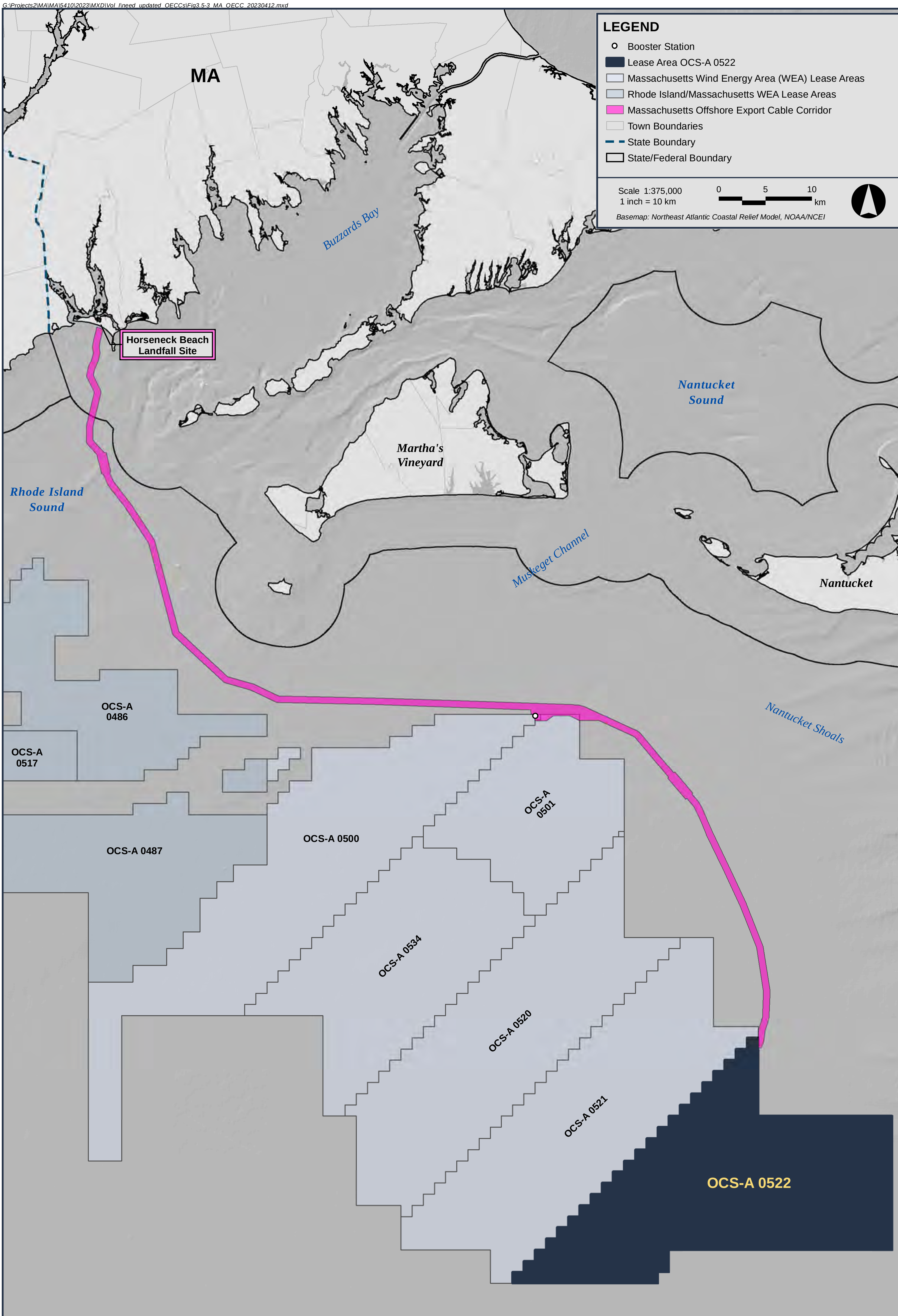

Figure 3.5-3
Massachusetts OECC

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flexibility for the installation process, which is more complex at cable crossings (see Section 3.5.6). From the Lease Area boundary to the landfall site, the Massachusetts OECC is approximately 126 km (68 NM).[42] The maximum length of each offshore export cable within the Massachusetts OECC is provided in Section 3.5.7. Water depths in the Massachusetts OECC range from 0 to 42 m (0 to 138 ft).

3.5.2.2 Connecticut OECC

Up to two HVDC offshore export cable bundles may be installed within the Connecticut OECC. The Connecticut OECC travels from the southwestern tip of Lease Area OCS-A 0522 along the southwestern edge of the MA WEA and then heads between Block Island and the tip of Long Island towards potential landfall sites near New London, Connecticut (see Figure 3.5-4). As the Connecticut OECC approaches shore, it splits into three variations to connect to three potential landfall sites (see Section 3.7.2). The "Eastern Point Beach Approach" of the Connecticut OECC connects to the Eastern Point Beach Landfall Site, the "Ocean Beach Approach" connects to the Ocean Beach Landfall Site, and the "Niantic Beach Approach" connects to the Niantic Beach Landfall Site (see Figure 3.5-4). The Connecticut OECC is typically 720 m (2,362 ft) wide, but is wider at expected cable crossings to enable the cables to cross perpendicularly and to provide flexibility during installation (see Section 3.5.6).[43] Depending on the approach used, the maximum length of the Connecticut OECC from the Lease Area boundary to the landfall site is approximately 171–179 km (92–96 NM).[44] The maximum length of each offshore export cable within the Connecticut OECC is provided in Section 3.5.7. Water depths in the Connecticut OECC range from 0 to 105 m (0 to 345 ft).

3.5.2.3 Cable Separation and Alignment within OECCs

The HVDC offshore export cable bundles or HVAC offshore export cables will typically be separated by a distance of 50–150 m (164–492 ft) to provide flexibility for micrositing, installation tools, and future potential cable repairs. This separation distance could be further adjusted during detailed engineering of the cable alignments to account for local conditions, such as deeper waters, micro-siting for sensitive habitat areas, or other environmental or technical reasons. Where Vineyard Northeast's offshore export cables are proximate to other

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[42] The length of the Massachusetts OECC is measured from the Lease Area boundary to the offshore edge of the corridor at the landfall site.

[43] At this time, the Proponent is requesting an easement for the full width of the Connecticut OECC (see Appendix I-A2) but expects to further refine the width of the requested easement prior to BOEM's Record of Decision.

[44] The length of the Connecticut OECC is measured from the Lease Area boundary to the offshore edge of the corridor at each landfall site.

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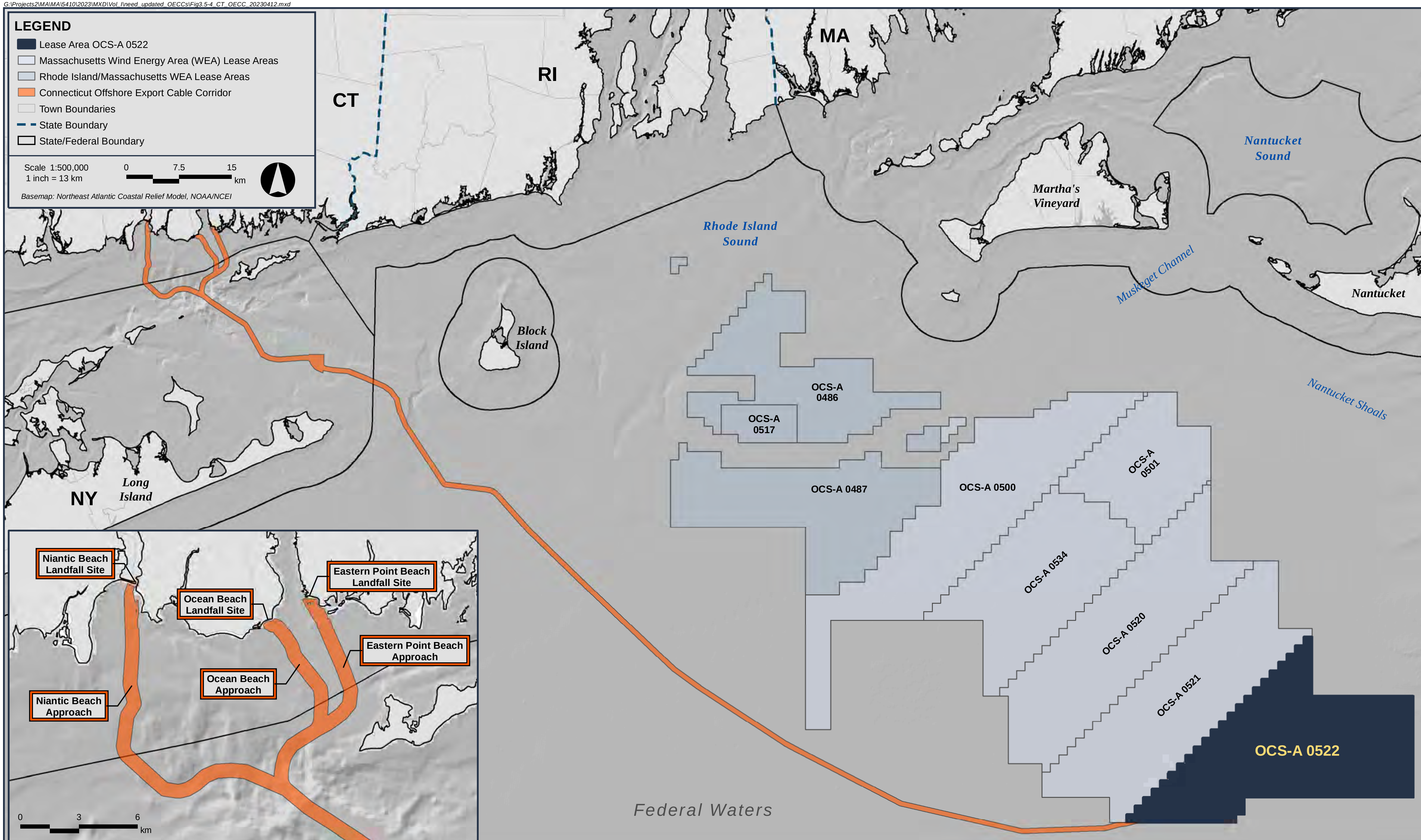

Figure 3.5-4
Connecticut OECC

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developers' cables, a separation distance of 250 m (820 ft) is generally recommended. However, the Proponent will determine the appropriate separation distances in agreement with the other developers, which will likely be memorialized in a proximity agreement.

Preliminary engineering of the offshore export cable alignments within the OECCs is ongoing. As noted in Section 2.8, the cable alignments will be micro-sited within the OECC to avoid shipwrecks by an appropriate buffer, to avoid US Army Corps of Engineers (USACE) dredged material disposal sites, and to avoid Federal Aids to Navigation (ATONs) by the Minimum Safe Distance[45] determined in consultation with USCG. The cable alignments will be designed to avoid sensitive habitats including eelgrass and hard/complex bottom where feasible, but avoidance of all sensitive habitats is not always possible. Route engineers must develop technically viable cable alignments that avoid steep slopes, provide suitable water depths for available cable installation vessels, enable feasible cable turning radii, avoid high concentrations of boulders or very stiff sediments where cable burial would be challenging, avoid magnetic anomalies, maintain a sufficient distance between cables, avoid crossing existing cables/pipelines to the extent possible, and cross existing cables/pipelines perpendicularly (where crossings are necessary).

3.5.3 Pre-Installation Activities

Prior to cable installation, the offshore export cable alignments may require boulder clearance and sand bedform dredging. Following those activities, pre-lay grapnel runs and pre-lay surveys will be performed to confirm that the cable alignments are suitable for installation. The Proponent will communicate with the fishing industry following the protocols outlined in its Fisheries Communication Plan (FCP) (see Section 8.3 and Appendix I-I) before beginning offshore export cable laying preparatory activities.

3.5.3.1 Boulder Clearance

Although the offshore export cable alignments will avoid surficial coarse deposits (including boulders) where feasible, large boulders may be present along the final offshore export cable alignments. It is currently anticipated that boulders larger than approximately 0.2–0.3 m (0.7–1 ft) will be avoided or relocated to create an installation corridor wide enough for the cable installation tool to proceed unobstructed along the seafloor.

Boulders up to approximately 2 m (7 ft) in size can be relocated based on tools that exist today. If required, boulder clearance is expected to be accomplished by a grab tool suspended from a vessel's crane, which lifts individual boulders clear of the alignment and relocates them elsewhere within the OECC. Boulders relocated by crane would be placed in close proximity

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[45] USCG defines the Minimum Safe Distance (MSD) as greater than or equal to the Position Tolerance (PT) + Chain Length (CL) + Length of Servicing Vessel (LSV) (+ shoaling consideration). The specific inputs for each ATON would be obtained from USCG.

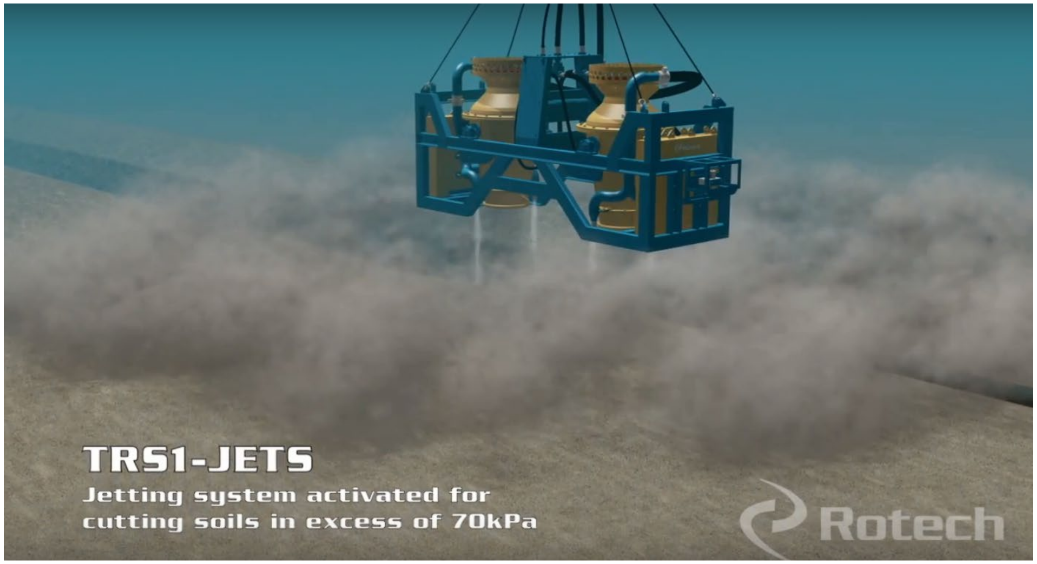
to their original location, but far enough from the planned cable alignment to avoid interference with the cable installation tool. To the maximum extent practicable, boulders will be relocated to avoid sensitive habitats and minimize seafloor impacts. Alternatively, a route clearance plow may be towed by a vessel along the cable alignment to push boulders aside (this may occur during the cable installation process, as described in Section 3.5.4.1). If a route clearance plow is used, boulders will be shifted perpendicular to the cable alignment. Potential seafloor disturbance from boulder clearance within each OECC is quantified in Section 3.5.7.

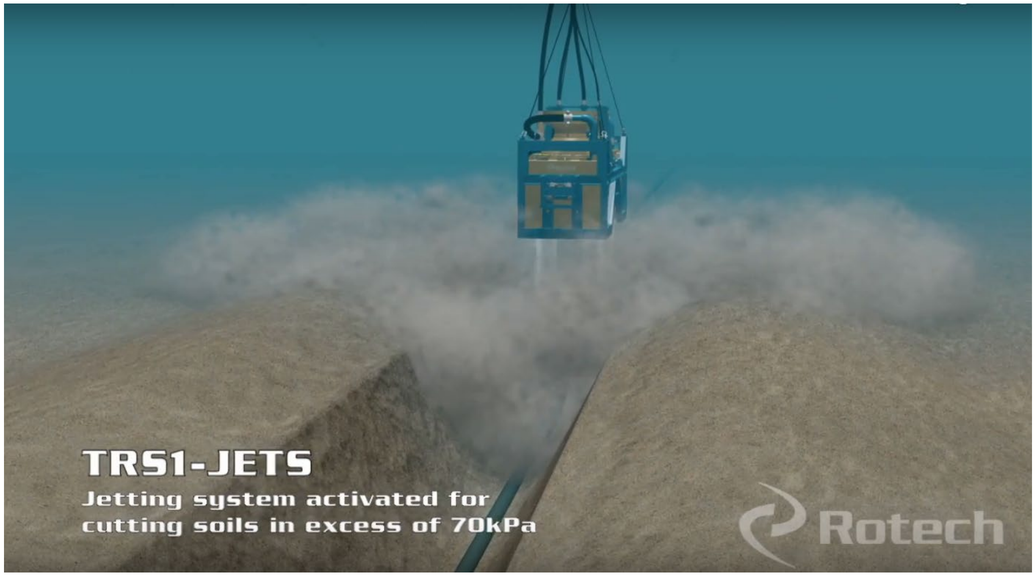
If there are large boulders (e.g., greater than 2 m [7 ft] in size) along the planned cable alignments that cannot be moved, the final cable alignments would be micro-sited around the boulders using a reasonable avoidance buffer. The size of the avoidance buffer would be defined based on the installation contractor's operating procedures and burial tool(s) in addition to any further engineering analysis.

3.5.3.2 Sand Bedform Dredging

Segments of the OECCs contain sand bedforms (i.e., ripples, megaripples, and sand waves), which may be mobile over time. The upper portions of these sand bedforms may require removal (i.e., dredging) so that the cable installation equipment can achieve sufficient burial depth into the stable sea bottom. Sand bedform dredging will be limited to the extent required to achieve sufficient cable burial depth. If required, sand bedform dredging may be accomplished by one or a combination of the following techniques:

- **Trailing suction hopper dredge:** With this method, one or two suction arms extend from the side of a vessel toward the seafloor (see Figure 3.5-5). The ends of the suction arm(s) are equipped with nozzles that direct pressurized seawater at the seafloor, loosening the seafloor sediments. The loosened sediments are then sucked up through the arm(s) into the vessel's hopper. Should a TSHD be used, it is anticipated that the vessel would dredge along the cable alignments until the hopper was full. Then, the TSHD would deposit the dredged material nearby within the OECC and only in areas of sand bedforms. The dredged material would be discharged via doors at the bottom of the vessel.
- **Controlled flow excavation:** Controlled flow excavation uses high volumes of pressurized water directed at the seafloor to push sediments aside (see Figure 3.5-5). The controlled flow excavation tool would be deployed by a vessel. Controlled flow excavation can be used to simultaneously remove the top of a sand bedform and bury the cable (see Section 3.5.4.1). Controlled flow excavation may require several passes to lower the cable to a sufficient burial depth. Controlled flow excavation is most likely to be used in areas where sand bedforms are less than 2 m (6.6 ft) high.





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

Controlled Flow Excavation

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

Trailing Suction Hopper Dredge

Figure 3.5-5

Types of Dredging Equipment

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- **Offshore excavator:** In shallow waters, an excavator may be used in limited areas to remove relatively small quantities of sand bedform material. The excavator would operate similarly to an onshore excavator, but would be mounted on a shallow draft vessel (which may or may not use stabilizing spud legs). The excavator arm could be equipped with a dredge pump, which operates similarly to a TSHD. Dredged material may be sidecast or collected in a vessel's hopper before being discharged elsewhere within the OECC and only in areas of sand bedforms.
- **Route clearance plow:** This method uses a plow deployed by a vessel to push sand to the side of the cable alignment.

The depth, length, area, and volume of dredging expected to be required for each OECC is provided in Section 3.5.7.

3.5.3.3 Pre-Lay Grapnel Runs

In the months preceding cable installation, a pre-lay grapnel run will be performed before installing each offshore export cable to clear the planned cable alignment of debris (e.g., discarded fishing gear, ropes, marine trash). [46] To complete the pre-lay grapnel run, a vessel will tow a grapnel train (i.e., a series of different size hooks) along the cable alignment. Depending on the size and type of debris, it will either be removed from the alignment or recovered to the

vessel deck. Any recovered fishing gear would be handled according to the protocols outlined in the FCP (see Section 8.3 and Appendix I-I). Potential seafloor disturbance from pre-lay grapnel runs within each OECC is quantified in Section 3.5.7.

3.5.3.4 Pre-Lay Surveys

Shortly before cable installation, the Proponent will perform pre-lay surveys of the final cable alignments to confirm that the alignments are free of obstructions and verify seafloor conditions. The pre-lay surveys are expected to be performed using multibeam echo-sounders and potentially magnetometers.

[46] Marine debris may also be cleared from the cable alignment during boulder clearance activities (see Section 3.5.3.1).

3.5.4 Cable Installation

The offshore export cables will be transported in one or more batches from a US or international manufacturing facility by the cable laying vessel or on a separate transport vessel (e.g., HTV or cable transport barge). If transported by the cable laying vessel, the cables would be brought directly to the OECCs or Lease Area from the manufacturing facility. If delivered by a separate transport vessel, the cables may be offloaded at a US staging port and subsequently loaded onto the cable laying vessel. Alternatively, the cables may be transferred from the transport vessel onto the cable laying vessel in port.

The offshore export cables are expected to be installed by one or more DP or anchored cable laying vessels. Anchored cable laying vessels may be equipped with spud legs that secure the vessel while its anchors are being repositioned. The cable installation tools (see Section 3.5.4.1) may be towed by the cable laying vessel or deployed from the vessel using an ROV. To install the cables close to shore, the cable laying vessel may temporarily ground nearshore. Alternatively, in shallow waters (where larger cable installation vessels cannot efficiently operate), the cable installation tools may be deployed from a shallow-water cable installation vehicle or seabed tractor. In this scenario, the vehicle or tractor may be controlled and powered from a shallower-draft vessel located nearby.

Any anchoring, spud leg deployment, or grounding will occur within surveyed areas of the OECCs and Lease Area. Vessel anchors and legs will avoid known sensitive seafloor habitats (i.e., eelgrass and hard/complex bottom) to the extent technically feasible and without compromising the vessel's safety or the cable's installation. Prior to the start of construction, contractors will be provided with a map of sensitive habitats to avoid so they can plan their anchoring positions accordingly. The maximum potential seafloor disturbance from vessels used during offshore export cable installation is estimated in Section 3.5.7.

The offshore export cables will be buried beneath the seafloor using the potential cable installation methods and tools described in Section 3.5.4.1. Each offshore export cable may be installed in multiple segments that are spliced together offshore (see Section 3.5.4.2 for a description of cable splicing). The ends of the offshore export cables will terminate at an ESP, booster station, or landfall site. Cable pull-in and termination at the ESP and booster station are described in Section 3.5.4.3 whereas installation at the landfall site is described in Section 3.7. Once the offshore export cables are installed, the cable contractor will perform an as-built survey of the cable alignments (see Section 3.5.4.4).

3.5.4.1 Cable Installation Techniques

The cables will be buried beneath the stable seafloor at a target depth of 1.5 to 2.5 m (5 to 8 ft).[47] The Proponent's engineers have determined that this target burial depth is more than twice the burial depth required to protect the cables from fishing activities and also generally provides a maximum of 1 in 100,000 year probability of anchor strike,[48] which is considered a negligible risk. Three methods can be used to install the offshore export cables:

- **Simultaneous lay and bury:** The cable installation tool simultaneously creates a trench in the seabed, lays the cable into the trench, and buries the cable. This method provides immediate protection of the cable but will likely occur more slowly than the other methods described below. The Proponent expects to use simultaneous lay and bury to install the offshore export cables.

- **Post-lay burial:** The cable is laid on the surface of the seabed and subsequently buried by a separate tool. This method can proceed faster than simultaneous lay and burial, but leaves the cables temporarily unprotected. Therefore, this method is most appropriate for short sections of cables (e.g., at the location of cable splices).

- **Pre-lay trenching:** The cable trench is excavated prior to cable installation and the excavated sediment is placed next to the trench. As the cable is laid or shortly thereafter, the trench is backfilled with the excavated sediment. Pre-trenching would only be used in limited circumstances where firmer ground (e.g., areas of stiff clay or high concentrations of boulders) is encountered. Pre-trenching is not suitable in sandy sediments where the excavated material would simply fall back into the trench before cable laying can be completed.

Several cable installation tools may be used to achieve a sufficient burial depth. The majority of the offshore export cables are expected to be installed via simultaneous lay and bury using jetting techniques or a mechanical plow, which are described below:

- **Jetting techniques (e.g., jet plowing or jet trenching):** Jetting tools typically have one or two arms that extend into the seabed or a plow. The arms or plow's share contain numerous nozzles that direct pressurized seawater at the seafloor to fluidize a narrow swath of sediment. The cable then sinks by its own weight or is lowered by the tool into the trench. Once the jetting tool moves on, the fluidized sediment naturally settles out of suspension, backfilling the narrow trench. Depending on the equipment used, jetting

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47 Unless the final Cable Burial Risk Assessment (CBRA) indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

48 Based on a preliminary CBRA (see Appendix II-T), in portions of the Ocean Beach Approach and Niantic Beach Approach of the Connecticut OECC, a greater target burial depth of approximately 3 m (10 ft) is needed to achieve a 1 in 100,000 year probability of anchor strike.

creates a trench up to approximately 1 m (3.3 ft) wide and is not expected to result in significant sidecast of materials from the trench. Jetting techniques can be used for simultaneous lay and bury or post-lay burial and are best suited for installation in sands or soft clays.

- **Mechanical plowing:** A mechanical plow contains a share that cuts a trench into the seabed and a moldboard that holds the sidewalls of the trench open. Some plowshares are equipped with jetting nozzles to increase performance. As the plow advances, the cable is fed into the trench created by the plow. While the plowshare itself would likely only be approximately 0.5 m (1.6 ft) wide, a 1 m (3.3 ft) wide trench disturbance is also conservatively assumed for this tool. This narrow trench will infill behind the tool, either by slumping of the trench walls or by natural infill, usually over a relatively short period of time. Mechanical plowing is typically used for simultaneous lay and burial and is best suited for stiffer soil conditions (but is also effective in a wide range of soil conditions).

Specialty cable installation techniques may be used along limited sections of the offshore export cables to maximize the likelihood of achieving sufficient burial depth (such as in areas of coarser or more consolidated sediment, rocky bottom, or other difficult conditions) while minimizing the need for cable protection and accommodating varying weather conditions. Specialty techniques include:

- **Mechanical trenching:** A mechanical trencher uses a rotating chain or wheel with cutting teeth/blades to cut a trench into the seabed. The cable is laid into the trench behind the trencher and the trench collapses and backfills naturally over time. Mechanical trenching is typically only used in more resistant sediments (e.g., clays and dense sands).

- **Precision installation:** In situations where a large tool is not able to operate or where another specialized installation tool cannot complete cable installation, a diver or ROV may be used to complete installation. The diver or ROV may use small jets or other small tools to complete installation.

- **Controlled flow excavation:** As further described in Section 3.5.3.2, controlled flow excavation uses high volumes of pressurized water directed at the seafloor to push sediments aside. Controlled flow excavation can be used for cable installation as well as dredging. This method may be used in limited locations, such as to bury cable splices or to bury a section of cable that does not achieve sufficient depth upon initial burial. Typically, a number of passes are required to lower the cable to a sufficient burial depth.

The offshore export cable installation method(s) and tool(s) ultimately used will be determined by the appointed cable installation contractor. The cable installation contractor will select tool(s) and methods(s) that maximize the likelihood of achieving the target burial depth, taking into account site-specific environmental conditions and cable properties. The Proponent will require the contractor to prioritize the least environmentally impactful cable installation alternative(s) that are practicable for each segment of cable.

Based on cable installation tools that are currently available, typical cable installation speeds are expected to range from 100 to 350 meters per hour (330 to 1,150 ft per hour). To preserve the integrity of the offshore export cables, cable installation will ideally be performed as a continuous action along the entire cable alignment between splices. Therefore, it is expected that offshore export cable installation activities will occur 24 hours per day.

The majority of the offshore export cables are expected to be installed with a single pass of the cable installation tool. However, in limited areas that are more challenging for cable burial, additional passes of the cable installation tool may be required to further lower the cable to a sufficient burial depth. Subsequent attempts with a different tool (such as controlled flow excavation) may also be required to help achieve sufficient burial. Additionally, prior to cable installation, a pre-pass jetting run (using a jet plow or jet trencher) may be conducted along targeted sections of the cable route to loosen stiff or hard sediments without installing the cable. A pre-pass jetting run maximizes the likelihood of achieving sufficient burial during a subsequent pass by the cable installation tool during simultaneous lay and bury operations. The expected maximum depth, width, and area of potential seafloor disturbance from the cable installation tool(s), including potential impacts from pre-pass jetting or multiple passes of the cable installation tool(s), are provided in Section 3.5.7.

As discussed in Section 3.5.5, while every effort will be made to achieve sufficient burial, a limited portion of the offshore export cables may not achieve a sufficient burial depth and will require cable protection.

3.5.4.2 Cable Splicing

Due to the length of the offshore export cables and other technical considerations, each cable may be installed in multiple segments that are spliced together offshore. A splice can be installed between two cable segments that are already installed (an omega or S-joint) or between one previously installed cable segment and the next segment to be installed (an in-line joint). Upon reaching the splicing location, the end(s) of the previously installed cable segment(s) will be retrieved from the seabed and brought inside the cable laying vessel or other specialized vessel (e.g., jack-up vessel). Prior to retrieving the cable ends for splicing, cable protection may be temporarily placed over the cable ends to protect them.

Inside a controlled environment onboard the vessel, the ends of the cable segments will be spliced together. Depending on the design of the cable and splice, the splicing process may take several days, in part, because it is a delicate process that can only be performed during good weather. Once cable splicing is completed, the spliced cable segments will be lowered to the seafloor and buried using one of the methods described in Section 3.5.4.1. If sufficient burial of the splice is not possible, cable protection may be installed over the splice (see Section 3.5.5). Potential seafloor impacts from vessels used during cable splicing operations are provided in Section 3.5.7.

3.5.4.3 Cable Pull-in, Termination, and Commissioning

Depending on the final construction schedule, the ends of the offshore export cables can be directly pulled into the ESP/booster station or temporarily wet-stored (during which, the cable ends are expected to be covered with cable protection). To commence cable pull-in, an ROV will likely recover a pre-installed messenger wire from the base of the foundation. The messenger wire will be connected to the end of the offshore export cable onboard the cable laying vessel. Then, using the messenger wire, a winch on the ESP or booster station topside will pull the cable up through the foundation and into the topside.

Where the offshore export cable enters the base of the foundation, the cable will likely be protected using a cable entry protection system, which is designed to reduce fatigue and mechanical loads as the cables transition above the seabed and into the foundation. The cable entry protection system consists of different components of composite material and/or cast-iron half-shells with suitable corrosion protection. The cable entry protection system will be mounted around the cable onboard the cable laying vessel before the cable is pulled into the foundation. Although a large majority of the cable entry protection system will likely lie on top of the scour protection (if used), it may extend a short distance beyond the edge of the scour protection. Additional cable protection may be placed on top of the cable entry protection system (mostly within the footprint of the scour protection) to secure the cable entry protection system in place and limit movement of the cable, which can damage the cable. Cable protection is described in Section 3.5.5 below.

Once the cable is inside the topside, the cable termination team will strip the cables to expose the power cores and fiber optic cables and connect them to the electrical infrastructure in the topside. After termination is complete, the export cables will be energized and commissioned. Jack-up vessels may be used for pull-in and commissioning work at the ESP(s) and booster station.

3.5.4.4 Post-Burial Cable Survey

During cable installation, the installation tool will likely record the precise location and achieved burial depth of each offshore export cable in real-time. If the depth of burial cannot be clearly established from any of the installation techniques, additional survey work may be undertaken. The Proponent will coordinate with USCG and the National Oceanic and Atmospheric Administration (NOAA) to ensure that the as-built cable alignments, including the location of cable protection and cable crossings, are included on nautical charts.

As discussed further in Section 4.2.3, the offshore cables will be surveyed periodically throughout the operational period.

3.5.5 Cable Protection

While every effort will be made to achieve sufficient burial, a limited portion of the offshore export cables (up to approximately 9% for the cables to Massachusetts and up to approximately 6% for the cables to Connecticut)[49] may require remedial cable protection if a sufficient burial depth cannot be achieved. Cable protection may also be used if the cables need to cross other infrastructure (e.g., existing cables, pipelines, etc.), to secure the cable entry protection system in place, or where a cable splice requires protection.

Potential cable protection methods include:

- **Rocks:** One or more layers of rock laid on top of the cable to provide protection. Rocks used for cable protection will be sized for site-specific conditions. If multiple layers are used, the lower layer(s) would consist of smaller sized rock followed by an upper armor layer consisting of larger rock. The rocks are expected to have a nominal rock diameter equivalent to that of a cube (D_{n50}) of approximately 25–500 millimeters (1–20 inches).[50]

- **Rock bags:** Rock encased in a net material (e.g., a polyester mesh) that is placed over a cable. The bag is equipped with a lifting point to enable accurate and efficient deployment as well as recovery, if necessary. The net material would be non-corrosive, rot-proof, and weather-resistant.

- **Concrete mattresses:** Prefabricated flexible concrete coverings consisting of high-strength concrete blocks cast around a mesh (e.g., ultra-violet stabilized polypropylene rope) that holds the blocks together. The mesh would be designed to have a decades-long lifespan. The flexible mattress settles over the contours of the cable. The mattress may also include aerated polyethylene fronds, which will float (resembling seaweed) and encourage sediments to be deposited on the mattress.

- **Half-shell pipes or similar:** Similar to the cable entry protection system described in Section 3.5.4.3 above, these products are made from composite materials and/or cast iron with suitable corrosion protection and are fixed around the cable to provide mechanical protection. Half-shell pipes (or similar solutions) are not used for remedial cable protection but could be used at cable crossings or where the cable must be laid on the surface of the seabed. The half-shell pipes do not ensure full protection from damage due to fishing trawls or anchor drags (although they will offer some protection, they will not prevent damage).

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[49] These percentages are based on the total length of the offshore export cables, including the portion of the cables within the Lease Area.

[50] Some rocks may be fragmented into smaller pieces during handling, transport, and installation.

The Proponent will evaluate the feasibility of using nature-inclusive cable protection designs, which refers to options that can be integrated in or added to the design of cable protection to create suitable habitat for native species (Hermans et al. 2020). Nature-inclusive designs can include adding an additional layer of larger rock to provide larger crevices, using methods that can be easily relocated with minimal disturbance during cable repairs (e.g., rock bags with lifting points), using mattresses with specially-designed concrete blocks that create additional nooks and crannies, and using mattresses with polyethylene fronds.

Freely laid rock is expected to be installed by a fallpipe vessel, but may also be installed using a vessel's crane/bucket or via side dumping from a vessel (similar to scour protection installation described in Section 3.3.4). Rock bags and concrete mattresses would be deployed by a vessel's crane or excavator arm (in nearshore areas) using a lifting point incorporated into the cable protection's design or using an installation frame. Half-shell pipes (or similar) would be fixed around the cable onboard the cable laying vessel before the cable is installed. The maximum dimensions of cable protection and area of potential seafloor disturbance from cable protection installation are provided in Section 3.5.7.

3.5.6 Cable Crossings

The offshore export cables will need to cross existing and proposed submarine cables and pipeline areas. As shown in Figure 3.5-6, Vineyard Northeast's offshore export cables within the Massachusetts OECC may cross the offshore cables proposed for Vineyard Wind 1 (two cables), New England Wind (up to five cables), SouthCoast Wind (up to 11 cables, with six of the cables crossed twice), and one designated cable area.[51] To account for other offshore wind projects that may be developed within the MA WEA and RI/MA WEA as well as unmapped infrastructure that may be identified during offshore surveys, the Proponent conservatively estimates that there will be up to 42 cable crossings for each HVAC cable/HVDC cable bundle within the Massachusetts OECC. The offshore export cables within the Connecticut OECC may cross the offshore cables proposed for Beacon Wind (up to four cables), South Fork Wind (one cable), and Sunrise Wind (one cable bundle) as well as eight other submarine cables and up to four designated cable and/or pipeline areas,[52] depending on which Connecticut landfall site is used. Accounting for future offshore wind projects and unmapped infrastructure, the Proponent has conservatively assumed there will be up to 37 crossings for each cable bundle in the Connecticut OECC.

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[51] A cable area identifies the location of one or more submarine cables within protected waters such as harbors, rivers, bays, estuaries, or other inland waterways.

[52] A cable area identifies the location of one or more submarine cables within protected waters (e.g., harbor, river). A pipeline area identifies the location of one or more pipelines within protected waters.

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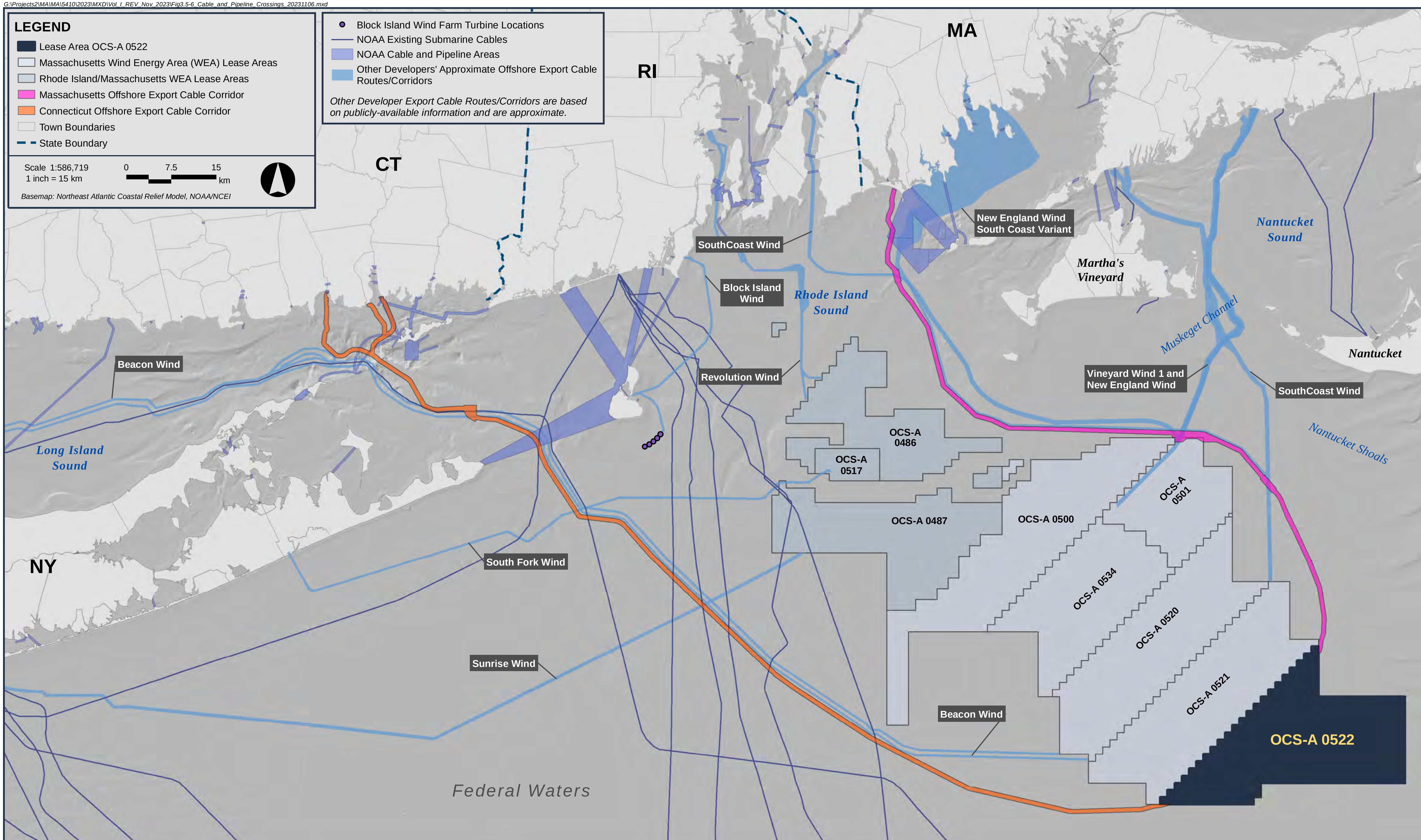

Figure 3.5-6
Expected Cable and Pipeline Crossings within the OECCs

VINEYARD NORTHEAST
VINEYARD OFFSHORE

For crossings of active, in-service cables and pipelines, the Proponent will make all reasonable efforts to enter into a crossing agreement with the cable's or pipeline's owner. The terms of the crossing agreement will govern the design, coordination process, and execution of the crossing. It is likely that the existing cable/pipeline will prevent the Proponent's offshore export cable from being buried to a sufficient depth at the crossing location. If the Proponent's cable is surface laid in the immediate vicinity of the cable crossing, half-shell pipe (or similar) would likely be applied to the cable. Remedial post-lay burial of the Proponent's cable on either side of the crossing may be performed to lower the cable beneath the seabed. Soon after installing the cable at the crossing, additional cable protection will likely be carefully placed on and around the crossing (see Section 3.5.5). The cable crossings will be designed to minimize the risk of snagging fishing equipment. The maximum potential seafloor disturbance at cable crossings is provided in Section 3.5.7.

If an existing cable is inactive/abandoned, it may alternatively be cut and removed prior to installing the Proponent's cables (in which case, cable protection may not be required).

3.5.7 Summary of Maximum Potential Seafloor Disturbance During Offshore Export Cable Installation

The maximum potential seafloor disturbance from offshore export cable installation (including pre-installation activities and cable protection) is provided in Table 3.5-1. Given that a portion of the offshore export cables will be installed within the Lease Area, Table 3.5-1 provides the maximum area of potential seabed disturbance for the export cables within the Lease Area as well as the OECCs.

Table 3.5-1 Seafloor Disturbance During Offshore Export Cable Installation

Parameter[1]	Massachusetts OECC + Lease Area[2]	Connecticut OECC + Lease Area[3]
Maximum number of offshore export cables	3	2
Maximum cable length within the OECC (per cable)[4]	132 km (71 NM)	188 km (101 NM)
Maximum cable length within the Lease Area (per cable)	13 km (7 NM)	23 km (12 NM)
Maximum cable length (per cable)	145 km (78 NM)	210 km (114 NM)
Maximum total length of offshore export cables	436 km (235 NM)	421 km (227 NM)
Maximum number of cable splices expected[5]	15 total (5 per cable)	14 total (7 per cable)

Table 3.5-1 Seafloor Disturbance During Offshore Export Cable Installation (Continued)

Parameter[1]	Massachusetts OECC + Lease Area[2]	Connecticut OECC + Lease Area[3]
Temporary Seafloor Disturbance from Cable Installation, Pre-Lay Grapnel Runs, and Boulder Clearance		
Typical maximum depth of cable trench (in areas without sand bedforms)	3 m (10 ft)	3 m (10 ft)
Maximum total width of disturbance from cable installation, pre-lay grapnel runs, and boulder clearance:	10 m (33 ft)	10 m (33 ft)
• Subset of total width for cable trench	1 m (3 ft)	1 m (3 ft)
• Subset of total width for cable trench. Additional surficial disturbance from installation tool skid/tracks, pre-lay grapnel runs, and boulder clearance[6]	9 m (30 ft)	9 m (30 ft)
Maximum total area of disturbance from cable installation, pre-lay grapnel runs, and boulder clearance	4.36 square kilometers (km^2) (1,077 acres)	4.21 km^2 (1,040 acres)
Temporary Seafloor Disturbance from Sand Bedform Dredging		
Maximum depth of disturbance where dredging occurs (includes 3 m [10 ft] cable installation trench depth)[7]	8.5 m (28 ft)	8.5 m (28 ft)
Maximum width of dredging (at bottom) per cable[8]	20 m (66 ft)	20 m (66 ft)
Maximum total length of dredging	4.9 km (2.6 NM)	15 km (7.8 NM)
Maximum total area of dredging	0.11 km^2 (26 acres)	0.41 km^2 (102 acres)
Maximum total volume of dredging	27,884 cubic meters (m^3) (36,471 cubic yards [yd^3])	451,628 m^3 (590,707 yd^3)
Temporary Seafloor Disturbance from Vessels		
Maximum total area of disturbance from cable laying vessel[9]	0.31 km^2 (75 acres)	0.29 km^2 (73 acres)
Maximum total area of disturbance during vessel grounding[10]	0.03 km^2 (7 acres)	0.02 km^2 (5 acres)
Maximum total area of vessel disturbance during cable splicing[11]	0.009 km^2 (2.2 acres)	0.008 km^2 (2.1 acres)
Long-Term Seafloor Disturbance from Cable Protection		
Maximum thickness of cable protection for insufficient burial	1.5 m (5 ft)	1.5 m (5 ft)
Maximum thickness of cable protection at cable crossings	2 m (7 ft)	2 m (7 ft)

Table 3.5-1 Seafloor Disturbance During Offshore Export Cable Installation (Continued)

Parameter[1]	Massachusetts OECC + Lease Area[2]	Connecticut OECC + Lease Area[3]
Long-Term Seafloor Disturbance from Cable Protection (Continued)		
Maximum width of cable protection	9 m (30 ft)	9 m (30 ft)
Maximum total length of cables requiring cable protection for insufficient burial	37 km (20 NM)	20 km (11 NM)
Maximum number of cable crossings expected	126 total (42 per cable)	74 total (37 per cable)
Maximum total length of cables requiring cable protection at cable crossings[12]	1.1 km (0.6 NM)	0.7 km (0.4 NM)
Maximum total area of cable protection for insufficient burial and cable crossings	0.34 km^2 (85 acres)	0.18 km^2 (45 acres)
Total Seafloor Disturbance		
Long-term seafloor disturbance OECC: Lease Area: Total:	 0.34 km^2 (83 acres) 0.007 km^2 (2 acres) 0.34 km^2 (85 acres)	 0.17 km^2 (43 acres) 0.008 km^2 (2 acres) 0.18 km^2 (45 acres)
Temporary seafloor disturbance[13] OECC: Lease Area: Total:	 4.33 km^2 (1,071 acres) 0.42 km^2 (105 acres) 4.76 km^2 (1,176 acres)	 4.31 km^2 (1,065 acres) 0.49 km^2 (121 acres) 4.80 km^2 (1,186 acres)
Total seafloor disturbance[14] OECC: Lease Area: Total:	 4.33 km^2 (1,071 acres) 0.42 km^2 (105 acres) 4.76 km^2 (1,176 acres)	 4.31 km^2 (1,065 acres) 0.49 km^2 (121 acres) 4.80 km^2 (1,186 acres)

Notes:

1. For HVDC offshore export cables, "per cable" refers to each cable bundle.
2. The maximum potential seafloor disturbance for the offshore export cables to Massachusetts assumes the use of three HVAC cables connecting to a booster station in the northwestern aliquot of Lease Area OCS-A 0534.
3. The maximum potential seafloor disturbance for the offshore export cables to Connecticut assumes the use of the approach to a Connecticut landfall site with the greatest seafloor disturbance.
4. The maximum length of cable within the OECC includes a 5% allowance for micro-siting and to account for the length of cable required to reach the transition vault at the landfall site.
5. Additional cable splices may be required if the cable is cut due to site conditions or adverse weather.
6. This width accounts for additional disturbance beyond the cable trench from the skids or tracks of the cable installation equipment (which slide over the surface of the seafloor), pre-pass jetting, multiple passes of the installation tool, pre-lay grapnel runs, and boulder clearance. The depth of disturbance from these activities would be less than the cable trench depth.
7. The average depth of disturbance where dredging occurs is expected to be far less than 8.5 m (28 ft).
8. It is assumed that the dredge corridor will be 20 m (66 ft) wide at the bottom (to allow for installation equipment maneuverability) with approximately 1:4 sideslopes. The top width of the dredge corridor will depend on the corridor's depth. The width of the dredge corridor includes the width of disturbance from the cable installation trench, the cable installation tool's skids/tracks, pre-pass jetting, multiple passes of the installation tool, pre-lay grapnel runs, and boulder clearance.

Table 3.5-1 Seafloor Disturbance During Offshore Export Cable Installation (Continued)

9. The cable laying vessel may use a nine-point anchoring system, which provides greater force on the cable burial tool than a spread with fewer anchors and enables greater burial depth. On average, anchors are assumed to reposition approximately every 400 m (1,312 ft), although anchor resetting is highly dependent on the contractor's specific vessel(s). The cable laying vessel is estimated to disturb approximately 280 m^2 (3,014 square feet [ft^2]) of the seafloor each time it repositions its anchors (30 m^2 [323 ft^2] per anchor and 10 m^2 (108 ft^2) for spud legs).
10. Vessel grounding may impact an area of up to 9,750 m^2 (104,948 ft^2) per cable.
11. If a jack-up vessel is used for cable splicing, the vessel would disturb approximately 600 m^2 (6,458 ft^2) of seafloor each time the vessel jacks-up.
12. This conservatively assumes that all cable crossings will require cable protection.
13. To avoid double-counting impacts, the total area of temporary seafloor disturbance does not include the 10 m (33 ft) wide disturbance from cable installation, pre-lay grapnel runs, and boulder clearance within the 20 m (66 ft) wide (at bottom) dredging corridor.
14. Because the long-term disturbance from cable protection will be within the area of temporary disturbance from cable installation, pre-lay grapnel runs, dredging, and boulder clearance, the total area of seafloor disturbance is the same as the area of temporary seafloor disturbance.

3.6 Inter-Array and Inter-Link Cables

Inter-array cables will connect strings of multiple WTGs to the ESP(s). If two or three ESPs are used, up to six inter-link cables may connect the ESPs together to provide redundancy and thus improve reliability.

3.6.1 Cable Design

3.6.1.1 Inter-Array Cable Design

The inter-array cables are expected to be 66–132 kV HVAC cables that contain three aluminum or copper conductors for power transmission and one or more fiber optic cables. The HVAC inter-array cable design will be conceptually similar to the HVAC offshore export cable design (see Section 3.5.1.2), but may differ due to the lower voltages and different performance specification requirements of the inter-array cables. For example, the inter-array cables may not include water blocking layer(s) and may have different armoring, including high-density polyethylene (HDPE) or other materials. Alternatively, 66–132 kV HVDC inter-array cables may be used, if such technology becomes available in the future. The HVDC inter-array cable design would be conceptually similar to the HVDC offshore export cable design described in Section 3.5.1.1. The inter-array cables will likely include DTS, DAS, OLPD monitoring, and/or a similar monitoring system to continuously assess the status of the cables and detect anomalous conditions (see Section 4.1.2).

Each section of the inter-array cable string must transmit an increasing amount of power in the direction from the outermost WTG to the ESP. Therefore, multiple cross sections with different capacities are envisioned for the inter-array cables. The inter-array cables will have a maximum outer diameter of approximately 0.23 m (0.75 ft).

3.6.1.2 Inter-Link Cable Design

The inter-link cables are expected to be the same cable type as the offshore export cables or the inter-array cables. As such, the inter-link cables may be HVAC or HVDC with a voltage of 66–525 kV. See Section 3.5.1 for a description of the offshore export cable design and Section 3.6.1.1 for a description of the inter-array cable design.

3.6.2 Inter-Array and Inter-Link Cable Routes

A variety of inter-array cable configurations may be used, including linear strings and branched strings. The WTG at the end of each string will have one outgoing connection (although redundant cables may be used to enhance reliability) and each subsequent WTG will have both incoming and outgoing inter-array cables.

The inter-array and inter-link cable layout is highly dependent upon the selected location and number of ESPs. The design and optimization of the inter-array and inter-link cable system will occur during the final design of Vineyard Northeast and will consider cable design and capacity, ground conditions, operating conditions, installation conditions, and potential cultural resources. This means that the Proponent is permitting a PDE for the inter-array and inter-link cables that includes any potential layout within the Lease Area. All areas where inter-array and inter-link cables are located will be surveyed and assessed in accordance with BOEM regulations and guidance. A representative inter-array and inter-link cable layout is provided as Figure 3.6-1 for illustrative purposes. The maximum length of the inter-array and inter-link cables is provided in Section 3.6.6.

3.6.3 Pre-Installation Activities

Prior to cable installation, the inter-array and inter-link cable alignments may require limited sand bedform dredging and boulder clearance. See Sections 3.5.3.1 and 3.5.3.2 for a description of boulder clearance and sand bedform dredging, respectively. Following those activities, pre-lay grapnel runs and pre-lay surveys will be performed to confirm that the cable alignments are free of obstructions and are suitable for installation. Pre-lay grapnel runs are described in Section 3.5.3.3 and pre-lay surveys are described in Section 3.5.3.4. The maximum potential seafloor disturbance from preparatory activities prior to inter-array and inter-link cable installation is provided in Section 3.6.6.

3.6.4 Cable Installation

The inter-array cables and inter-link cables (if used) may be transported directly from a US or international manufacturing facility to the Lease Area in the cable laying vessel. Alternatively, they may be delivered by a separate transport vessel to a US staging port and subsequently transferred onto the cable laying vessel.

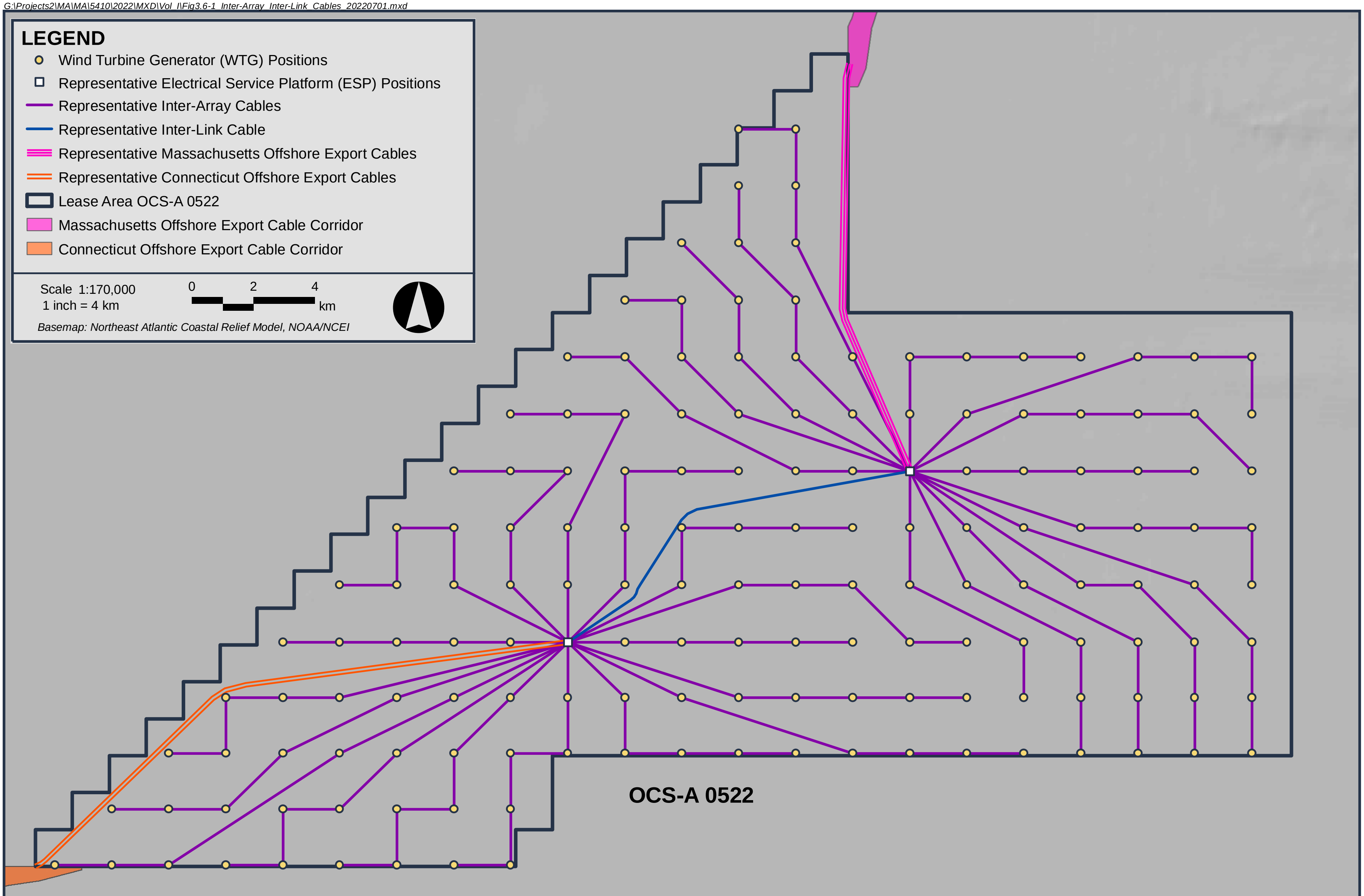

Figure 3.6-1
Representative Inter-Array and Inter-Link Cable Layout

Upon arrival at the Lease Area, the first end of an inter-array cable will be pulled into a WTG or ESP foundation using winches installed on the foundation. Once the first end of the cable is secured inside the foundation, the cable laying vessel will lay the cable as it moves towards the next foundation in the inter-array cable string. As the cable laying vessel approaches the next foundation, the remaining cable length required for the second-end pull-in will be calculated, and the cable will be cut. Then, the second end of the cable will be pulled into the foundation.

The inter-array cables will be buried beneath the stable seafloor at a target depth of 1.5 to 2.5 m (5 to 8 ft).[53] Based on currently available technologies, the expected installation method for the inter-array cables is post-lay burial using a jetting technique (see Section 3.5.4.1). Using this method, the cable laying vessel would surface lay the inter-array cables between foundations. Cable burial would then be performed in a subsequent operation by the cable laying vessel or by a dedicated burial vessel. However, the inter-array cables may be installed using any of the methods and installation tools described for offshore export cables in Section 3.5.4.1. The cable laying vessel and burial vessel (if used) are expected to be DP vessels; anchoring is not expected for inter-array cable installation.

The inter-link cables will also be buried beneath the stable seafloor at a target depth of 1.5 to 2.5 m (5 to 8 ft).[54] Inter-link cable installation will follow a process similar to inter-array cable installation or offshore export cable installation (see Section 3.5.4), except that the cable will be installed between ESPs. Whereas inter-array cable installation is expected to use DP vessel(s), inter-link cable installation may be performed using an anchored vessel. Any seafloor disturbance during inter-link cable installation, including disturbance from anchoring, will occur within surveyed areas of the Lease Area. The maximum potential seafloor disturbance from inter-link and inter-array cable installation is provided in Section 3.6.6.

The inter-array and inter-link cables will likely be protected using a cable entry protection system where they enter the WTG and ESP foundations. As further described in Section 3.5.4.3, the cable entry protection system is expected to be mounted around the cable onboard the cable laying vessel before the cable is pulled into the WTG or ESP. Additional cable protection may be placed over the cable entry protection system to secure it in place and limit movement of the cable.

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53 Unless the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

54 Unless the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

After the inter-array and inter-link cables are pulled into the WTG and ESP foundations, the cable termination team will strip the cables to expose the power cores and fiber optic cables and connect them to electrical infrastructure located in the top of the foundation or in the ESP topside. After termination is complete, the cables will be energized and commissioned. See Section 3.5.4.3 for additional description of cable pull-in, termination, and commissioning.

The Proponent expects that the final alignments of the inter-array and inter-link cables will be documented either at the time of installation or shortly thereafter with an as-built survey. Cable monitoring and surveys during O&M are described in Sections 4.1.2 and 4.2.3.

3.6.5 Cable Protection

The Proponent conservatively estimates that up to approximately 2% of the total length of the inter-array and inter-link cables could require cable protection, with the majority of the cable protection likely located adjacent to the foundation's scour protection.[55] Where feasible, the inter-array and inter-link cable layout will be designed to avoid areas with increased risk of not achieving the target burial depth. In addition, the inter-array and inter-link cable layout will be designed to avoid cable crossings; thus, no cable protection for cable crossings is expected.

Cable protection methods, which include freely laid rock, rock bags, concrete mattresses, and half-shell pipes (or similar), and installation techniques are described in Section 3.5.5. The maximum dimensions of cable protection and the area of potential seafloor disturbance from cable protection installation are provided in Section 3.6.6.

3.6.6 Summary of Potential Seabed Disturbance During Inter-Array and Inter-Link Cable Installation

The maximum potential seafloor disturbance from inter-array and inter-link cable installation is provided in Table 3.6-1.

Table 3.6-1 Seafloor Disturbance During Inter-Array and Inter-Link Cable Installation

Parameter	Inter-Array + Inter-Link Cables
Maximum total inter-array cable length	356 km (192 NM)
Maximum total inter-link cable length	120 km (65 NM)
Maximum total inter-array and inter-link cable length	476 km (257 NM)

55 The estimate of cable protection includes any length of the cable entry protection system beyond the scour protection. As described in Section 3.6.4, additional cable protection may be used to secure the cable entry protection system in place.

Table 3.6-1 Seafloor Disturbance During Inter-Array and Inter-Link Cable Installation (Continued)

Parameter	Inter-Array + Inter-Link Cables
Temporary Seafloor Disturbance from Cable Installation, Pre-Lay Grapnel Runs, and Boulder Clearance	
Maximum depth of cable trench (in areas without sand bedforms)	3 m (10 ft)
Maximum total width of disturbance from cable installation, pre-lay grapnel runs, and boulder clearance:	10 m (33 ft)
• Subset of total width for cable trench	1 m (3 ft)
• Additional surficial disturbance from installation tool skid/tracks, pre-lay grapnel runs, and boulder clearance[1]	9 m (30 ft)
Maximum total area of disturbance from cable installation, pre-lay grapnel runs, and boulder clearance	4.76 km^2 (1,176 acres)
Temporary Seafloor Disturbance from Sand Bedform Dredging	
Maximum depth of disturbance where dredging occurs (includes 3 m [10 ft] cable installation trench depth)[2]	8.5 m (28 ft)
Maximum width of dredging (at bottom) per cable[3]	20 m (66 ft)
Maximum total length of dredging	3.2 km (1.7 NM)
Maximum total area of dredging	0.08 km^2 (19 acres)
Maximum total volume of dredging	35,200 m^3 (46,040 yd^3)
Temporary Seafloor Disturbance from Vessels	
Maximum total area of disturbance from cable laying vessel for inter-link cables[4]	0.08 km^2 (21 acres)
Long-Term Seafloor Disturbance from Cable Protection	
Maximum thickness of cable protection for insufficient burial	1.5 m (5 ft)
Maximum width of cable protection	9 m (30 ft)
Maximum total length of cables requiring cable protection for insufficient burial	9.5 km (5.1 NM)
Maximum total area of cable protection for insufficient burial	0.09 km^2 (21 acres)

Table 3.6-1 Seafloor Disturbance During Inter-Array and Inter-Link Cable Installation (Continued)

Parameter	Inter-Array + Inter-Link Cables
Total Seafloor Disturbance	
Long-term seafloor disturbance	0.09 km^2 (21 acres)
Temporary seafloor disturbance[5]	4.89 km^2 (1,208 acres)
Total seafloor disturbance[6]	4.89 km^2 (1,208 acres)

Notes:

1. This width accounts for additional disturbance beyond the cable trench from the skids or tracks of the cable installation equipment (which slide over the surface of the seafloor), pre-pass jetting, multiple passes of the installation tool, pre-lay grapnel runs, and boulder clearance. The depth of disturbance from these activities would be less than the cable trench depth.
2. The average depth of disturbance where dredging occurs is expected to be far less than 8.5 m (28 ft).
3. It is assumed that the dredge corridor will be 20 m (66 ft) wide at the bottom (to allow for installation equipment maneuverability) with approximately 1:4 sideslopes. The top width of the dredge corridor will depend on the corridor's depth. The width of the dredge corridor includes the width of disturbance from the cable installation trench, the cable installation tool's skids/tracks, pre-pass jetting, multiple passes of the installation tool, pre-lay grapnel runs, and boulder clearance.
4. The cable laying vessel may use a nine-point anchoring system, which provides greater force on the cable burial tool than a spread with fewer anchors and enables greater burial depth. On average, anchors are assumed to reposition approximately every 400 m (1,312 ft), although anchor resetting is highly dependent on the contractor's specific vessel(s). The cable laying vessel is estimated to disturb approximately 280 m^2 (3,014 ft^2) of the seafloor each time it repositions its anchors (30 m^2 [323 ft^2] per anchor and 10 m^2 (108 ft^2) for spud legs).
5. To avoid double-counting impacts, the total area of temporary seafloor disturbance does not include the 10 m (33 ft) wide disturbance from cable installation, pre-lay grapnel runs, and boulder clearance within the 20 m (66 ft) wide (at bottom) dredging corridor.
6. Because the long-term disturbance from cable protection will be within the area of temporary disturbance from cable installation, pre-lay grapnel runs, dredging, and boulder clearance, the total area of seafloor disturbance is the same as the area of temporary seafloor disturbance.

3.7 Landfall Sites

Vineyard Northeast's offshore export cables will transition onshore at two landfall sites (one in Massachusetts and one in Connecticut). At the landfall sites, the offshore export cables will connect to the onshore export cables within underground transition vaults. The landfall sites are described in Sections 3.7.1 and 3.7.2. Construction at the landfall sites is described in Section 3.7.3.

3.7.1 Massachusetts Landfall Site

Offshore export cables installed within the Massachusetts OECC will transition onshore at the Horseneck Beach Landfall Site (see Figure 3.5-3). The Horseneck Beach Landfall Site is located in portion of a paved parking area within Horseneck Beach State Reservation, a state-owned facility in Westport, Massachusetts that is managed by the Massachusetts Department of Conservation and Recreation (DCR) (Mass.gov c2022). The precise location of the landfall site within the Horseneck Beach State Reservation will be determined in coordination with DCR and local officials. The landfall site is near the entrance to Buzzards Bay, east of the Westport River. Nearby land uses include the public beach (and associated bathhouse), a campground, and open space within the State Reservation as well as a beach club (Baker's Beach Club) and homes west of the State Reservation.

3.7.2 Connecticut Landfall Site

Offshore export cables installed within the Connecticut OECC will transition onshore at one of the following landfall sites shown on Figure 3.5-4:

- **Ocean Beach Landfall Site:** The Ocean Beach Landfall Site is located in a portion of a paved parking area within Ocean Beach Park in New London, Connecticut. Ocean Beach Park is a public recreation facility owned by the City of New London that includes a beach, boardwalk, swimming pool, and bathhouse, among other facilities (Ocean Beach Park c2017). The landfall site is located near the mouth of the Thames River. Nearby land uses primarily include private residences.

- **Eastern Point Beach Landfall Site:** The Eastern Point Beach Landfall Site is located in a portion of a paved parking area on Eastern Point in Groton, Connecticut. The beach, which is located near the mouth of the Thames River, is managed by the City of Groton's Parks and Recreation Department (City of Groton [date unknown]). Nearby land uses include the public beach and associated bathhouse, recreation facilities (e.g., playground), and open space as well as private residences to the north and east.

- **Niantic Beach Landfall Site:** The Niantic Beach Landfall Site is located in a paved parking area at Niantic Beach in East Lyme, Connecticut. The landfall site is near the mouth of the Niantic River. The town-managed beach includes a boardwalk and bathhouse (Town of East Lyme c2022). The beach is abutted by Route 156 and train tracks. Nearby land uses include a marina.

The precise location of the landfall site will be determined through consultations and coordination with state and local officials.

3.7.3 Landfall Site Construction

At each landfall site, the offshore export cables are expected to transition onshore using horizontal directional drilling (HDD). Although not anticipated, if detailed engineering for the Connecticut landfall sites determines that HDD is technically infeasible, offshore open trenching may be used to bring the offshore export cables onshore.[56]

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[56] Open trenching at the Horseneck Beach Landfall Site in Massachusetts is unforeseen. In the event that consultations with state and local agencies result in the identification of an alternative Massachusetts landfall site, open trenching could be required.

Horizontal Directional Drilling

HDD is a trenchless installation method that avoids or minimizes impacts to the beach, intertidal zone, and nearshore areas and achieves a burial significantly deeper than any expected erosion. HDD also avoids or minimizes impacts to boardwalks and any jetties located near the landfall sites. HDD at the landfall sites will follow these steps:

1. **Excavation of the approach and exit pits:** To support HDD activities, the Proponent will set up an approximately 4,500 m^2 (1.1 acre) HDD staging area in a parking lot or other previously disturbed area. At the onshore HDD staging area, an approximately 5 m (16 ft) by 5 m (16 ft) approach pit will be excavated to provide the contractor with access to the proper drilling trajectory and serve as a reservoir for drilling fluids. Offshore, an up to ~50 m (164 ft) by 15 m (49 ft) exit pit will be excavated for each cable/cable bundle using techniques such as controlled flow excavation or an offshore excavator (see Section 3.5.3.2). An offshore excavator, if used, would operate similarly to an onshore excavator, but would be mounted on a shallow draft vessel (which may or may not use stabilizing spud legs). At the exit pit, a cofferdam (or similar method) may be used depending on subsurface conditions and the depth of burial.

2. **Drilling and reaming of the bore holes:** Bore holes will be drilled between the onshore approach pit and the offshore exit pit in an arc beneath the beach and nearshore zone. After the initial path is drilled, the drill head will likely be replaced with a larger cutter head to enlarge the bore hole. The maximum expected diameter of ground disturbance from drilling and reaming the bore holes is 1.5 m (5 ft). One bore hole is needed for each offshore export cable/cable bundle. The length and maximum depth of the bore hole depends on the width of the dune and beach area, the proximity of the HDD staging area, the extent of any nearshore sensitive resources, bathymetry, and geologic conditions. The bore holes are anticipated to be approximately 300–1,800 m (980–5,910 ft) long, subject to further detailed engineering. HDD will require the use of a drilling fluid to cool and lubricate the drilling equipment and to extract excavated material from the bore hole. The drilling fluid is expected to be a slurry of bentonite (a naturally-occurring, inert, and non-toxic clay) and water. During drilling, the mixture of drill cuttings and used drilling fluids will be collected in the approach pit, filtered, and separated to enable reuse of the drilling fluid. Non-reusable excess drilling fluids and drill cuttings are typically classified as clean fill and will be transported to an appropriate disposal site (e.g., gravel pits, local landfall, farm fields/pastures). Filtered water may be released if it meets water quality requirements. Measures to minimize the remote potential for inadvertent releases of drilling fluid are described in Section 6.2.

3. **Conduit and cable insertion:** Once the bore holes are completed, a plastic (e.g., HDPE or polyvinyl chloride [PVC]) or steel conduit will be inserted into the holes. The conduits are expected to be up to approximately 1.2 m (4 ft) in diameter. Next, the offshore export cables will be inserted into the seaward end of the conduits and pulled through

the conduits towards shore. A jack-up vessel may be used to facilitate this process.[57] Thermal grout may be used to fill the interstitial space between the offshore export cable and cable conduit to enhance the thermal characteristics of the cable (i.e., to enhance heat dissipation from the cable). Grout would likely be pumped from a vessel into the seaward end of the conduit. At the landward end of the conduit, the non-hazardous mixture of displaced water, grout, and sand would be collected, dewatered, and disposed of per applicable regulations. If grout is not used, a mixture of seawater and/or sand will occupy the interstitial space between the cable and conduit. Next, the seaward end of each conduit will be buried beneath the seafloor, likely using divers with hand-jets. If softer sediments are present, silt curtains will be employed in and around the area of hand-jetting to contain turbidity.

4. **Cable pull-in to transition vaults:** Up to three transition vaults could be located at the Massachusetts landfall site and up to two transition vaults could be located at the Connecticut landfall site. Onshore, between the approach pit and the transition vault(s), the offshore export cables will be installed in open trenches (see Section 3.8.3.2 for a description of open trenching onshore). Once the offshore export cables are pulled into the underground concrete transition vault(s), they will be connected to the onshore export cables. If HVAC cables are used, inside the transition vault(s), each offshore export cable will be separated and spliced into three separate single-core onshore export cables. If HVDC cables are used, the offshore power cables and fiber optic cables will simply be joined together with the onshore power and fiber optic cables. Each vault is anticipated to be up to approximately 7 m (23 ft) wide by 22.5 m (74 ft) long by 5 m (16 ft) deep (including backfill overtop of the vault). Immediately adjacent to the transition vault(s), there may be smaller fiber optic cable vault(s) and/or link boxes.

5. **Site restoration:** The Proponent will restore the onshore HDD staging area to match pre-existing conditions. Any paved areas that have been disturbed will be properly repaved. Offshore, the exit pit will be backfilled.

Offshore Open Trenching

Although not anticipated, if open trenching is used to bring the offshore export cables onshore at the Connecticut landfall site, the process will begin with the installation of a temporary, three-sided cofferdam constructed of sheet piles likely using a vessel-mounted crane and vibratory hammer. The cofferdam will be open at the landward end to allow for the installation of plastic (e.g., HDPE or PVC) conduits toward the onshore transition vault(s). Once the sheet piles are

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57 If a jack-up vessel is used for landfall site construction, the vessel would disturb approximately 600 m^2 (6,458 ft^2) of seafloor each time the vessel jacks-up. It is conservatively assumed that the vessel would jack-up twice per cable/cable bundle. See Section 3.11 for a summary of the maximum potential seafloor disturbance during offshore construction.

installed, the tops will be cut off approximately 1.5 m (5 ft) above mean high water and the cofferdam seams will be sealed. Although the cofferdam will be located outside of areas normally subject to significant vessel traffic, the location will be properly marked to warn vessels of the temporary cofferdam's presence.

Within the cofferdam, a trench for the cable conduits will be excavated using vessel-mounted equipment. During trench excavation, the area inside the cofferdam will be dewatered to facilitate conduit installation in a dry or semi-dry condition. Excess trench spoils are expected to be placed on the vessel in containment with dewatering features to allow filtered water to return to the ocean. Each trench will then be partially backfilled with clean sand and gravel to achieve the required bedding elevation for the conduits. After the conduits are installed within the trench (each conduit will have an anti-floatation collar on the seaward end), the trenches will be backfilled with sand and gravel. Then, the sheet piles will be removed using vessel-mounted equipment. The seaward end of the conduits will be left temporarily unburied in preparation for the insertion of the offshore export cables. After the offshore export cables/cable bundles (one per conduit) are pulled through the conduits toward the transition vault(s), the seaward end of the conduits will be reburied beneath the seafloor.

Any riprap, jetty, seawall, boardwalk, or other infrastructure that is removed to accommodate open trenching will be restored to its original conditions or reinforced as required by governing agencies. Use of open trenching, as opposed to the more equipment-intensive and time-consuming HDD, could minimize temporary disturbances to nearby neighbors.

3.8 Onshore Cables and Points of Interconnection

Power generated by Vineyard Northeast will be delivered to the regional electric grid at two points of interconnection (POIs) (one in Massachusetts and one in Connecticut). In Massachusetts, power will be delivered to one of the following potential POIs:

- **Pottersville POI:** The 115 kV Pottersville Substation in Somerset, Massachusetts is operated by National Grid.
- **Brayton Point POI:** National Grid has proposed to construct and operate a new 345 kV substation near Brayton Point in Somerset, Massachusetts.[58]
- **Bell Rock POI:** The 115 kV Bell Rock Substation in Fall River, Massachusetts is operated by National Grid.

In Connecticut, power from Vineyard Northeast will be delivered to the electric grid at the following POI:

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[58] National Grid would be responsible for the development, permitting, construction, and operation of the substation at Brayton Point.

- **Montville POI:** The 345 kV Montville Substation in Montville, Connecticut is operated by Eversource Energy.

For each POI, onshore export cables will connect the landfall site to a new onshore substation site and grid interconnection cables will connect the onshore substation site to the POI. The potential onshore cable routes are described in Sections 3.8.1 and 3.8.2. The design of the onshore cables and installation methods are described in Section 3.8.3. See Section 3.9 for a discussion of Vineyard Northeast's onshore substations.

Modifications may be required at each POI to accommodate Vineyard Northeast's interconnection. The design and schedule of this work will be determined by the results of interconnection studies. Any required system upgrades at the POI would be constructed by the existing substation's owner/operator. Based on negotiations with the substation's owner/operator, the Proponent may install onshore cables[59] (i.e., perform ground disturbing activities) within the property line of the existing substation.

3.8.1 Massachusetts Onshore Cable Routes and POI

From the Horseneck Beach Landfall Site (see Section 3.7.1), the onshore cables will follow one of the onshore cable routes in Bristol County, Massachusetts shown on Figure 3.8-1 to reach the Pottersville POI, the Brayton Point POI, or the Bell Rock POI. Likely onshore cable routes are described below;[60] however, Vineyard Northeast may ultimately use any combination of route segments shown on Figure 3.8-1 to reach any of the three potential POIs.[61]

- **Horseneck Beach Eastern Onshore Cable Route:** The approximately 30 km (19 mi) long route begins at the landfall site, crosses the Westport River, and proceeds generally north through the Town of Westport and City of Fall River to reach the Bell Rock POI. The route primarily follows town roads and portions of state highways, including Route 88, Route 6, and Blossom Road. Land use along the route is predominantly forested/parkland and agricultural land, although low density residential areas are located along a limited part of the route and there is a commercial area proximate to the I-195/Route 6 interchange.

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59 At the Brayton Point POI, the Bell Rock POI, and the Montville POI, the Proponent's grid interconnection cables are expected to be installed within an underground duct bank. Onshore cables at the Pottersville POI may be installed within an underground duct bank or as overhead transmission lines (see Section 3.8.3.3).

60 The lengths of the Massachusetts onshore cable routes include conservatism to account for the uncertainty regarding the location of the onshore substation site within the [redacted] Onshore Substation Site Envelopes (see Section 3.9.1).

61 For example, any of the variants to the Horseneck Beach Western Onshore Cable Route could be used in conjunction with the southern portion of the Horseneck Beach Eastern Onshore Cable Route.

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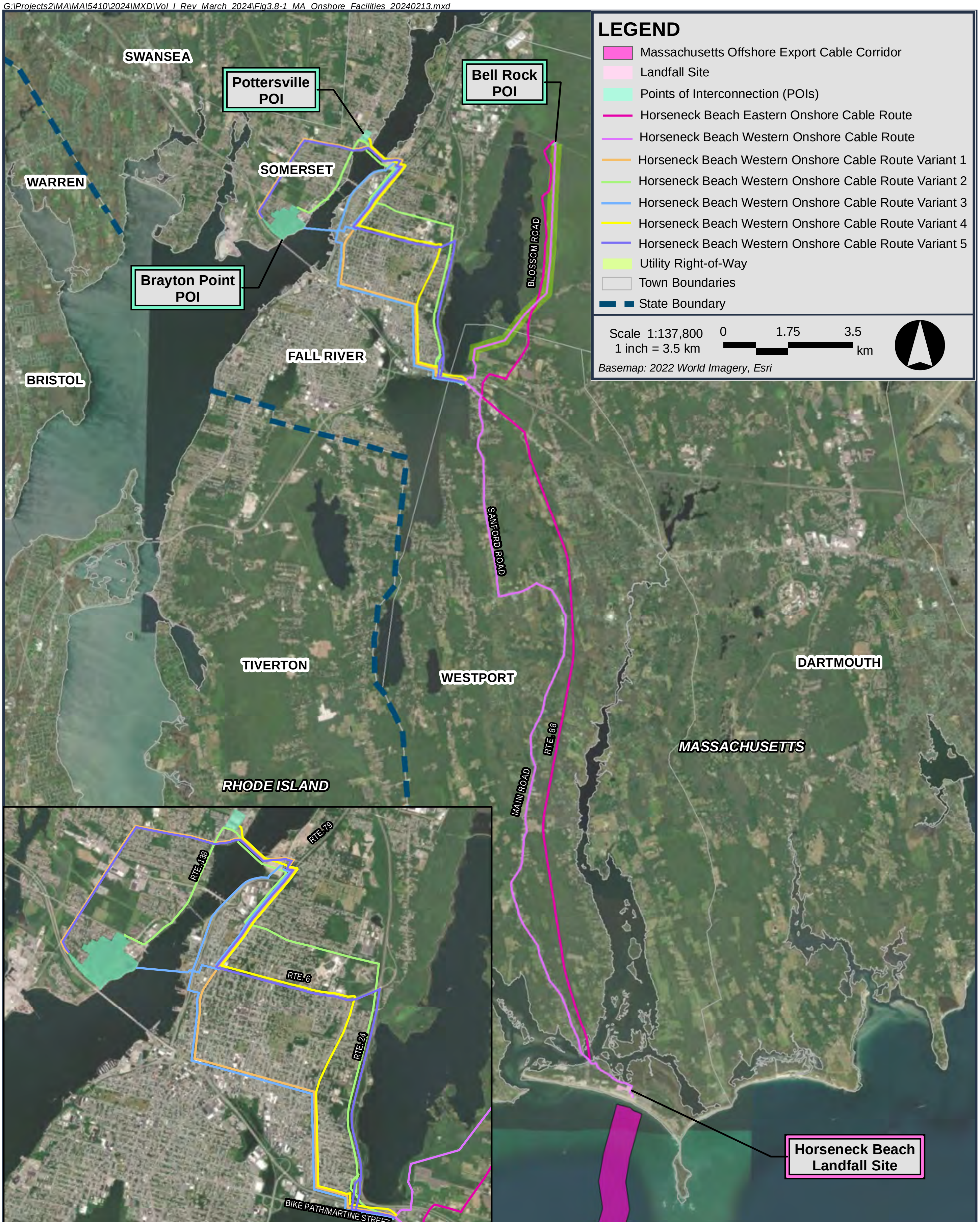

Figure 3.8-1
Onshore Facilities in Massachusetts

- **Horseneck Beach Western Onshore Cable Route:** This route is located primarily west of and largely parallels the Horseneck Beach Eastern Onshore Cable Route. The Horseneck Beach Western Onshore Cable Route is approximately 35 km (22 mi) long and travels north from the landfall site, across the Westport River, and through the Town of Westport and City of Fall River to reach the Bell Rock POI. The route primarily follows town roads (such as Main Road and Sandford Road) and utility rights-of-way (ROWs) through a mix of agricultural land, low to moderate density residential areas, and commercial areas. This route includes the following variants, which begin near the intersection of Route 6 and Old Bedford Road and cross the Taunton River to reach the Pottersville or Brayton Point POIs:
  - **Variant #1:** This variant travels through Westport, Fall River, and Somerset to reach the Brayton Point POI [redacted]. The variant follows a bike path as well as city/town and state roads, including Route 6, Bedford Street, North Main Street, Read Street, and Brayton Point Road, primarily through commercial areas and moderate to high density residential areas. The total route length with this variant is ~38 km (24 mi).
  - **Variant #2:** This variant travels through Westport, Fall River, and Somerset to reach the Pottersville POI or the Brayton Point POI [redacted]. The variant follows city/town and state roads, including Route 24, Langley Street, North Main Street, and Riverside Avenue, primarily through moderate to high density residential, commercial, and industrial areas. The total route length with this variant is ~33 km (20 mi) to reach the Pottersville POI and ~36 km (22 mi) to reach the Brayton Point POI.
  - **Variant #3:** This variant travels through Westport, Fall River, and Somerset to reach the Brayton Point POI [redacted]. The variant follows a bike path as well as city/town and state roads, including Route 6, Bedford Street, North Main Street, Route 138, and Route 79, primarily through high density residential and commercial areas. The total route length with this variant is ~37 km (23 mi).
  - **Variant #4:** This variant travels through Westport, Fall River, and Somerset to reach the Pottersville POI [redacted]. The variant follows city/town and state roads, including Route 6 and North Main Street, primarily through high density residential and commercial areas. The total route length with this variant is ~34 km (21 mi).

- **Variant #5:** This variant travels through Westport, Fall River, and Somerset to reach the Brayton Point POI [redacted]. The variant follows a bike path as well as city/town and state roads, including Route 24, Route 6, North Main Street, Read Street, and Brayton Point Road, primarily through commercial areas and moderate to high density residential areas. The total route length with this variant is ~39 km (24 mi).

3.8.2 Connecticut Onshore Cable Routes and POI

Between the landfall site (see Section 3.7.2) and the Montville POI, the onshore cables will be installed within one of the following potential onshore cable routes in New London County, Connecticut, which are shown on Figure 3.8-2:[62]

- **Ocean Beach Onshore Cable Route:** This route begins at the Ocean Beach Landfall Site and travels generally north approximately 21 km (13 mi) through New London, Waterford, and Montville, Connecticut to reach the POI. The route mostly follows town and state roads, including Ocean Avenue, US Highway 1, Route 213, Clark Lane, Jefferson Avenue, Vauxhall Street, Williams Street, Old Norwich Road, and Route 32. The route passes through a mix of low to high density residential areas, commercial areas, and forests/parkland.

- **Eastern Point Beach Onshore Cable Route:** This approximately 23 km (14 mi) route begins at the Eastern Point Beach Landfall Site and travels generally north through the towns of Groton and Ledyard, Connecticut before crossing the Thames River into Montville, Connecticut to reach the POI. The route primarily follows utility ROWs, but also follows town and state roads such as Route 349 and Benham Road. Land use along the route is mostly forested/parkland, although moderate density residential areas and commercial areas are located along portions of the route.

- **Niantic Beach Onshore Cable Route:** This approximately 20 km (13 mi) route begins at the Niantic Beach Landfall Site in East Lyme, Connecticut and travels northeast along Route 156 before joining the Ocean Beach Onshore Cable Route near the intersection of US Highway 1 and Clark Lane. From Clark Lane northward to the POI, the Niantic Beach and Ocean Beach Onshore Cable Routes are identical. Land use along the Niantic Beach Onshore Cable Route is a mix of low to moderate density residential areas, commercial areas, and forests/parkland.

[62] The lengths of the Connecticut onshore cable routes include conservatism to account for the uncertainty regarding the location of the onshore substation site within the [redacted] Onshore Substation Site Envelope (see Section 3.9.2).

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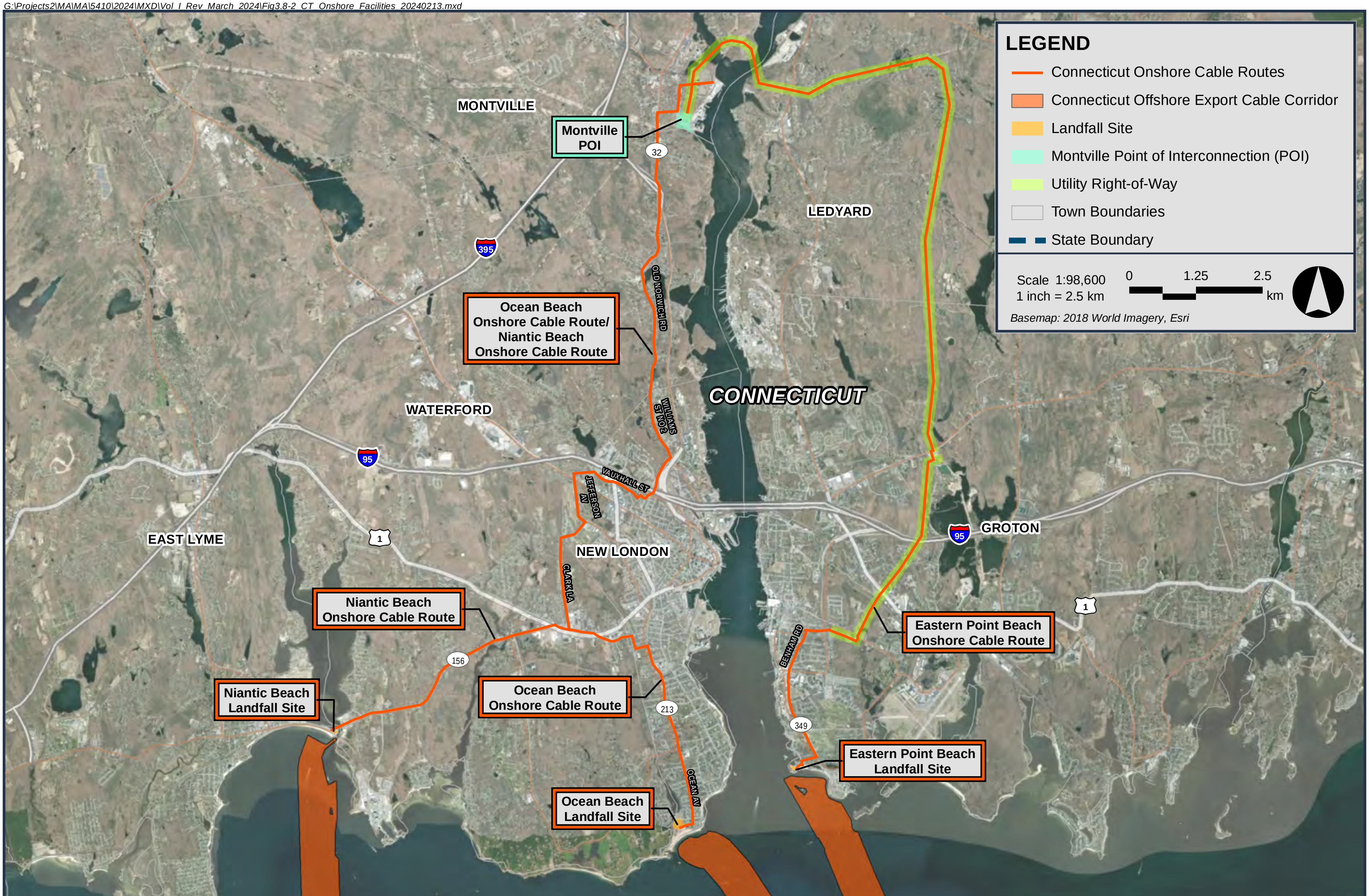


Figure 3.8-2
Onshore Facilities in Connecticut

VINEYARD NORTHEAST
VINEYARD OFFSHORE

3.8.3 Onshore Cable Design and Installation

The design of the onshore export cables and grid interconnection cables is described in Section 3.8.3.1. The onshore cables are expected to be installed via open trenching (see Section 3.8.3.2). Where the onshore cables cross wetlands, waterbodies, railroads, or busy roadways, specialty crossing methods are expected to be employed (see Section 3.8.3.3). Construction staging areas located along the onshore cable routes may be used to support cable installation activities (see Section 3.8.3.4).

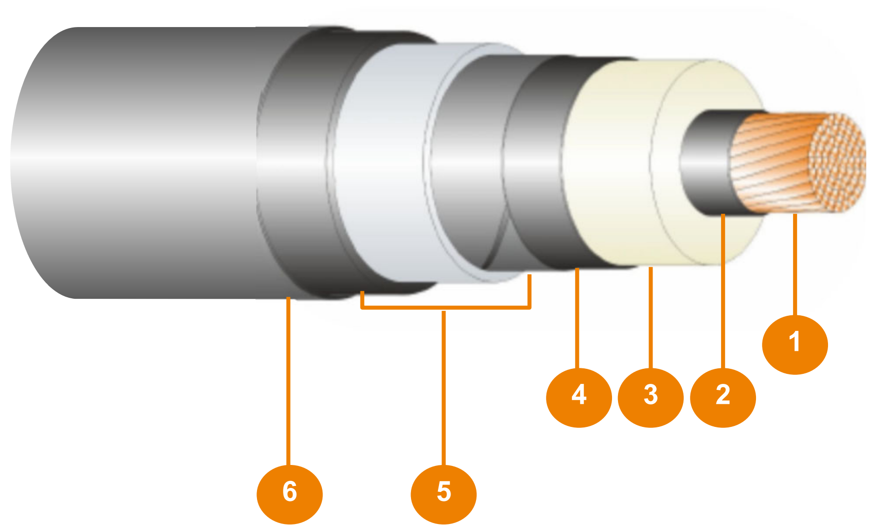
3.8.3.1 Onshore Cable Design

Onshore export cables will transmit power from the landfall sites to the onshore substation sites. The onshore export cables in Connecticut will be HVDC cables whereas the onshore export cables in Massachusetts may be HVDC or HVAC cables. In both Massachusetts and Connecticut, HVAC grid interconnection cables will transmit power from the onshore substation sites to the POIs.

The 320–525 kV HVDC onshore export cables will be similar in design to the HVDC offshore export cables (see Section 3.5.1.1), except that the power and fiber optic cables would not be bundled together or contain armoring. As a result, up to six individual HVDC power cables and one or more fiber optic cables could be installed in each onshore export cable route. Each HVDC power cable is expected to contain a single aluminum or copper conductor that is encapsulated in insulation, water blocking layer(s), a metallic sheath, and an outer jacket (see Figure 3.8-3). These outer layers protect the cable, prevent direct contact between the conductor and the ground, and control and minimize thermal and electrical losses.

The 220–345 kV HVAC onshore export cables (if used) and the 115–345 kV HVAC grid interconnection cables are expected to be comprised of a single core (copper or aluminum conductor) encapsulated by insulation and wrapped in water-blocking layer(s), a metallic sheath, and a non-metallic outer jacket (see Figure 3.8-4). Three of these cables would make up a single alternating current circuit. As a result, up to nine HVAC onshore export cables and one or more fiber optic cables could be installed within the selected Massachusetts onshore export cable route. Up to 24 HVAC grid interconnection cables and one or more fiber optic cables will be installed to connect each onshore substation site to the POI.

Regardless of whether HVDC or HVAC onshore cables are used, they will not contain any fluids.

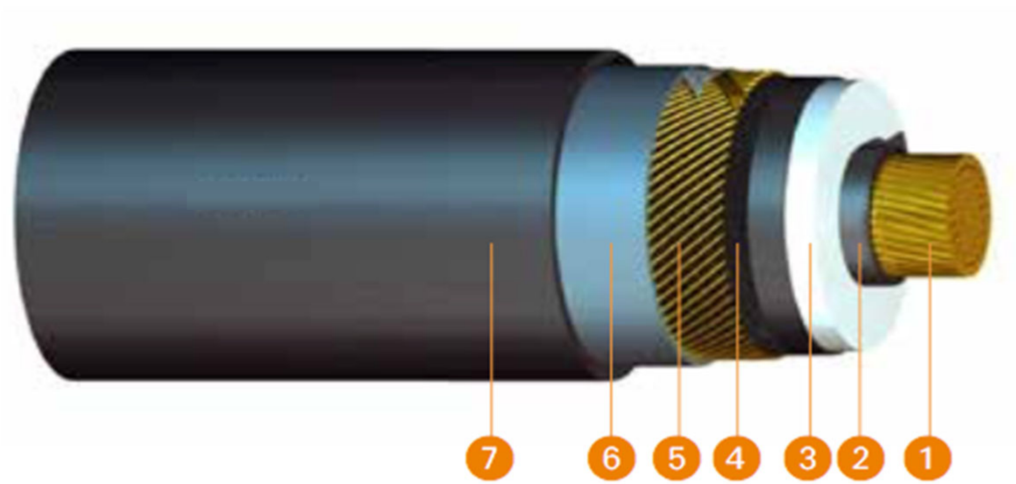


Design:

1. Conductor (Al or Cu)
2. Inner semi-conducting layer
3. Insulation
4. Insulation shield
5. Metallic sheath and water barrier
6. Outer jacket

Figure 3.8-3
HVDC Onshore Cable Schematic

VINEYARD NORTHEAST
VINEYARD OFFSHORE



Design:

1. Conductor (Al or Cu)
2. Inner semi-conducting layer
3. Insulation
4. Outer semi-conducting layer
5. Wire screen
6. Metallic sheath
7. Outer jacket

Figure 3.8-4
HVAC Onshore Cable Schematic

VINEYARD NORTHEAST
VINEYARD OFFSHORE

3.8.3.2 Typical Onshore Cable Installation

The onshore cables are expected to be installed primarily underground within public roadway layouts or within existing utility ROWs.[63] The underground onshore cables may be installed within a duct bank or installed within directly buried conduit(s).

The duct bank would consist of plastic conduits (e.g., HDPE or PVC) encased in concrete (i.e., cast in-place concrete). For HVDC cables, the power cables may be installed in separate conduits or within the same conduit (particularly at underground trenchless crossings). Additional conduits may be accommodated within the duct bank for fiber optic cables and grounding. For HVAC cables, each onshore cable and fiber optic cable is expected to be installed within its own conduit. Spare conduits and grounding may also be accommodated within the duct bank.

Both HVDC and HVAC onshore cables typically require splices approximately every 150–610 m (500–2,000 ft) or more. At each splice location, one or more underground splice vaults will be installed. The splice vaults are typically two-piece (top and bottom) pre-formed concrete chambers with openings at both ends to admit the onshore cables.

The duct bank and splice vaults are expected to be installed in open trenches using conventional construction equipment (e.g., hydraulic excavator, loader, dump trucks, flatbed trucks, crew vehicles, cement delivery trucks, and paving equipment). The trench dimensions will vary along the onshore cable route (depending on the duct bank layout) but are expected to measure up to approximately 3.4 m (11 ft) in depth, 6.7 m (22 ft) in width at the bottom, and 8.5 m (28 ft) in width at the top. In locations where splice vaults are necessary, the excavated area will be larger (up to approximately 13 m [43 ft] wide, 15 m [50 ft] long, and 6 m [20 ft] deep). Since the splice vaults may be installed anywhere along the onshore cable routes, the maximum extent of disturbance along the entire route is based on the dimensions of the area excavated for splice vaults.

Open trenching along existing public roadway layouts is expected to primarily occur within paved areas or within 3 m (10 ft) of pavement. Any pavement will be removed before excavating and shoring the trenches. Minimal tree trimming and/or tree clearing may be needed where the routes follow existing roadway layouts, depending on the final duct bank alignment.[64] Tree trimming, tree clearing, and/or grading may be required to facilitate onshore cable installation where the onshore cable routes follow existing utility ROWs, in limited areas where the routes depart from the public roadway layout (particularly near complex crossings),

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[63] In limited areas, the onshore cable routes may depart from public roadway layouts or utility ROWs, particularly at complex crossings (e.g., crossings of busy roadways, railroads, wetlands, and waterbodies).

[64] Subject to further engineering and consultations with local and state agencies (e.g., Massachusetts Department of Transportation [MassDOT]).

at trenchless crossing staging areas (see Section 3.8.3.3), and at the POIs. The work, however, will be confined to as narrow a corridor as possible. Excavated material will be hauled away in trucks daily and recycled or disposed of in accordance with state regulations.

Dewatering of the trench will be necessary in areas where groundwater is encountered, where soils are saturated, or at times when the trench is affected by stormwater. In these areas, groundwater would be pumped from one or more sumps within the trench or vault using submersible pumps. Best management practices, such as passing collected water through a dewatering fractionization tank (frac tank) and filtering it prior to release, will be used to avoid pumping sediment-laden water from the excavated areas. Standard erosion control practices will be employed to minimize erosion during trenching operations and construction activities in general.

Once the trench is opened, plastic conduits will be assembled and installed using spacers to maintain the desired conduit arrangement. During this process, the plastic conduits may be stockpiled at a nearby construction staging area (see Section 3.8.3.4) or along the road. Then, concrete will be poured into the trench to form the duct bank and the prefabricated splice vaults will be installed using cranes.

Next, the trenches will be backfilled. The top of the duct bank and splice vaults (except for at-grade manhole covers) typically has a minimum of 0.9 m (3 ft) of cover comprised of properly compacted backfill (e.g., sand, fluidized thermal material, native fill) topped by pavement or topsoil. However, if required due to existing conditions (e.g., at certain utility crossings), the minimum cover will be 0.8 m (2.5 ft). Trenches that are not backfilled by day's end will be covered with steel plates overnight. Openings in the roadway shoulder will be protected and barricaded to ensure traffic and pedestrian safety. Completed trench sections that are within roadways will be re-paved in accordance with state and local standards. For construction within utility ROWs, any disturbed vegetated areas will be loamed and seeded to match pre-existing vegetation.

Once the duct bank and splice vaults are in place, the onshore cables will be delivered on a cable reel transport vehicle and pulled through the conduits from one splice vault to another using truck-mounted winches. Then, the onshore cables will be spliced together, energized, and commissioned.

In limited, select areas along the onshore cable routes where future mechanical loading is not of concern, the onshore cables may be installed in directly buried conduit(s) (without the surrounding concrete duct bank) within open trenches that are subsequently backfilled. In this scenario, a board or concrete cap may be installed above the cables for mechanical protection along with warning tape, pending clarification of various requirements along the onshore cable routes. Splice pits (rather than splice vaults) may be located along the routes to facilitate cable pulling activities.

To avoid and minimize traffic impacts during onshore construction activities, the Proponent will develop a Traffic Management Plan (TMP) and will coordinate the timing of activities with state and local agencies (see Section 3.1). All work will be performed in accordance with local, state, and federal safety standards, as well as any company-specific requirements.

3.8.3.3 Specialty Cable Crossing Techniques

In most instances, underground trenchless crossing methods are expected to be used where the onshore cable routes traverse unique features such as busy roadways, railroads, wetlands, and waterbodies to avoid impacts to those features. For example, the Proponent intends to use trenchless crossing techniques where the Massachusetts onshore export cables cross the Westport River and where the grid interconnection cables cross the Taunton River and land at the Brayton Point POI (if Variant #3 of the Horseneck Beach Western Onshore Cable Route is used [see Figure 3.8-1]).[65] The Proponent also intends to use trenchless crossing techniques where the Connecticut onshore export cables cross the Thames River.

Underground trenchless crossing methods primarily include:

- **Horizontal directional drilling:** HDD involves drilling a bore hole in an arc beneath a feature (e.g., wetland, roadway), enlarging the bore hole, and then inserting a conduit (typically made of plastic or steel) into the bore hole. An intersect bore (i.e., where drill rigs are used on both ends of the bore) may be used to minimize bore hole pressures and the potential for inadvertent fluid returns. The cables are subsequently pulled through the conduits. For additional description of HDD, see Section 3.7.3.

- **Pipe jacking:** Pipe jacking uses hydraulic jacks to thrust a specially designed casing pipe through the ground, led by a guidance system, to excavate a tunnel between the jacking shaft and receiving shaft. Pipe jacking methodologies include microtunnel, earth pressure balance machines, conventional non-pressurized tunnel-boring machines, open shield machines, and auger boring. These methods require an entrance and exit pit that is excavated to the depth of the tunnel.

- **Direct pipe:** The direct pipe trenchless drilling method uses a drill head welded to a pipe casing. As drilling progresses, the pipe casing is extended. Once the drill path beneath the feature is complete, the drill head is cut off and the pipe remains in place, becoming the casing for the cables. This method also requires an entrance and exit pit.

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65 If Variant #3 of the Horseneck Beach Western Onshore Cable Route is used, the trenchless crossing of the Taunton River would extend under the pond at the Brayton Point POI, if needed to avoid impacts to the pond.

Staging areas to support underground trenchless crossings may require tree trimming, tree clearing, and grading within an area that is wide enough to accommodate construction equipment and materials and to provide access to the work zone.

Depending on the final location of the onshore substation site in Massachusetts and the transmission technology employed (HVAC or HVDC), the northern crossing of the Taunton River [redacted] (see Figure 3.8-1) may require overhead transmission lines if further field data collection and detailed engineering confirms that an underground trenchless crossing at that location is technically or commercially infeasible. The overhead transmission lines would be comprised of up to 24 individual conductors that are ~30 mm (1.2 inch) in diameter and likely arranged in bundles of four. At this time, it is envisioned that up to two lattice-type towers would be located [redacted] and up to two lattice-type towers would be located w[redacted]. The overhead transmission towers are anticipated to have a maximum height of approximately 115 m (377 ft) above ground and a base footprint of up to approximately 45 m (148 ft) by 45 m (148 ft). The total length of overhead transmission is estimated to be approximately 940 m (3,084 ft). The overhead transmission towers and lines would be marked and lit in accordance with FAA guidance.

3.8.3.4 Construction Staging Areas

The Proponent's contractor will identify construction staging areas (i.e., equipment laydown and storage areas) proximate to the onshore cable routes. With the exception of staging areas for trenchless crossings (see Section 3.8.3.3), the Proponent anticipates that construction staging areas will either be in paved areas or at locations already utilized for similar activities and are therefore not expected to cause new ground disturbance.

3.9 Onshore Substations

Vineyard Northeast will include two onshore substations (one in Massachusetts and one in Connecticut) that will increase or decrease the voltage of the power transmitted by the export cables in preparation for interconnection to the electric grid at the POIs. If HVDC export cables are used, the power will also be converted from direct current to alternating current at the onshore substation.

Since the Proponent has not yet secured site control for the onshore substation sites, the Proponent has identified several "onshore substation site envelopes." The onshore substation sites will be located within the onshore substation site envelopes described in Sections 3.9.1 and 3.9.2. The design and construction of the onshore substations are described in Section 3.9.3.

3.9.1 Massachusetts Onshore Substation Site

In Massachusetts, the onshore substation site will be located within one of the following areas shown on Figure 3.8-1:

- [redacted]
- [redacted]
- [redacted]

Although the Proponent may select an onshore substation site parcel that contains state-mapped wetlands, the footprint of the onshore substation site would be sited to avoid wetlands.

3.9.2 Connecticut Onshore Substation Site

In Connecticut, the onshore substation site will be located within [redacted]

3.9.3 Onshore Substation Design and Construction

Vineyard Northeast will include two new onshore substations (one in Massachusetts and one in Connecticut).

If HVDC export cables are used, the onshore substations would contain equipment to convert the power from direct current to alternating current and, if necessary, the equipment to step up or step down the export cable voltage to match the voltage at each POI. At this time, the Proponent expects that a one-story conventional steel frame building (with a typical height of ~21 m [69 ft]) will be constructed to enclose a large portion of the HVDC voltage source converter components; the alternating current interface yard and power transformers, cooling fans, and the phase reactor cooling enclosure would be immediately outside the building. However, if this design is not feasible, alternative designs may be used, including a stacked design (where a stacked converter hall occupies two floors of a building). A stacked design would result in a taller building of approximately 40 m (131 ft) but a smaller substation footprint. The HVDC onshore substation may include a small separate storage building.

If HVAC export cables are used to deliver power to a POI in Massachusetts, the onshore substation would include transformers, switchgear, and other necessary equipment to step up or step down the export cable voltage to match the electric grid's voltage at the POI. The onshore substation may use either an air-insulated switchgear design or a gas-insulated switchgear design pending detailed, site-specific engineering. The new onshore substation may include a small control room/service area, which may include fire protection systems as well as heating and cooling systems. The typical height of an HVAC substation building is up to approximately 17 m (56 ft). With the exception of the service area/control room, the substation equipment is expected to be located outside.

For both HVAC and HVDC onshore substations, depending on the onshore substation sites selected and technologies available at the time construction proceeds, battery storage may be a feasible option that could be included as part of a future Construction and Operations Plan (COP) modification.

The onshore substation equipment will be mounted on concrete foundations with secondary oil containment designed in accordance with industry and local utility standards. A stormwater management system at the onshore substation sites will include low-impact development (LID) strategies (e.g., grass water quality swales to capture and convey site runoff, deep sump catch basin[s] to pretreat surface runoff, etc.), which are designed to capture, treat, and recharge stormwater runoff. The Proponent will develop a Spill Prevention, Control, and Countermeasure (SPCC) Plan for each onshore substation site as part of the state permitting process, which will describe onshore spill prevention and response procedures (see Section 6.2).

The onshore substations may include lightning masts approximately 27.5 m (90 ft) in height.[66] It is expected that the slender profile of the lighting masts and their proposed grey color will minimize potential visual effects. Outdoor lighting will be used at the onshore substation sites during construction and commissioning. During operations (see Section 4.3), the majority of the lights will only be used on an as-needed basis (e.g., if equipment inspection is needed at night). For security reasons, a few lights will typically be illuminated on dusk–to-dawn sensors and a few lights will likely be controlled by motion sensors. Outdoor lighting at the onshore substation sites will typically be equipped with light shields to prevent light from encroaching into adjacent areas. The Proponent will ensure that the lighting scheme complies with local requirements. A security fence and gates will be installed to enclose the onshore substations. Vegetative buffers may be installed to provide visual screening and sound attenuation walls may be installed to mitigate potential noise impacts, if needed.

Construction of each onshore substation is anticipated to include the following steps:

1. **Site preparation:** Temporary fencing and a security gate will be installed around the perimeter of the construction area and temporary erosion control measures (e.g., silt fencing, hay bales) will be deployed. Although the Proponent intends to prioritize industrial/commercial sites that have been previously disturbed, depending on the onshore substation sites ultimately selected, land clearing and grading may be needed prior to excavation and trenching (for equipment foundations, cable trenches, containment, drainage, and retaining walls). Some onshore substation sites may require up to approximately 0.06 square kilometers (km^2) (15 acres) of tree clearing and ground disturbance (per site) from grading, excavation, and trenching.[67]

2. **Installation of the substation equipment and cables:** Equipment foundations (e.g., footings) and any containment sumps will be installed, and any buildings will be constructed. Then, substation equipment will be delivered by heavy-load vehicles and installed (likely using cranes). The onshore export cables and grid interconnection cables will be connected to the substation's electrical equipment, and other wiring and connections will be completed.

3. **Commissioning:** The onshore substation will be energized and commissioned. During commissioning, the electrical infrastructure as well as safety, controls, and communication systems will be tested.

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[66] Alternatively, if the onshore substation's electrical equipment is entirely enclosed within a building (e.g., in a stacked design), lighting spikes, which are anticipated to be ~1 m (3 ft) in height, may be located on top of the building.

[67] The actual size of the onshore substation site parcel may be larger than the area cleared and disturbed to accommodate the onshore substation.

4. **Site clean-up and restoration:** Permanent perimeter security fencing will be installed, and temporary erosion controls will be removed. The periphery of the site (outside the security fencing) will be restored and revegetated (if required). Vegetative buffers for visual screening and sound attenuation walls may be installed, if needed.

3.10 Construction Ports and Logistics

3.10.1 Construction Ports

As described in Sections 3.2 through 3.6, the WTGs, ESP(s), booster station (if used), foundations, and offshore cables may be transferred from the manufacturing facility to one or more staging ports before being transported to the Lease Area or OECCs. The Proponent has identified several ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Canada that may be used to stage offshore components (see Table 3.10-1 and Figure 3.10-1). These staging ports could be used for frequent crew transfer and to offload, store, pre-assemble, inspect, pre-commission, and/or load components onto vessels for delivery to the Lease Area and OECCs.[68] The Proponent has identified a wide range of potential staging ports due to the uncertainty in Vineyard Northeast's construction schedule and the expected demand for ports by other offshore wind developers in the coming years. Only a subset of the ports described in Table 3.10-1 would be used to stage components. The combination of staging ports used during construction will depend on the final construction schedule as well as the availability and capability of each port to support staging activities.

Offshore components may alternatively be delivered directly from the manufacturing facilities to the Lease Area or OECCs. Additionally, some basic activities associated with marine construction in general (rather than offshore wind specifically) such as refueling,[69] restocking supplies, sourcing parts for repairs, vessel mobilization/demobilization, and infrequent crew transfer may occur out of ports other than those listed in Table 3.10-1. These activities would be well within the realm of normal port activities.

Each port under consideration for Vineyard Northeast is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time construction proceeds. The Proponent does not expect to implement any port improvements. Any port improvements would be independent of Vineyard Northeast, all permits and approvals would be obtained by the site owner/lessor, and the port would be available for use by multiple developers once any necessary upgrades are made by the owner/lessor.

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[68] Some components (e.g., monopiles) may instead be pulled by tugs while floating in the water rather than loaded onto vessels.

[69] Some bunkering (i.e., refueling) and restocking of supplies could also occur offshore.

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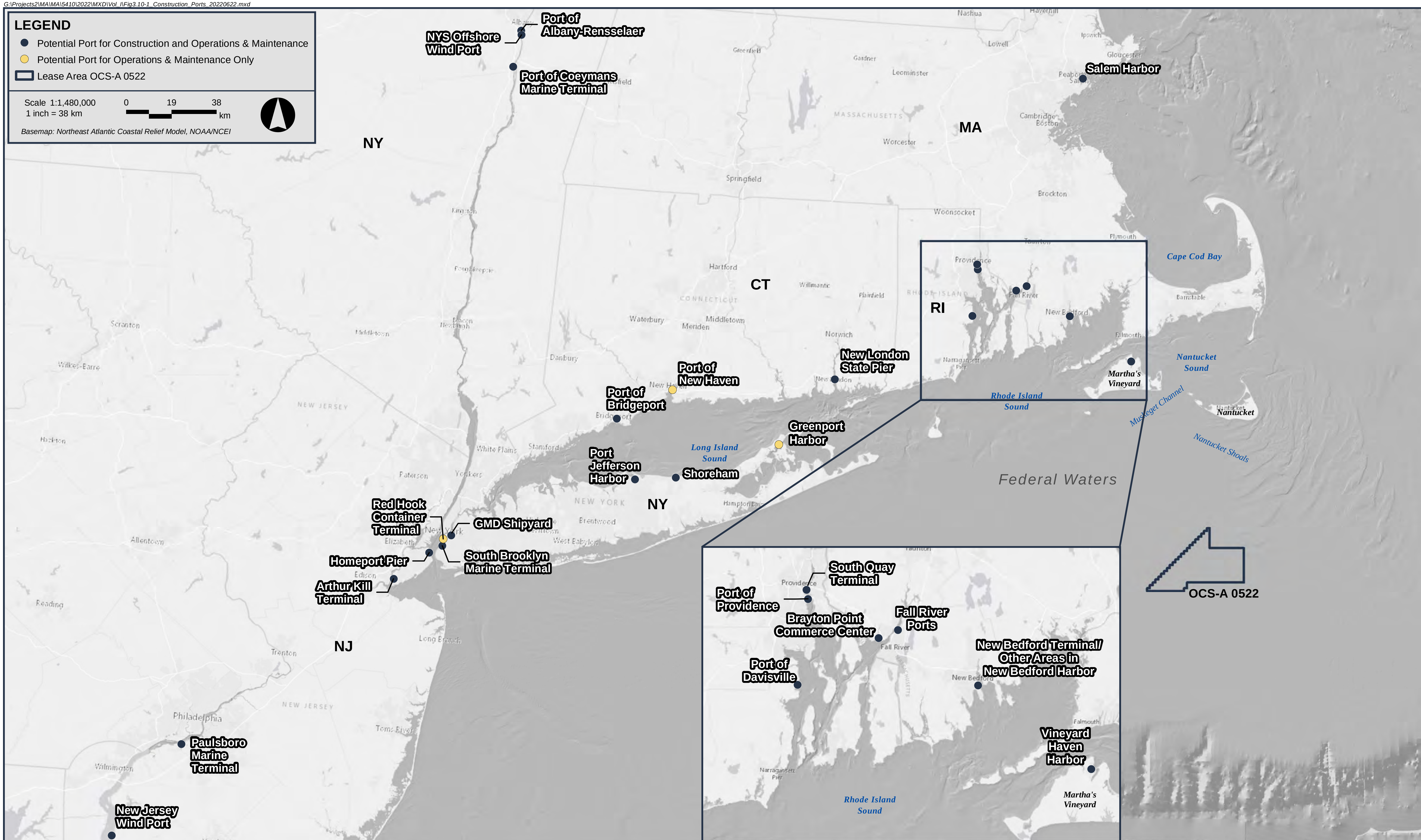

Figure 3.10-1
Potential Construction and O&M Ports in the US

VINEYARD NORTHEAST
VINEYARD OFFSHORE

Table 3.10-1 Potential Staging Ports During Construction

Port	Description
Massachusetts Ports	
Brayton Point Commerce Center	The Brayton Point Commerce Center is located at the former coal-fired Brayton Point Power Plant along the shore of Mount Hope Bay in Somerset. It has an ~213 m (~700 ft) quayside and a water depth of 10 m (34 ft). In December 2018, Brayton Point was purchased by Commercial Development Company, Inc. via affiliate Brayton Point LLC. The port will be capable of component manufacturing, staging operations, and maintenance for offshore wind and other related sectors (Commercial Development Company c2021; Froese 2019). In addition, the Prysmian Group purchased 0.19 km^2 (47 acres) of the 1.2 km^2 (300 acre) site for use as a submarine cable factory (Hockett 2022).
Fall River Ports	Fall River is located along the eastern shore of Mount Hope Bay at the mouth of the Taunton River. Potential port facilities in Fall River could include, but are not limited to, those identified by the Massachusetts Clean Energy Center's (MassCEC's) (2017) *2017 Massachusetts Offshore Wind Ports and Infrastructure Assessment* as potentially viable offshore wind ports.
Port of New Bedford: • New Bedford Marine Commerce Terminal • Other areas in New Bedford	The Port of New Bedford is a protected industrial harbor on the northwest side of Buzzards Bay. The 0.12 km^2 (30 acre) New Bedford Marine Commerce Terminal was purpose-built for staging offshore wind project components. The facility, which is owned and operated by MassCEC, has full load-bearing capacity for large crawler cranes, a modern heavy-lift quayside, and an on-site warehouse (Port of New Bedford c2018). The Proponent may use other areas in the Port of New Bedford, such as those identified by MassCEC's (2017) *2017 Massachusetts Offshore Wind Ports and Infrastructure Assessment* as potentially viable offshore wind ports. For example, Foss and Cannon Street Holdings LLC are developing the New Bedford Foss Marine Terminal to serve as a new operations base and terminal logistics facility for offshore wind projects. The new terminal would provide storage and laydown yards for equipment and materials, berth facilities for tug and barge operations, and host CTV and SOV support services (Grantor 2022; Memija 2022).
Salem Harbor	When the Salem Harbor Power Station natural gas power plant replaced a coal and oil plant along the Salem waterfront, it opened 0.17 km^2 (42 acres) for redevelopment. The site, which is located ~35 km (~22 mi) northeast of Boston, includes shared access to a 244 m (800 ft) deep water wet berth that is periodically used for visiting cruise ships. The area also includes ~700 m (~2,300 ft) of frontage on Salem Harbor, which hosts active commercial, recreational, and water transportation facilities. The site is currently being developed into a WTG assembly and staging port (Salem Offshore Wind Terminal [date unknown]).

Table 3.10-1 Potential Staging Ports During Construction (Continued)

Port	Description
Massachusetts Ports (Continued)	
Vineyard Haven Harbor	Vineyard Haven Harbor, on the north side of Martha's Vineyard, provides a number of services to vessels as large as 84 m (275 ft) in length and has onshore facilities that house multiple business entities. A planned operations and maintenance facility at the Tisbury Marine Terminal would provide three slips for vessels designed to service offshore wind projects (MV Times 2021).
Rhode Island Ports	
Port of Davisville (Quonset)	The Port of Davisville is in a sheltered harbor at the mouth of Narragansett Bay in North Kingstown. The Port of Davisville includes five terminals, 1,372 m (4,500 ft) of berthing space at two 366 m (1,200 ft) long piers, a bulkhead, on-dock rail, and 0.23 km^2 (58 acres) of laydown and terminal storage (QDC 2019). The Port of Davisville also has heavy lift capacity. The port's Pier 2 expansion and modernization finished in July 2022 while Pier 1 reconstruction is currently underway. Construction of a new pier at Terminal 5 is currently in the permitting process. All three projects will support the offshore wind industry (King 2021; State of Rhode Island 2022).
Port of Providence (ProvPort)	The Port of Providence is located along the Providence River in the City of Providence. The privately-owned marine terminal occupies approximately 0.47 km^2 (115 acres) and provides 1,280 m (4,200 ft) of berthing space, 12,077 square meters (m^2) (130,000 square feet [ft^2]) of covered storage, and more than 0.08 km^2 (20 acres) of open lay down area. ProvPort also has on-dock rail service (ProvPort [date unknown]). Marine transportation into ProvPort is facilitated by a federally-maintained navigational channel that accommodates deep-draft vessels (RI CRMC 2010).
South Quay Terminal	The South Quay Terminal is located on the Providence River in East Providence. Waterfront Enterprises, LLC began construction in September 2022 to develop the over 0.13 km^2 (33 acre) greenfield site as a staging area for offshore wind construction as well as other mixed uses (Amaral 2022).
Connecticut Ports	
Port of Bridgeport	The Port of Bridgeport is located in a sheltered area on the north side of Long Island Sound at the mouth of the Pequonnock River. Bridgeport is a federal shipping port and a terminus of the Bridgeport to Port Jefferson ferry. The Connecticut Port Authority is responsible for overseeing the development of the port (Connecticut Port Authority c2022a). Other offshore wind developers have proposed to redevelop a site in Bridgeport as an O&M hub.
New London State Pier	The New London State Pier is located on the Thames River in New London. The Connecticut Port Authority is currently upgrading the State Pier into a heavy-lift capable port facility to support and accommodate WTG staging and assembly, which includes adding ~0.03 km^2 (~7 acres) of land to the existing site (AJOT 2023; Black 2022; Connecticut Port Authority c2022b).

Table 3.10-1 Potential Staging Ports During Construction (Continued)

Port	Description
New York Ports	
Capital Region Ports: • Port of Albany-Rensselaer • NYS Offshore Wind Port • Port of Coeymans Marine Terminal	The ~1.62 km^2 (400 acre) Port of Albany-Rensselaer features deep-water facilities and wharves on both sides of the Hudson River. The port includes 1,280 m (4,200 ft) of wharf on the Albany side of the river and 366 m (1,200 ft) of wharf on the Rensselaer side. The developed portion of the port is used for offloading cargo, storage, offshore wind development activities, and other various functions. To expand the port, the Albany Port District Commission has acquired ~0.33 km^2 (82 acres) of riverfront property on Beacon Island in Glenmont, which is planned to include a 152 m (500 ft) wharf and ~0.058 km^2 (~14 acres) of manufacturing facilities and/or staging areas for offshore wind project components (Hallisey 2023; NYSERDA 2022; Port of Albany c2019). Across the river from Glenmont, the proposed NYS Offshore Wind Port in East Greenbush may also be developed to support the needs of the offshore wind industry. The proposed site consists of ~0.45–0.80 km^2 (112–197 acres) of riverfront property (NYoffshorewind 2019). Farther south along the Hudson River, the 1.8 km^2 (450 acre) Port of Coeymans Marine Terminal is an industrial port owned by Carver Companies. The port offers a heavy lift dock that can accommodate vessels up to 230 m (750 ft), cargo handling equipment, and storage facilities. The port serves a variety of activities such as marine construction, aggregates handling, small manufacturing, and disaster recovery projects and is expected to be upgraded to support offshore wind projects (Carver Companies c2022).
Staten Island Ports: • Arthur Kill Terminal • Homeport Pier	The proposed Arthur Kill Terminal is a 0.13 km^2 (32 acre) port facility in Staten Island that is designed to support offshore wind project staging and assembly. The terminal will feature strong bearing capacity for WTGs, on-site warehouse storage for equipment, and a 416 m (1,365 ft) quayside designed for simultaneous vessel berthing (Arthur Kill Terminal 2023). Homeport Pier, which is located on Staten Island just north of the Verrazano-Narrows Bridge, is the former site of a 0.14 km^2 (35 acre) Naval Base and includes a 430 m (1,410 ft) pier. The site may be redeveloped to support offshore wind projects (Waterwire 2019).
Brooklyn Ports: • South Brooklyn Marine Terminal (SBMT) • GMD Shipyard	The ~0.30 km^2 (73 acre) SBMT, which is owned by the New York City Economic Development Corporation (NYC EDC) and operated by Sustainable South Brooklyn Marine Terminal (SSBMT), is located along the Upper New York Bay in Brooklyn, New York City. The industrial waterfront facility will be upgraded by other offshore wind developers to include two heavy load wharves and a new bulkhead, which will support staging, installation, and maintenance of offshore wind projects (bp 2022; NYSERDA 2022). The GMD Shipyard, which is located within the Brooklyn Navy Yard on the East River, has the largest dry dock facility in New York City. The shipyard also has ~335 m (~1100 ft) of wet berth and several cranes (GMD Shipyard Corp c2017).

Table 3.10-1 Potential Staging Ports During Construction (Continued)

Port	Description
New York Ports (Continued)	
Long Island Ports: • Shoreham • Port Jefferson Harbor	The New York State Energy Research and Development Authority (NYSERDA) has identified the 2.8 km^2 (700 acre) site of the decommissioned Shoreham Nuclear Power Plant as a potential site for offshore wind port facilities. The site, which is located on the north shore of Long Island, would require significant investments and upgrades by other entities to support offshore wind projects. Port Jefferson Harbor is also located on the north shore of Long Island. The sheltered harbor is a terminus of the Bridgeport to Port Jefferson ferry and includes a marina. Like Shoreham, Port Jefferson Harbor would require significant investments and upgrades to support offshore wind projects.
New Jersey Ports	
Paulsboro Marine Terminal	The 0.81 km^2 (200 acre) Paulsboro Marine Terminal is located on the Delaware River. The terminal, which is owned by the South Jersey Port Corporation, is undergoing two phases of construction to support the offshore wind industry. Phase 1 is now complete and encompasses a 0.20 km^2 (50 acre) footprint and includes a 259 m (850 ft) berth. Phase 2 would add two berths, warehouses, and a monopile manufacturing facility (Holt Logistics Corp 2023; Jacobs 2022; South Jersey Port Corporation c2022).
New Jersey Wind Port	The New Jersey Wind Port is located on the eastern shore of the Delaware River, southwest of the City of Salem (Durakovic 2021). The port will be developed to support the offshore wind industry in two phases. Phase 1 commenced in late 2021, with the goal to complete the 0.12 km^2 (30 acre) staging port in early 2024. Phase 2 is anticipated to be completed in 2026 and will include an additional 0.14 km^2 (35 acre) staging area and 0.24–0.28 km^2 (60–70 acres) for manufacturing space, heavy-lift wharfs, and component laydown areas (State of New Jersey c1996–2023).
Canadian Ports	
Potential Canadian Ports: [1] • Port of Halifax • Sheet Harbor • Port Saint John	

Note:
1. Analysis of potential Canadian ports that may be used is ongoing.

3.10.2 Surveys

3.10.2.1 Geophysical and Geotechnical Surveys

Offshore and nearshore geophysical surveys are expected to be conducted just prior to construction, during construction, and post-construction for activities such as pre-lay surveys, verifying site conditions, ensuring proper installation of components, conducting as-built surveys, inspecting the depth of cable burial, and inspecting foundations. The surveys may be conducted using survey vessels, ROVs, remotely operated towed vehicles (ROTVs), autonomous offshore vehicles/vessels, and/or divers. Geophysical survey instruments may include, but are not limited to, side scan sonar, single and multibeam echosounders, magnetometers/gradiometers, and sub-bottom/seismic profilers. A detailed list of geophysical survey equipment that may be used is provided as Appendix I-B. Measures to protect marine species during geophysical survey work are described in Sections 4.7 and 4.8 of COP Volume II.

Additional geotechnical surveys may be conducted after the site assessment period to inform the final design and engineering of the offshore facilities. Geotechnical surveys may include vibracores, cone penetration testing, and deep borings. Offshore geotechnical work would only be conducted in areas already reviewed and cleared for cultural resources. Any unanticipated discoveries of cultural resources would be managed in accordance with Vineyard Northeast's Unanticipated Discoveries Plan.

3.10.2.2 UXO/DMM Surveys and Mitigation

Before installing the offshore facilities, the Proponent will investigate the potential for unexploded ordnances (UXO) and/or discarded military munitions (DMM) to be present in the Lease Area and OECCs and will evaluate the associated risks in accordance with the As Low As Reasonably Practical (ALARP) risk mitigation principle. UXO are fired military munitions, such as bombs, mines, torpedoes, and grenades, that remain unexploded by design or malfunction whereas DMM are unfired military munitions that have been abandoned or improperly discarded (Miliary Munitions [date unknown]).

The Proponent has performed desktop studies to assess the potential risk from UXO in the Lease Area and OECCs based on historical records and previous surveys (see Appendix II-B24). The desktop studies evaluate the probability of encountering UXO, the probability of detonation, and the consequence of a detonation for various offshore site assessment and construction activities. The desktop studies found there to be a moderate risk of encountering UXO in the Lease Area and varying low and moderate risk of encountering UXO in the OECCs.

The Proponent expects to conduct UXO/DMM surveys to further investigate portions of the Lease Area and OECCs for the presence of UXO and DMM prior to the start of construction. Geophysical equipment used during UXO/DMM investigation surveys may include magnetometers, side scan sonar, high resolution sub-bottom imagers, and/or single and multibeam echosounders. Based on the results of the investigation surveys, the Proponent may perform UXO/DMM identification surveys, which may include the use of ROVs and/or divers, to further investigate potential UXO/DMM.

If the surveys identify UXO/DMM within the Lease Area and/or OECCs, the Proponent will implement mitigation measures in accordance with the ALARP principle. The Proponent will prioritize avoidance of UXO/DMM wherever possible by micro-siting structures and cables around the object. Where avoidance is not possible (e.g., due to layout restrictions, presence of archaeological resources, etc.), UXO/DMM will be relocated or otherwise disposed of (e.g., via deflagration [burning without detonating], detonation, or dismantling the UXO/DMM to extract explosive components). The selection of the appropriate mitigation method will be determined in consultation with a UXO/DMM specialist and relevant agencies (e.g., the Department of Defense) based on the location, size, and condition of the UXO/DMM. If relocation or disposal is selected as the mitigation strategy, the Proponent would develop a thorough plan, in coordination with relevant agencies, that describes the method of removal/disposal and identifies the measures that will be taken to protect marine life, cultural resources, and human health and safety.

Since the Proponent has not yet performed detailed UXO/DMM surveys, the exact number and type of UXO/DMM that may be present, and which subset of those UXO/DMM cannot be avoided by micro-siting, are unknown (further evaluation is ongoing). For the purposes of impact analyses, the Proponent conservatively assumes that up to two UXO in the Lease Area, four UXO in the Massachusetts OECC, and four UXO in the Connecticut OECC may need to be detonated in place (each detonation would occur on different days).

3.10.3 Buoys

The Proponent expects to temporarily deploy one or more meteorological oceanographic ("metocean") buoys in up to 50 locations within the Lease Area to monitor weather and sea state conditions during construction. These metocean buoy(s) will provide forecasting and real-time weather conditions to inform contractors if conditions (especially wave height) are suitable for installation activities and to protect the health and safety of workers during construction. In addition, the Proponent may use temporary safety marker buoys in up to 10 locations within the Lease Area to notify other mariners of the presence of construction activities. These metocean and safety marker buoys would be relocated as the location of construction activities shifts within the Lease Area.

The floating metocean and safety marker buoys are expected to be anchored to the seafloor using a steel chain connected to a single concrete, steel, or cast-iron mooring weight on the seafloor. The mooring weight will occupy an expected seafloor footprint of approximately 4

m^2 (43 ft^2)[70] and is expected to vertically penetrate to a depth of approximately 2.5 m (8 ft). Any seafloor disturbance from the buoys' anchors will occur within surveyed areas of the Lease Area that have been cleared for cultural resources. The maximum potential seafloor disturbance from the use of metocean and safety marker buoys during construction is provided in Section 3.11.

One or more mooring buoys could also be deployed in the Lease Area to moor construction vessels (e.g., CTVs), which would reduce engine usage and potentially reduce overall seafloor disturbance associated with vessel anchorage. The area of seafloor disturbance from the mooring buoy's anchor, the size of which is highly dependent on the vessels that are ultimately used during construction, cannot be estimated at this time but is presumed to be within the conservative total area of seafloor disturbance for the Lease Area presented in Section 3.11.

The metocean buoy(s), safety marker buoys, and mooring buoys will not use fuel oil to avoid the risk of accidental release and emissions into the environment. The buoys will be equipped with the proper lighting, marking, and signaling equipment per USCG Private Aid to Navigation (PATON) requirements.

3.10.4 Vessels, Offshore Equipment, and Aircraft

Offshore construction will require several types of vessels, many of which will be specifically designed for offshore wind construction and cable installation. In general, while performing construction work, vessels may anchor, moor to other vessels or structures, operate on DP, or jack-up. DP enables a vessel to maintain a very precise position by continuously adjusting the vessel's thrusters and propellers to counteract winds, currents, and waves. Jack-up vessels are self-propelled or non-self-propelled vessels with legs that extend to the seafloor to elevate the hull to provide a safe, stable working platform. Anchored vessels may use one or more anchors to remain stationary or to propel the vessel. For vessels other than anchored cable laying vessels (which must maintain tension on anchor lines), where it is considered impossible or impracticable to avoid a sensitive seafloor habitat when anchoring, the use of mid-line anchor buoys will be considered (where feasible and considered safe) as a potential measure to reduce impacts from anchor line sweep.

The types of vessels that are expected to be used during offshore construction of Vineyard Northeast are provided in Table 3.10-2 based on current methodologies for offshore wind construction. Table 3.10-2 includes general vessel types rather than specific vessels because the Proponent has not selected the contractors or specific vessels that will carry out construction activities.

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70 Excludes anchor sweep, which cannot be quantified at this early stage in the construction planning process.

It is challenging to precisely quantify the number of vessels and vessel trips from each port at the early planning stages of Vineyard Northeast because they depend on: (1) the specific vessels and ports used; (2) the final construction schedule; and (3) the installation and transportation methods employed, which continue to evolve rapidly and will vary based on the final project design. The estimated number of vessels and vessel trips presented below, which are based on current understanding of a potential construction schedule, are likely conservative and subject to change.

Assuming the maximum design scenario (see Section 3.11), it is estimated that an average of ~25 vessels would operate at the Lease Area or along the OECCs at any given time during offshore construction. During the most active period of construction, it is conservatively estimated that a maximum of approximately 61 vessels could operate in the Offshore Development Area at one time.[71] Up to approximately 3,800 total vessel round trips are expected to occur during the busiest year of offshore construction. During the most active month of construction, it is anticipated that an average of approximately 19 daily vessel round trips could occur. All vessels used during the construction of Vineyard Northeast will be equipped with Automatic Identification System (AIS) to track vessel activity and monitor compliance with permit requirements.

In addition to vessels, helicopters may be used for crew transfer and visual inspections of the offshore facilities. Fixed-wing aircraft or drones (autonomous underwater/surface vessels or aerial drones) may be used to support environmental monitoring and mitigation.

Offshore equipment during construction could include generators, winches, welding equipment, pressure washers, motion compensation platforms, air compressors, forklifts, and other larger offshore construction equipment (e.g., cranes, cable installation tools, pile driving hammers), which are described throughout Section 3.

71 This includes vessels at the Lease Area, at the OECCs, and in transit to, from, or within a port.

Table 3.10-2 Representative Construction Vessels

Vessel Type	Expected Number of Vessels	Expected Vessel Activity
Anchor handling tug supply (AHTS) vessels	1–6	Vessels that primarily handle and reposition the anchors of other vessels (e.g., cable laying vessels), but may also be used to transport equipment or for other services.
Barges	2–10	Vessels with or without propulsion that may be used for transporting components (e.g., foundations, WTGs, etc.) or installation activities.
Bunkering vessels	1–4	Vessels used to supply fuel and other provisions to other vessels offshore.
Cable laying vessels	1–5	Specialized vessels/barges that lay and bury offshore cables into the seafloor.
Crew transfer vessels (CTVs)	2–12	Smaller vessels that transport crew, protected species observers, parts, and/or equipment.
Dredging vessels	1–2	Specialized vessels used to remove the upper portions of sand bedforms.
Heavy lift vessels (HLVs)	1–4	Vessels that may be used to lift, support, and orient the WTGs, ESP(s), booster station, and foundations during installation.
Heavy transport vessels (HTVs)/modified cargo vessels	2–12	Ocean-going vessels that may transport components to staging ports or directly to the Lease Area.
Jack-up vessels	1–9	Vessels that extend legs to the seafloor to provide a safe, stable working platform. Jack-up vessels may be used to install foundations, ESP and booster station topsides, and/or WTGs, to transport components to the Lease Area, for offshore accommodations, for cable splicing activities, and/or for cable pull-in at the landfall sites.
Scour/cable protection installation vessels	1–3	Vessels (e.g., fallpipe vessels) that may be used to deposit a layer of rock around the foundations or over limited sections of the offshore cable system.
Service operation vessels (SOVs)	1–3	Larger vessels that provide offshore living accommodations and workspace as well as transport crew to and from the Lease Area.
Support vessels	1–8	Multipurpose vessels (e.g., work boats, supply boats, accommodation vessels, diving support vessels) that may be used for a variety of activities, such as the pre-lay grapnel runs, supporting cable installation, commissioning WTGs, or transporting equipment.
Survey vessels	1–3	Specialized vessels used to perform geophysical, geotechnical, and environmental surveys.
Tugboats	2–16	Ocean-going vessels or smaller harbor craft used to transport equipment and barges.

3.10.5 Onshore Equipment and Vehicles

Onshore construction equipment is expected to be similar to that used during typical public works projects (e.g., road resurfacing, storm sewer installation, transmission line construction). Onshore substation construction and cable installation will likely require cranes, excavators, backhoes, trenchers, drilling tools (see Section 3.8.3.3), front end loaders, forklifts, concrete delivery trucks, dump trucks, and delivery vehicles, among other equipment. Onshore cable pulling and splicing will likely require winches, cable reel trucks, generators, and support vehicles.

3.11 Summary of the Maximum Design Scenario and Potential Seafloor Disturbance

The benefits and potential impacts of Vineyard Northeast to physical, biological, socioeconomic, visual, and cultural resources, which are discussed in COP Volume II, are based on the "maximum design scenario" for each resource. The maximum design scenario, which is based on the PDE described in Sections 3.2 through 3.10, allows analysis of the maximum impacts that could occur from Vineyard Northeast:

- For the offshore facilities, the maximum design scenario is the full buildout of all 160 WTG/ESP positions within the Lease Area. Up to three of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. If two or three ESPs are used, they may be co-located at the same grid position (co-located ESPs would only be installed on monopiles). In addition, the Proponent may install a booster station in the northwestern aliquot of Lease Area OCS-A 0534. As a result, Vineyard Northeast could include up to 162 monopile foundations (assuming the use of co-located ESPs) or up to 161 piled jacket foundations as well as associated scour protection. The maximum design scenario also includes three HVAC offshore export cables in the Massachusetts OECC (with a maximum total length of 436 km [235 NM]) and two HVDC offshore export cable bundles in the Connecticut OECC (with a maximum total length of 421 km [227 NM]), up to 356 km (192 NM) of inter-array cables, up to 120 km (65 NM) of inter-link cables, and associated cable protection.[72]

- For the onshore facilities, the maximum design scenario is the construction of two landfall sites (the Horseneck Beach Landfall Site in Massachusetts and either the Ocean Beach Landfall Site, the Eastern Point Beach Landfall Site, or the Niantic Beach Landfall Site in Connecticut), two onshore cable routes (one in Massachusetts and one in Connecticut), and two new onshore substations (one in Westport, Fall River, or Somerset, Massachusetts and one in Montville, Connecticut).

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[72] The length of the offshore export cables includes the length of the cables within the Lease Area.

Table 3.11-1 summarizes the maximum area of potential long-term and temporary seafloor disturbance within the Lease Area and OECCs during construction. The maximum area of potential seafloor disturbance is based on the installation of 157 WTGs, three ESPs, and one booster station, all supported by jacket foundations, as well as three HVAC offshore export cables in the Massachusetts OECC, two HVDC cable bundles in the Connecticut OECC, and the maximum length of inter-array and inter-link cables. This provides the maximum seafloor disturbance from the overall construction of Vineyard Northeast rather than the maximum disturbance from each individual activity (e.g., WTG installation and commissioning).

Table 3.11-1 Summary of Maximum Potential Seafloor Disturbance During Construction

Activity	Long-Term Seafloor Disturbance	Temporary Seafloor Disturbance	Total Seafloor Disturbance	Basis of Calculation
WTG installation and commissioning	N/A	0.75 km^2 (186 acres)	0.75 km^2 (186 acres)	Temporary seafloor disturbance from anchored and/or jack-up vessels used during the installation and commissioning of 157 WTGs (see Table 3.2-2).
WTG foundation installation (including scour protection installation)	1.83 km^2 (452 acres)	0.57 km^2 (140 acres)	2.40 km^2 (592 acres)	Long-term seafloor disturbance from the installation of jacket foundations and associated scour protection for 157 WTGs (see Table 3.3-1). Temporary seafloor disturbance from anchored and/or jack-up vessels used during the installation of 157 WTGs (see Table 3.3-1). It is assumed that the area of temporary disturbance from vessels is beyond the footprint of scour protection.
ESP topside installation and commissioning	N/A	0.02 km^2 (4 acres)	0.02 km^2 (4 acres)	Temporary seafloor disturbance from anchored and/or jack-up vessels used during the installation and commissioning of three ESP topsides (see Table 3.4-3).
ESP foundation installation (including scour protection installation)	0.10 km^2 (24 acres)	0.01 km^2 (3 acres)	0.11 km^2 (27 acres)	Long-term seafloor disturbance from the installation of jacket foundations and associated scour protection for three ESPs (see Table 3.4-4). Temporary seafloor disturbance from anchored and/or jack-up vessels used during the installation of three ESP foundations (see Table 3.4-4). It is assumed that the area of temporary disturbance from vessels is beyond the footprint of scour protection.
Booster station topside installation and commissioning	N/A	0.006 km^2 (1 acre)	0.01 km^2 (1 acre)	Temporary seafloor disturbance from anchored and/or jack-up vessels used during the installation and commissioning of one booster station topside (see Table 3.4-3).

Table 3.11-1 Summary of Maximum Potential Seafloor Disturbance During Construction (Continued)

Activity	Long-Term Seafloor Disturbance	Temporary Seafloor Disturbance	Total Seafloor Disturbance	Basis of Calculation
Booster station foundation installation (including scour protection installation)	0.02 km^2 (5 acres)	0.004 km^2 (1 acre)	0.02 km^2 (5 acres)	Long-term seafloor disturbance from the installation of a jacket foundation and associated scour protection for one booster station (see Table 3.4-4). Temporary seafloor disturbance from anchored and/or jack-up vessels used during the installation of one booster station foundation (see Table 3.4-4). It is assumed that the area of temporary disturbance from vessels is beyond the footprint of scour protection.
Offshore export cable installation (including cable protection installation) Massachusetts OECC + Lease Area Connecticut OECC + Lease Area	 0.34 km^2 (85 acres) 0.18 km^2 (45 acres)	 4.76 km^2 (1,176 acres) 4.80 km^2 (1,186 acres)	 4.76 km^2 (1,176 acres) 4.80 km^2 (1,186 acres)	Long-term seafloor disturbance from the installation of cable protection for three HVAC offshore export cables in the Massachusetts OECC and Lease Area as well as two HVDC cable bundles in the Connecticut OECC and Lease Area (see Table 3.5-1). Temporary seafloor disturbance from cable installation, pre-lay grapnel runs, sand bedform dredging, boulder clearance, and vessels for three HVAC offshore export cables in the Massachusetts OECC and Lease Area as well as two HVDC cable bundles in the Connecticut OECC and Lease Area (see Table 3.5-1). The long-term disturbance from cable protection is expected to be within the area of temporary seafloor disturbance.

Table 3.11-1 Summary of Maximum Potential Seafloor Disturbance During Construction (Continued)

Activity	Long-Term Seafloor Disturbance	Temporary Seafloor Disturbance	Total Seafloor Disturbance	Basis of Calculation
Inter-array and inter-link cable installation (including cable protection installation)	0.09 km^2 (21 acres)	4.89 km^2 (1,208 acres)	4.89 km^2 (1,208 acres)	Long-term seafloor disturbance from the installation of cable protection for the inter-array and inter-link cables (see Table 3.6-1). Temporary seafloor disturbance from cable installation, pre-lay grapnel runs, sand bedform dredging, boulder clearance, and vessels for the maximum length of inter-array and inter-link cables (see Table 3.6-1). The long-term disturbance from cable protection is expected to be within the area of temporary seafloor disturbance.
Landfall site construction	N/A	0.01 km^2 (2.4 acres)	0.01 km^2 (2.4 acres)	Temporary seafloor disturbance from the installation of the offshore HDD exit pit and use of jack-up vessels at the landfall site.
Temporary buoy installation	N/A	0.0002 km^2 (0.06 acres)	0.0002 km^2 (0.06 acres)	Temporary seafloor disturbance from the installation of metocean buoy(s) at 50 locations and safety marker buoy(s) at 10 locations within the Lease Area.
Maximum total disturbance in the Lease Area	2.03 km^2 (501 acres)	7.15 km^2 (1,767 acres)	9.08 km^2 (2,244 acres)	Seafloor disturbance from the installation of 157 WTGs, three ESPs, inter-array cables, inter-link cables, and a portion of the offshore export cables.
Maximum total disturbance in the Massachusetts OECC	0.35 km^2 (87 acres)	4.35 km^2 (1,075 acres)	4.37 km^2 (1,079 acres)	Seafloor disturbance from the installation of three HVAC offshore export cables and one booster station.
Maximum total disturbance in the Connecticut OECC	0.17 km^2 (43 acres)	4.31 km^2 (1,066 acres)	4.31 km^2 (1,066 acres)	Seafloor disturbance from the installation of two HVDC offshore export cable bundles.

3.12 Detailed Engineering and Certified Verification Agent Review

Vineyard Northeast will employ the best available and safest technologies.[73] The facilities will be designed in a manner that does not unreasonably interfere with other uses of the Outer Continental Shelf (OCS) or cause undue harm or damage to life, natural resources, the human environment, or objects of historical/archeological significance. The design process will ensure that the facilities can be decommissioned as described in Section 5.

Vineyard Northeast's offshore facilities will be designed based on site-specific conditions in accordance with applicable US and international standards (see Section 3.12.1). Once the majority of the engineering and design has been finalized, the Proponent will develop one or more Facility Design Reports (FDRs) and Fabrication and Installation Reports (FIRs) for the proposed offshore facilities. The FDRs will contain the specific details of the offshore facilities' design, including structural drawings, justification for referenced design standards, design and load calculations, and summaries of the environmental, engineering, and geotechnical data used as the basis for the designs. The FIRs will describe how each structure will be fabricated, transported, installed, and commissioned. The FDRs and FIRs will be reviewed by a third-party CVA (see Section 3.12.2) that certifies the design conforms to all applicable standards. The onshore facilities will be designed according to US, state, and local standards by a reputable engineering firm in the US.

3.12.1 Design Standards

BOEM's renewable energy regulations do not prescribe the design standards that should be used for offshore wind energy facilities. Thus, BOEM recommends that applicants use a "design basis" approach, where the applicant proposes, with justification, which criteria and standards to apply to each offshore component.[74] As such, the Proponent has created a Hierarchy of Standards, provided as Appendix I-C, that outlines the high-level codes and standards that will inform the design and engineering of Vineyard Northeast's offshore facilities. If any codes or standards listed in the hierarchy contradict each other, the higher in the hierarchy shall apply. The Proponent will refine the list of design standards, as necessary, to ensure their acceptance by the CVA. As engineering progresses, the Proponent will develop design basis documents for the offshore components, which will be submitted as part of the FDRs. These documents will provide a much greater level of detail on codes and standards to be adopted for the design, fabrication, and installation of the offshore facilities, following the framework outlined in Appendix I-C.

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[73] As defined in 30 CFR Part 585.113, "Best available and safest technology means the best available and safest technologies that BOEM determines to be economically feasible wherever failure of equipment would have a significant effect on safety, health, or the environment."

[74] See BOEM's (2020) *Information Guidelines for a Renewable Energy Construction and Operations Plan (COP).*

3.12.2 Certified Verification Agent

The Proponent has nominated a Certified Verification Agent (CVA) for Vineyard Northeast as required by 30 CFR § 585.626(b)(20) and 30 CFR § 285.706(a) (see Appendix I-D). The third-party CVA will conduct an independent assessment of the offshore facilities' design as well as fabrication, installation, and commissioning methods. Prior to construction, the CVA will conduct a facility design review and certify in the FDRs that the offshore facilities are designed to withstand site-specific environmental and functional load conditions for the duration of the facilities' intended service life. The CVA will also review and certify the FIRs. During construction, the CVA will conduct periodic on-site inspections to ensure that the facilities are fabricated and installed in conformance with accepted engineering practices, the approved COP, and the FIRs.

The CVA's statement of qualifications has been provided as Appendix I-D1. In accordance with 30 CFR Part 285.706, the statement of qualifications addresses the following:

- the CVA's previous experience in third-party verification or in the design, fabrication, installation, or major modification of offshore energy facilities
- the technical capabilities of the staff assigned to the project, including whether the staff are or are under the supervision of registered professional engineers
- the size and type of organization or corporation
- the availability of appropriate technology to perform the CVA's duties
- the CVA's ability to perform their duties given prior commitments and to avoid any conflicts of interest
- the CVA's previous experience with BOEM and Bureau of Safety and Environmental Enforcement (BSEE) requirements and procedures (if any)
- the scope of work to be performed by the CVA (see Appendix I-D2)

3.13 Phase 2 of Vineyard Northeast

The Proponent is proposing to develop Vineyard Northeast in phases pursuant to 30 CFR § 585.238. Phase 1, which is fully described throughout this COP, includes the full buildout of the entire Lease Area, the Massachusetts OECC, the Connecticut OECC, and associated onshore transmission systems. Phase 2 could include a New York OECC and associated onshore transmission system, additional POIs and associated routing variants in Southeastern Massachusetts, and additional POIs and associated routing variants in Southeastern Connecticut. Following COP approval of Phase 1, the Proponent would submit a Phase 2 COP revision per 30 CFR § 585.634 that provides the information required for BOEM to conduct its review of the new offshore and onshore transmission systems, as well as any necessary state or federal permits.

3.13.1 Potential New York OECC and Onshore Transmission System

Phase 2 could include a New York OECC that would enable power from Vineyard Northeast to be transmitted to one or more POIs on Long Island, New York City, and/or the surrounding area. If the Proponent is awarded a project in Lease Area OCS-A 0522 under a future New York offshore wind solicitation, the New York OECC and associated onshore transmission system would be developed as part of Phase 2 of Vineyard Northeast pursuant to 30 CFR § 585.238.

3.13.2 Potential Southeastern Massachusetts POIs and Routing Variants

Massachusetts electric distribution companies have proposed significant upgrades to Southeastern Massachusetts' regional electric grid in order to improve grid reliability, enhance grid resilience, and increase the grids' capacity to host future renewable energy projects. The timing and extent of these future upgrades to the regional electric grid, which are beyond the Proponent's control, may improve the feasibility of potential POIs in Southeastern Massachusetts. Accordingly, the Proponent may identify one or more additional POIs in Southeastern Massachusetts, along with associated onshore facilities and variant(s) to the Massachusetts OECC, as part of Phase 2 of Vineyard Northeast pursuant to 30 CFR § 585.238. The "Southeastern Massachusetts Routing Envelope" shown in Figure 3.13-1 generally indicates the region where the additional POI(s), onshore facilities, and offshore export cables may be installed. The Massachusetts OECC variant(s) would only be located within state waters.

3.13.3 Potential Southeastern Connecticut POIs and Routing Variants

Electric transmission companies have proposed upgrades to the regional electric grid in Southeastern Connecticut. The timing and extent of these future upgrades to the regional electric grid, which are beyond the Proponent's control, may improve the feasibility of potential POIs in Southeastern Connecticut. As a result, the Proponent may identify one or more additional POIs in Southeastern Connecticut, along with associated onshore facilities, as part of Phase 2 of Vineyard Northeast pursuant to 30 CFR § 585.238.

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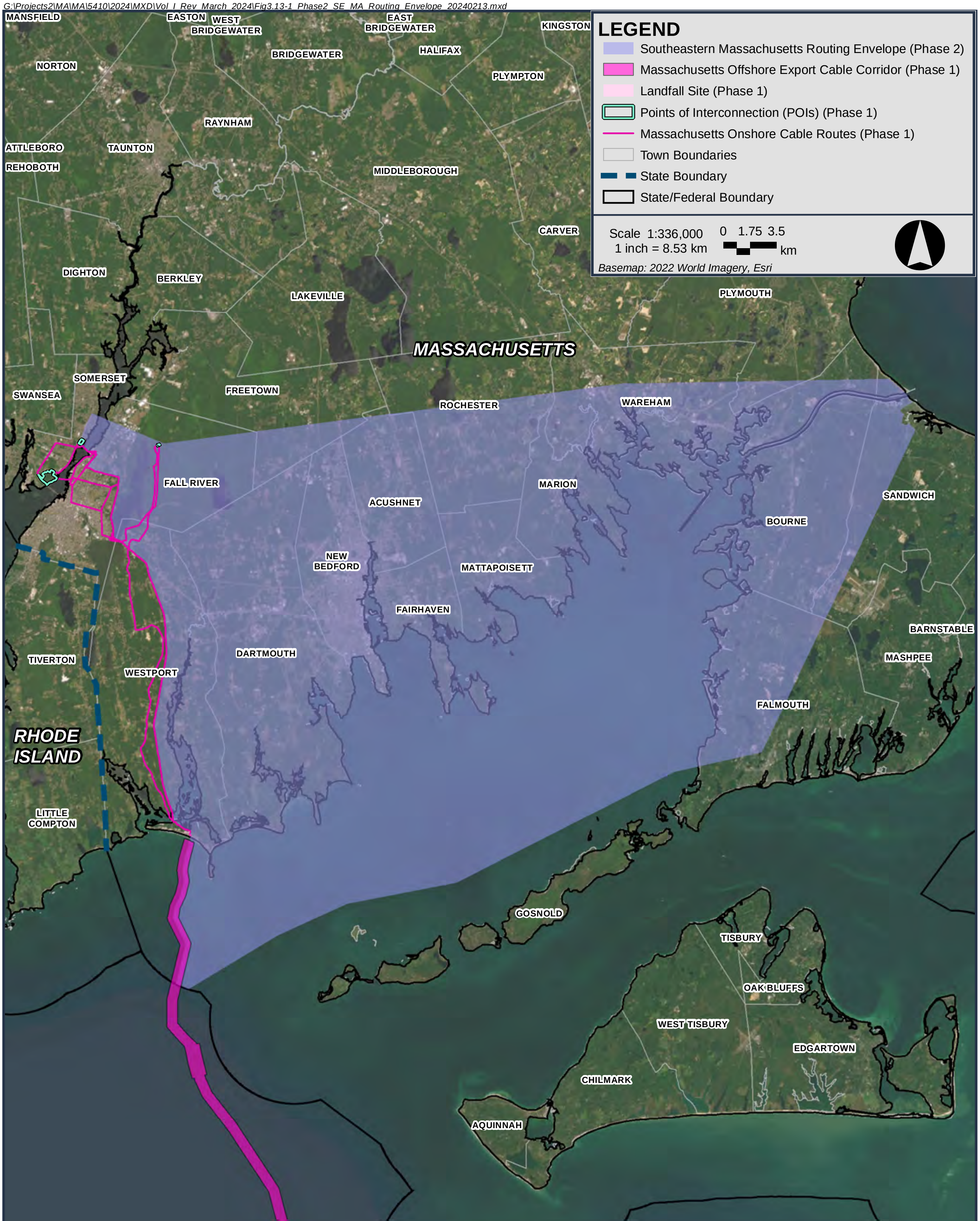

Figure 3.13-1
Phase 2 Southeastern Massachusetts Routing Envelope

4 Operations and Maintenance

Vineyard Northeast's facilities are expected to operate for approximately 30 years. The Proponent, the selected wind turbine generators' (WTGs') original equipment manufacturer(s) (OEM[s]), and/or another third party will be responsible for the day-to-day operation of the offshore and onshore facilities. The offshore and onshore facilities will be continuously remotely monitored from one or more control center(s) located at the Proponent's operations and maintenance (O&M) facilities and/or a third party's facilities. Additional details regarding the location, staffing, and monitoring capabilities of the control center(s) will be provided in the Proponent's Emergency Response Plan (see Section 6.1).

To minimize equipment downtime, maximize energy production, and verify that the facilities remain in a safe condition, the Proponent will conduct regular inspections and preventative maintenance. The Proponent's O&M plan and maintenance schedule for each primary component (i.e., WTG, electrical service platform [ESP], etc.) will be developed based on OEM recommendations and experience gained from similar projects operating globally. This inspection and preventive maintenance strategy will be reviewed regularly and continuously improved. Data collected from the continuous monitoring of the facilities will be analyzed to identify and correct potential equipment failures in advance. However, it is anticipated that some repairs may be required throughout the operational period.

The monitoring, control, and communication systems for the offshore facilities are described in Section 4.1. Inspections, surveys, maintenance, and potential repair activities for the offshore facilities are discussed in Section 4.2. Section 4.3 describes the O&M of the onshore facilities. The potential O&M facilities and ports are described in Section 4.4.1. Vessels, equipment, aircraft, and vehicles used during O&M are discussed in Sections 4.4.2 and 4.4.3.

4.1 Offshore Monitoring, Control, and Communication

4.1.1 WTG, ESP, and Booster Station Monitoring and Control Systems

The WTGs, ESP(s), and booster station (if used) will be designed to operate autonomously and will not be manned. The offshore facilities will be equipped with a supervisory control and data acquisition (SCADA) system. The SCADA system will continuously monitor, gather, process, and display real-time data from environmental and condition monitoring sensors located on the offshore equipment. Parameters that could be monitored include temperature, vibration, current, and voltage, among many others. Data from the SCADA system is expected to be transmitted from the offshore facilities to the control center(s) through fiber optic cables included in the offshore cables (see Sections 3.5.1 and 3.6.1 for a description of the offshore cables' design).

The SCADA system will notify operators of alarms or warnings and enable the operators to remotely interact with and control devices (e.g., sensors, valves, pumps, motors), override automatic functions, and reset systems. The SCADA system also allows operators to shut down equipment for maintenance or at the request of grid operators or agencies. The Proponent will work with the United States Coast Guard (USCG) and the Department of Defense (DoD) to develop a procedure for shutting down WTGs in the vicinity of an emergency (e.g., search and rescue operations) upon request from the USCG or DoD. The formal shutdown procedure will be described in the Proponent's Emergency Response Plan (see Section 6.1) and will be tested on a regular basis.

Although the SCADA system will incorporate redundancies, the WTGs will also include self-protection systems that will be activated if the SCADA system fails or if a WTG operates outside its limits. These self-protection systems may stop or curtail WTG production or disconnect the WTG from the electric grid.

4.1.2 Offshore Cable Monitoring

The Proponent anticipates that the offshore cables will include a monitoring system, such as distributed temperature sensing (DTS), online partial discharge (OLPD) monitoring, and/or distributed acoustic sensing (DAS), to continuously monitor the cables' status. DTS uses the fiber optic cables within the offshore cables to measure the cables' temperature along their entire length; significant changes in temperature can be used to predict potential cable failure and may indicate cable exposure. An OLPD monitoring system can detect and locate areas of potential insulation damage within the cables, which can be an early indicator of cable failure. A DAS system uses the offshore cables' fiber optics to detect acoustic vibrations along the entire length of the cables, which can indicate potential damage or other anomalous conditions.

4.1.3 Communication Systems

In addition to the SCADA system described in Section 4.1.1, the Proponent will likely use multiple communication systems (e.g., radio, satellite, wireless networks) during O&M. Normal marine and aviation communications channels, such as very high frequency (VHF) radio and/or TErrestrial Trunked RAdio (TETRA) for vessels, will be used. The Proponent may install radio or wireless antennas on the WTGs and/or ESP(s) to strengthen or provide coverage throughout the Lease Area.

Emergency communication protocols will be developed as part of the Emergency Response Plan (see Section 6.1 and Appendix I-E2).

4.1.4 Weather and Sea Forecasting and Monitoring

The Proponent expects to contract professionals to provide regular weather forecasts. These forecasts would cover key meteorological parameters, such as temperature, wind, and visibility, as well as oceanographic parameters, such as wave conditions. The ESP(s) and booster station may include a small weather station to monitor real-time conditions offshore.

4.1.5 Lighting, Marking, and Signaling

To aid marine navigation, the WTGs, ESP(s), booster station (if used), and their foundations will be equipped with marine navigation lighting, marking, and signaling in accordance with USCG and Bureau of Ocean Energy Management (BOEM) guidance. Each WTG, ESP, and booster station will be maintained as a Private Aid to Navigation (PATON). Based on USCG's current *ME, NH, MA, RI, CT, NY, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance*,[75] the Proponent expects the lighting, marking, and signaling scheme of the offshore facilities during the operational period to include the following:

- Unique alphanumeric identifiers will be displayed on the WTGs, ESP(s), booster station and/or their foundations following the *Rhode Island and Massachusetts Structure Labeling Plot* (see Appendix I-A1). For the WTGs, the alphanumeric identifiers will be on the tower, nacelle, and potentially the foundation. The alphanumeric identifiers on the WTG tower will be as close to 3 meters (m) (10 feet [ft]) high as possible and will be visible from all directions. The alphanumeric identifiers on the ESP(s) and booster station will be as close to 1 m (3 ft) high as possible and will be visible from all directions.

- The WTG's air draft restriction will be indicated directly on the WTG foundation and/or tower and will be visible in all directions.

- Each foundation will be coated with high-visibility yellow paint above sea level.

- Each structure will include yellow flashing lights that are visible in all directions at a distance of 2 to 5 nautical miles (NM) (~3.7 to 9.3 kilometers [km]).[76] The intensity of the lights will depend on the location of the structure within the Lease Area.

- Mariner Radio Activated Sound Signals (MRASS) will be located on select foundations.

- Automatic Identification System (AIS) will be used to mark the WTGs, ESP(s), and booster station (virtually or using physical transponders).

The Proponent will work with the USCG, BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) to determine the appropriate marine lighting, marking, and signaling scheme for the offshore facilities, including the number, location, and type of AIS transponders and MRASS. The Proponent expects to provide a detailed lighting, marking, and signaling plan

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[75] USCG's PATON guidance for offshore wind energy structures in First District-area waters is periodically updated in District 1 Local Notice to Mariners (LNMs).

[76] The approximate maximum height of the marine navigation lights above water is equal to the maximum height of the foundation (including the transition piece) above water, which is provided in Tables 3.3-1 and 3.4-4.

to BOEM, BSEE, and USCG prior to construction of the offshore facilities. Additional information on marine navigation lighting, marking, and signaling can be found in the Navigation Safety Risk Assessment (NSRA) (see Appendix II-G).

In accordance with BOEM and Federal Aviation Administration (FAA) guidance, the WTGs will be no lighter than pure white (RAL 9010) and no darker than light grey (RAL 7035) in color; the Proponent expects that the WTGs will be off-white/light grey to reduce their visibility against the horizon. The ESP and booster station topsides are expected to be light grey in color.

All WTGs will include an aviation obstruction lighting system in compliance with FAA and/or BOEM guidance. Based on current guidance, the aviation obstruction lighting system will consist of two synchronized red flashing lights placed on the nacelle of each WTG. If the WTGs' total tip height is 213.36 m (699 ft) or higher, there will be at least three additional low intensity flashing red lights on the tower approximately midway between the top of the nacelle and sea level. If the height of the ESP(s) or booster station exceeds 60.96 m (200 ft) above Mean Sea Level or any obstruction standard contained in 14 CFR Part 77, they will similarly include an aviation obstruction lighting system in compliance with FAA and/or BOEM guidelines. The aviation obstruction lights will be visible to pilots in all directions and will flash 30 times per minute, if approved by BOEM.

The Proponent will use an Aircraft Detection Lighting System (ADLS) or similar system that automatically activates all aviation obstruction lights when aircraft approach the structures, subject to BOEM approval. The use of an ADLS would substantially reduce the amount of time that the aviation obstruction lights are illuminated (see Appendix II-I for an analysis of how often the ADLS would likely be activated).

Other lighting (e.g., helicopter hoist status lights on the WTGs, helipad lights on the ESP[s]) may be utilized for safety purposes. Temporary outdoor lighting on the ESP(s) and booster station may be necessary if any maintenance occurs at night or during low-light conditions; these lights would not be illuminated if no technicians are present.

4.2 Offshore Maintenance, Inspections, and Surveys

4.2.1 WTGs, ESP(s), and Booster Station

The Proponent will perform routine inspections and preventative maintenance for the WTGs, ESP(s), and booster station (if used). Most scheduled maintenance activities will be performed using service operation vessels (SOVs), service accommodation and transfer vessels (SATVs), crew transfer vessels (CTVs), and/or helicopters (see Section 4.4.2). Annual maintenance is expected to include cleaning, safety inspections and tests, inspections for coating performance and cracks, coating touch up, electrical component service, bolt tightening, and replacement of consumables (e.g., lubrication oil, diesel fuel in generators) and small components (e.g., filters, hoses). The WTGs' inspection and preventative maintenance schedule will follow the recommendations and instructions specified by the OEM.

Unscheduled repairs or component replacement may also be necessary. As described in Section 4.4.2, the replacement of large components (e.g., WTG blades) may require jack-up vessels or other larger vessels similar to those used during construction. The extent and duration of seafloor disturbance during any repair/component replacement activities would be significantly smaller than during installation (see Section 3.2.2 for a description of WTG installation and Section 3.4.1 for a description of ESP and booster station topside installation).

4.2.2 Foundations and Scour Protection

The Proponent will inspect the foundations at regular intervals. In accordance with industry standards and the Proponent's O&M plan, the Proponent expects to perform annual above water visual inspections of the foundations' internal and external structures (e.g., ladders and boat landings) to ensure structural integrity is maintained, to assess the corrosion protection system, and to detect or verify signs of obvious overloading, deteriorating coating systems, excessive corrosion, and bent, missing, or damaged structural components above the water line. The Proponent will also conduct underwater inspections of the foundations and scour protection to confirm structural integrity and to assess corrosion, marine growth, scour protection performance, and the presence of marine debris (e.g., monofilament and other fishing gear). At this time, the Proponent expects to perform underwater surveys of each foundation (including scour protection) within six months of commissioning; subsequent inspections at each foundation location will occur at least once within the first five years. After the first five years of operations, the frequency of surveys may be adjusted based on the results of the previous surveys. See Section 4.2.4 for further discussion of survey activities during O&M.

Other scheduled foundation maintenance will likely include safety inspections and tests (for lifting equipment, safety equipment, hook-on points, etc.), inspection and repair of the corrosion protection system (e.g., anode cages), coating touch up, and preventative maintenance of cranes, electrical equipment, and other auxiliary equipment. Marine growth and guano may need to be removed, which could be accomplished using a brush followed by a high-pressure washing tool (using seawater) or similar equipment.

Some unscheduled repairs or minor component replacement may be necessary if a foundation is damaged. Additionally, a limited amount of the scour protection applied during construction may require replacement or remediation. As described in Section 4.4.2, the vessels and equipment used to perform repair activities would be similar to those used during construction. The extent and duration of seafloor disturbance during repair activities (if any) would be significantly smaller than during foundation installation (see Sections 3.3.5 and 3.4.2).

4.2.3 Offshore Cables

As described in Section 4.1.2, the Proponent anticipates that the offshore cables will include a monitoring system. If the cables' monitoring system detects an anomalous condition, the Proponent will carefully review the issue and determine whether an ad-hoc cable survey is necessary. Additionally, it is expected that the offshore cables will be surveyed within six months, one year, and two years of commissioning, and then every three years thereafter. The Proponent expects the survey that occurs within six months of commissioning to occur along the entire length of the offshore cables. The remaining surveys are expected to be risk-based surveys (i.e., focused on sections of the offshore cables at greater risk for de-burial). This survey schedule may be adjusted over time based on the results of the ongoing surveys and the performance of the cable monitoring system. The Proponent also expects to develop a Post-Storm Monitoring Plan prior to construction that describes how and when the Proponent will monitor the offshore cables following a major storm. See Section 4.2.4 for additional discussion of survey activities during O&M.

In the unlikely scenario that cable monitoring or surveys detect that a segment of cable no longer meets a sufficient burial depth, an analysis will be performed to determine whether additional measures (e.g., cable reburial or application of cable protection) are necessary. In addition, during operations, a limited amount of the cable protection applied during construction may require replacement or remediation.

If a cable repair is needed, the damaged segment would be uncovered, cut, and extracted from the seabed. The damaged section would then be replaced with a new section of cable, which would be spliced to the existing cable onboard a vessel, and the repaired cable would be lowered to the seabed and reburied.[77] The repaired cable will likely be reburied using controlled flow excavation, although any of the installation tools described for offshore export cables in Section 3.5.4.1 could be used. While the types of vessels and equipment used for reburying exposed cables, installing cable protection, or cable repairs are similar to those used during construction (see Section 3.5.4), the seafloor disturbance would be much smaller in extent and duration.

4.2.4 Surveys and Environmental Monitoring

As described in Sections 4.2.2 and 4.2.3, the Proponent will conduct underwater inspections and surveys of the offshore facilities throughout the operational period using survey vessels, remotely operated vehicles (ROVs), remotely operated towed vehicles (ROTVs), autonomous offshore vehicles/vessels, and/or divers. Geophysical survey equipment may include, but is not limited to, side scan sonar, single and multibeam echosounders, magnetometers/gradiometers, and sub-bottom/seismic profilers. A detailed list of geophysical survey equipment that may be used is provided as Appendix I-B. Measures to protect marine species during geophysical survey work are described in Sections 4.7 and 4.8

[77] If an inter-array or inter-link cable is damaged, the entire segment between WTGs and/or ESPs may be removed and replaced. The ends of the new inter-array or inter-link cable segment would be pulled into the WTG/ESP foundations rather than spliced to an existing cable.

of COP Volume II. Although not anticipated, geotechnical surveys may be performed during O&M. Any offshore geotechnical work would only be conducted in areas already reviewed and cleared for cultural resources.

In addition, the Proponent may use fixed-wing aircraft, drones (autonomous underwater/surface vessels or aerial drones), and/or for-hire fishing vessels to support environmental monitoring and mitigation during O&M.

4.3 Onshore O&M

The onshore cables and onshore substations will be remotely monitored (likely via the SCADA system described in Section 4.1) and inspected at regular intervals. The Proponent expects to maintain the onshore substations in accordance with future interconnection agreements. Scheduled maintenance at the onshore substations is expected to include safety inspections and tests, service of high-voltage equipment and auxiliary systems (e.g., fire protection system, heating and ventilation system), and replacement of consumables (e.g., lubrication oil).

If needed, any repair work at the onshore substations would occur within the fenced perimeter of the onshore substation sites. If onshore cable repairs are required, the cables would typically be accessed through manholes installed at the splice vaults and transition vaults. Onshore maintenance and repair activities are expected to require minimal use of worker vehicles and construction equipment (see Section 4.4.3).

4.4 O&M Facilities, Ports, and Logistics

4.4.1 O&M Facilities and Other Ports

The Proponent expects to use one or more onshore O&M facilities to support the operation of Vineyard Northeast's offshore facilities. The O&M facilities, which could be located at or near any of the ports identified in Table 4.4-1, are expected to include dock space for SOVs, SATVs, CTVs, and/or other support vessels (see Section 4.4.2). The O&M facility would likely be used for dispatching technicians and crew exchange, bunkering, and loading supplies and spare parts onto vessels. The O&M facilities may also include offices, a control room, training space for technicians, employee parking, and/or warehouse space for parts and tools. Any development/improvements of an O&M facility would be independent of Vineyard Northeast, all permits and approvals would be obtained by the site owner/lessor, and the port would be available for use by multiple developers once any necessary upgrades are made by the owner/lessor.

The Proponent, along with its contractors, will maintain a sufficient stock of spare parts and materials (e.g., spare cables, spare WTG components) based on OEM recommendations and experience gained from similar projects operating globally. It is anticipated that smaller spare parts and consumables will be stored primarily at the O&M facilities, while larger spare parts would likely be stored at either the OEM facilities or other storage facilities, as needed.

Although the Proponent expects most vessel activity during operations to be based out of one or more of the ports listed in Table 4.4-1, some basic maritime activities such as refueling,[78] restocking supplies, sourcing parts for repairs, vessel mobilization/demobilization, and infrequent crew transfer (activities well within the realm of normal port activities) may occur out of ports other than those listed in Table 4.4-1. If a significant maintenance event or repair activity is required, the Proponent may use one of the construction ports identified in Table 3.10-1. Each port under consideration for use during the operation of Vineyard Northeast is either located in an industrial waterfront area with sufficient existing infrastructure or where another entity may develop such infrastructure by the time operation begins. Although the use of Canadian ports during O&M is not anticipated, a Canadian port could be used to support a significant maintenance event.

In addition to the O&M facilities, the Proponent may lease space at an airport hangar in reasonable proximity to the Lease Area for aircraft (e.g., helicopters) used to support operations (see Section 4.4.2).

Table 4.4-1 Potential Ports During O&M

Port
Massachusetts Ports
Brayton Point Commerce Center
Fall River Ports
Port of New Bedford (New Bedford Marine Commerce Terminal & other areas in New Bedford)
Salem Harbor
Vineyard Haven Harbor
Rhode Island Ports
Port of Davisville (Quonset)
Port of Providence (ProvPort)
South Quay Terminal
Connecticut Ports
Port of Bridgeport
New London State Pier
Port of New Haven
New York Ports
Capital Region Ports (Port of Albany-Rensselaer, NYS Offshore Wind Port, Port of Coeymans Marine Terminal)
Staten Island Ports (Arthur Kill Terminal & Homeport Pier)
Brooklyn Ports (South Brooklyn Marine Terminal, GMD Shipyard, & Red Hook Container Terminal)
Long Island Ports (Shoreham, Port Jefferson Harbor, & Greenport Harbor)

78 Some bunkering (i.e., refueling) and restocking of supplies could also occur offshore.

Table 4.4-1 Potential Ports During O&M (Continued)

Port
New Jersey Ports
Paulsboro Marine Terminal
New Jersey Wind Port
Canadian Ports
Potential Canadian Ports (Port of Halifax, Sheet Harbor, & Port Saint John)[1]

Note:
1. Analysis of potential Canadian ports that may be used is ongoing.

All ports listed above may also be used during construction and are described in Section 3.10.1, with the exception of the Port of New Haven, Greenport Harbor, and the Red Hook Container Terminal, which are described below:

- **Port of New Haven:** The port is located on the north side of Long Island Sound at the mouth of the Quinnipiac River. The port serves vessels, trucks, and rail transportation and includes three berths, warehouse space, and ~0.2 square kilometers (km2) (50 acres) of outdoor storage area (CT DOT c2022).

- **Red Hook Container Terminal:** The terminal is located along the Upper New York Bay in Brooklyn, New York City. The ~0.32 km^2 (80 acre) terminal currently operates as a bulk cargo and container terminal and includes warehouse space and cranes (Red Hook… [date unknown]).

- **Greenport Harbor:** The harbor, which located on the tip of Long Island, is home to numerous commercial docks that could be rented to offshore wind developers and used for crew transfer, provisioning, weather standby, repairs, and possibly fuel and water delivery (Nalepinski 2019).

4.4.2 Vessels, Offshore Equipment, and Aircraft

The Proponent expects to use one or a combination of the following logistical approaches during the routine O&M of Vineyard Northeast:

- **Service operation vessel(s):** The Proponent may use one or more SOVs to provide workers with offshore accommodations during multi-week service trips to the Lease Area. The SOV(s) would remain offshore for extended periods of time and return to port periodically to restock fuel, food, and other supplies. An SOV is usually equipped with a dynamic positioning (DP) system and typically includes sleeping quarters, a large open deck, workspace, lifting and winch capacity, and possibly a helipad (see Figure 4.4-1 for photos of a representative SOV). The SOV(s) will likely include a gangway that allows workers to access the WTGs, ESP(s), or booster station directly from the SOV.

Figure 4.4-1
Representative Service Operation Vessel

VINEYARD NORTHEAST
VINEYARD OFFSHORE

CTVs, daughter craft (i.e., smaller vessels that reside on the SOV), and/or helicopters may be used in conjunction with the SOV(s) to transfer technicians and supplies between the SOV, the offshore facilities, and shore.

- **Service accommodation and transfer vessels:** The Proponent may use one or more SATVs for multi-day or week-long service trips to the offshore facilities. The SATVs, which are smaller than SOVs but are larger than CTVs, would transport workers between the offshore facilities and shore and provide offshore accommodations.

- **Crew transfer vessels and helicopters:** In this approach, multiple CTVs and/or helicopters would make frequent trips (e.g., daily) to transfer crew and supplies between the offshore facilities and shore (see Figure 4.4-2 for photos of a representative CTV). As described in Section 4.4.1, the helicopters would be based at a general aviation airport in reasonable proximity to the Lease Area.

The Proponent may periodically use larger vessels (e.g., jack-up vessels, cable laying vessels) to perform certain maintenance and repair activities, if needed. These vessels would be similar to the vessels used during construction (see Section 3.10.4). Offshore equipment during maintenance and repair activities could include generators, welding equipment, surface preparation equipment (i.e., to remove rust and prepare the surface for coating touch-ups), pressure washers, and other larger offshore construction equipment (e.g., cranes, cable installation tools). Mooring buoys, which are described in Section 3.10.3, could be deployed in the Lease Area during the operational period to moor vessels (e.g., SOV daughter craft).

During the busiest year of O&M, an average of approximately nine vessels are anticipated to operate in the Offshore Development Area at any given time, although additional vessels may be required during certain maintenance or repair activities. Based on the maximum design scenario, approximately 575 vessel round trips are estimated to take place annually during O&M. However, these estimates are highly dependent on the logistics approach used during O&M, the location of the O&M facilities, the timing and frequency of activities, and the final design of the offshore facilities. All vessels used during the operation of Vineyard Northeast will be equipped with AIS to track vessel activity and monitor compliance with permit requirements.

4.4.3 Onshore Equipment and Vehicles

Onshore inspection, maintenance, and repair activities are expected to require minimal use of worker vehicles and construction equipment, which would be similar to the types of equipment and vehicles used during onshore construction (see Section 3.10.5). Onshore equipment may include, but is not limited to, cranes, excavators, backhoes, trenchers, front end loaders, forklifts, concrete delivery trucks, dump trucks, generators, winches, delivery vehicles, cable reel trucks, and support vehicles.

Figure 4.4-2
Representative Crew Transfer Vessel

VINEYARD NORTHEAST
VINEYARD OFFSHORE

5 Decommissioning

5.1 Decommissioning Requirements

At the end of the operating term, Vineyard Northeast's facilities will be decommissioned. Prior to decommissioning, the Proponent will submit a Decommissioning Application to the Bureau of Safety and Environmental Enforcement (BSEE) for review and approval. This process will include an opportunity for public comment and consultation with agencies, Native American tribes, and stakeholders.

The facilities will be decommissioned in accordance with the stipulations in Lease OCS-A 0522, 30 CFR Part 285, Subpart I, and the Decommissioning Application. As required in Section 13 of Lease OCS-A 0522, unless otherwise authorized, the Proponent 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 Lease Area and any project easement(s) within two years following lease termination in accordance with any approved Site Assessment Plan (SAP), Construction and Operations Plan (COP), or approved Decommissioning Application and the applicable regulations. Pursuant to 30 CFR § 285.910(a), all offshore facilities will be removed to a depth of 4.5 meters (m) (15 feet [ft]) below the mudline, unless otherwise authorized by BSEE.

5.2 Decommissioning Concept

Decommissioning of the offshore and onshore facilities at the end of their operational life is essentially the reverse of the construction process. As the offshore facilities are removed, they will be carefully inventoried to ensure that all of the components are removed in accordance with the decommissioning requirements described in Section 5.1. The Proponent expects to conduct seabed surveys where the offshore facilities were located to verify site clearance per 30 CFR § 285.910(b).

The following sections outline the general decommissioning concept and procedures for each component based on technology that exists today. However, by the time the facilities are decommissioned, technological advances in methods and equipment servicing the offshore wind industry may result in other decommissioning methods that are more efficient and further minimize environmental impacts. As described in Section 5.1, the Proponent will submit a Decommissioning Application at the end of the operational period, which will provide greater detail on the decommissioning procedures and incorporate any technological advancements in decommissioning methods.

5.2.1 WTGs, ESP(s), and Booster Station

First, the wind turbine generators (WTGs), electrical service platform (ESP) topside(s), and booster station topside (if present), will be disconnected from the offshore cables. Prior to dismantling the WTGs and topsides, they will be properly drained of all fluids and chemicals, which will be brought to a port for proper disposal and/or recycling. Next, the WTGs and topsides will be deconstructed (down to the foundation) in a manner closely resembling the installation process using vessels similar to those used during construction (see Section 3.10.4). Depending on the design of the ESP and/or booster station topside and available crane capacity, some of the major electrical gear may be removed before the topside is dismantled from the foundation. The removed components will be transported by vessels to a port for recycling or disposal in accordance with applicable regulations. Metal components are expected to be recycled whereas the fiberglass WTG blades are expected to be cut into manageable pieces and disposed of at an approved onshore solid waste facility. [79]

5.2.2 Foundations and Scour Protection

Once the WTGs, ESP topside(s), and booster station topside are removed, the foundations will be cut and removed to a depth of 4.5 m (15 ft) below the mudline (unless otherwise authorized by BSEE). To provide access for cutting, sediments inside the monopiles and/or jacket piles may be removed. The foundations will likely be cut using underwater acetylene cutting torches, mechanical cutting, a high-pressure water jet, or a combination of these methods. Depending upon the available crane's capacity, the foundation may be cut into several sections to facilitate handling. The cut piece(s) would then be lifted onto a vessel for transport to an appropriate port for recycling. Any sediments previously removed from the pile's interior would be returned to the depression once the pile is removed. Scour protection (if present) may be removed or left in place, depending on input from federal and state agencies and relevant stakeholders. If removal is selected as the preferred option, the scour protection will likely be recovered using a dredging vessel and transported to shore for reuse or disposal.

5.2.3 Offshore Cables

The offshore export cables, inter-array cables, and inter-link cables (if used) may be retired in place or removed, depending on the outcome of consultations with the Bureau of Ocean Energy Management (BOEM) and other appropriate regulatory agencies regarding the preferred approach to minimize environmental impacts. If removal is required, after the cables are disconnected from the WTGs, ESP(s), and booster station and pulled out of the J-tubes (or similar opening in the foundation), they would be extracted from the seabed. To remove the cables, it may be necessary to fluidize the sediments covering the cables using equipment similar to the cable installation tools used during construction (see Section 3.5.4). Then, the cables will be loaded onto vessels and transported to port for further handling and recycling. Any cable protection used to cover portions of the offshore cables may be removed (before removing the cables) and transported to shore for reuse/disposal or left in place, subject to discussions with agencies and relevant stakeholders.

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[79] Recyclable blades are under development and may be used for Vineyard Northeast if such technologies are technically feasible and commercially viable at the time of procurement.

5.2.4 Onshore Facilities

The onshore facilities could be retired in place or retained for future use, subject to discussions with local agencies. Leaving the splice vaults, conduits, and duct bank (if present) in place will avoid disruption to the streets and enable the infrastructure to be repurposed for other projects. If removal of the onshore cables from the duct bank is preferred, the cables will be pulled out of the duct banks likely using winches, loaded onto truck-mounted reels, and transported offsite for recycling or possible reuse elsewhere. Although it is envisioned that the onshore substations will be left in place for future reuse, if disassembly is required, the process and activities will resemble substation construction (see Section 3.9.3).

5.2.5 Vessels, Equipment, Vehicles, and Aircraft

The vessels, equipment, and aircraft used to decommission the offshore facilities are expected to be similar to those used during construction (see Section 3.10.4). Vessels will likely include heavy lift vessels (HLVs), jack-up vessels, heavy transport vessels (HTVs), ocean-going barges, tugboats, and crew transfer vessels (CTVs), among others. Onshore decommissioning activities are expected to primarily require the use of winches, delivery vehicles, cable reel trucks, and support vehicles.

5.3 Financial Assurance for Decommissioning

The Proponent will provide financial assurance for the decommissioning of Vineyard Northeast in accordance with the applicable requirements under 30 CFR Part 585, Subpart E and/or any approved departures thereto.

6 Health, Safety, & Environmental Protection

The Proponent is firmly committed to safety and full compliance with applicable health, safety, and environmental (HSE) protection laws, regulations, and standards. This commitment extends throughout the pre-construction, construction, operational, and decommissioning periods of Vineyard Northeast. All construction, operations and maintenance (O&M), and decommissioning activities will be performed by properly trained personnel.

Sections 6.1 and 6.2 describe the plans and practices that the Proponent will implement to protect the health and safety of its employees and the public as well as the environment. Section 6.3 describes the safe handling and storage of chemicals and wastes that the Proponent expects to use during the construction and operation of Vineyard Northeast. The recycling and/or disposal of decommissioned components, including the removal of fluids and chemicals from the offshore facilities, is generally described in Section 5.

6.1 Health, Safety, and Environmental Management System

The Proponent's Health, Safety, and Environmental Management System, also known as the Safety Management System (SMS), is a living document that contains the HSE policies and procedures that will be followed during the construction and operation of Vineyard Northeast as well as the minimum requirements for working at Vineyard Northeast's facilities. The Proponent's HSE Management System draws on the team's prior experience and will be regularly updated to incorporate lessons learned. A draft of the HSE Management System is provided in Appendix I-E. The HSE Management System meets the requirements for an SMS found at 30 CFR § 285.810 by including a description of:

- procedures to ensure the safety of personnel or anyone on or near Vineyard Northeast's facilities;
- remote monitoring, control, and shut down capabilities;
- emergency response procedures (including the Emergency Response Plan [ERP]);
- fire suppression equipment;
- procedures for testing the HSE Management System; and
- methods for ensuring that the personnel who operate the Vineyard Northeast facilities are properly trained.

The HSE Management System also contains company-specific policies beyond those prescribed by 30 CFR §285.810.

As noted above, the overall HSE Management System will include an ERP to address non-routine events (e.g., marine incidents). The ERP will describe standard operating procedures (e.g., the formal wind turbine generator [WTG] shutdown procedure); the location, staffing, and monitoring capabilities of the Proponent's control center(s); and the Proponent's communications capabilities with the United States Coast Guard (USCG). A draft ERP template is included as Appendix I-E2. The Proponent expects to prepare the detailed ERP for Vineyard Mid-Northeast just prior to construction in coordination with USCG.

6.2 Spill Response Plans and Prevention Measures

The Proponent has prepared a draft Oil Spill Response Plan (OSRP), provided as Appendix I-F, in accordance with 30 CFR §585.627(c), 30 CFR Part 254, and other applicable federal and state oil spill response regulations. The OSRP describes spill prevention measures for the offshore facilities as well communication, notification, containment, removal, and mitigation procedures in the unforeseen event of an offshore spill. The OSRP also describes training, equipment testing, and periodic drills to prepare for a spill response. Routine training on the contents of the OSRP will be conducted regularly to ensure personnel are familiar with the plan's requirements and are prepared to respond to emergencies, should they occur. As described in the OSRP, the WTGs, electrical service platform(s) (ESP[s]), and booster station will be equipped with secondary containment around oil-filled equipment to prevent a discharge of oil into the environment. The ESP(s) and booster station will likely include an oil/water separator. A final OSRP will be submitted to the Bureau of Safety and Environmental Enforcement (BSEE) prior to construction.

In addition to the OSRP, the Proponent's contractors will have their own spill response plans in accordance with applicable regulations. All contractors' spill response plans will be reviewed to ensure they comply with the applicable regulations and are consistent with the Proponent's OSRP. In the event of a spill or incident, the contractors' plans will be used, in conjunction with the OSRP, to contain and/or stop an incident.

Annex 10 of the draft OSRP provides an oil spill modeling study to assess the trajectory and weathering of oil following a catastrophic release of all oil contents from the toppling of an ESP (the largest oil-containing component) at two representative locations within the Lease Area. The oil spill modeling study identifies the worst-case discharge scenario, the longest period of time that the discharged oil would reasonably be expected to persist on the water's surface, and minimum travel times for the spill to reach shore.

Horizontal directional drilling (HDD) (and potentially other trenchless crossing methods described in Section 3.8.3.3) will use bentonite or another non-hazardous drilling fluid. Crews are trained to closely monitor both the position of the drill head and the drilling fluid pressure to reduce the risk of inadvertent releases of pressurized drilling fluid to the surface (i.e., drilling fluid seepage). The Proponent will develop an HDD Inadvertent Release Response Plan, which will describe measures to reduce the risk of an inadvertent release and the immediate corrective actions that will be taken in the unlikely event of an inadvertent release.

The Proponent will also develop a Spill Prevention, Control, and Countermeasure (SPCC) Plan for each onshore substation site, in accordance with 40 CFR Part 112 and applicable state regulations, during the state permitting process. The SPCC Plans will identify what oils are stored at the onshore facilities, how oil is delivered and transferred, spill prevention and control procedures, spill response and notification procedures, training, inspections, recordkeeping, and reporting requirements. As further described in Section 3.9.3, the onshore substations will be equipped with secondary oil containment and a stormwater management system. All onshore waste that may cause environmental harm will be stored in proper containers and placed in designated, secure locations until it is collected by the selected waste contractor. Proper spill containment gear and absorption materials will be maintained at the onshore facilities for immediate use in the event of any inadvertent spills or leaks.

Where practicable, onshore vehicle fueling and all major equipment maintenance will be performed offsite at commercial service stations or a contractor's yard. Larger, less mobile equipment (e.g., excavators, paving equipment) will be refueled as necessary onsite. Any such field refueling will be performed in accordance with applicable on-site construction refueling regulations. Procedures for onshore refueling of construction equipment will be finalized during consultations with the appropriate state, regional, and local authorities.

6.3 Chemical Use, Waste Generation, and Disposal

The construction and operation of Vineyard Northeast will generate some solid and liquid wastes and require the use of some chemicals. Wastes and chemicals from construction and operation can be broadly grouped into the following categories:

- **Conventional wastes from equipment installation and maintenance:** Solid waste is expected to consist primarily of short lengths of cable trimmings as well as equipment packaging or protective wrappings (e.g., paper, cardboard, plastics, empty cans). Liquid wastes may include waste oils, paints, varnishes, cleaners, solvents, and adhesives. Conventional wastes from offshore equipment installation and maintenance will be returned to port and properly disposed of or recycled. Small amounts of leftover paints, coatings, and other potentially hazardous materials will be segregated for proper disposal. See Table 6.3-1 for a list of wastes that may be produced during Vineyard Northeast.

- **Conventional and operational wastes from vessels:** Conventional and operational wastes from vessels include domestic water, uncontaminated bilge and ballast water, deck drainage, treated grout hose flush water, sewage, uncontaminated fresh or seawater used for vessel air conditioning, food waste, and paper waste (see Table 6.3-1). As further discussed in Section 3.2 of COP Volume II, the vessels used during construction and operation will meet USCG waste and ballast water management regulations, among other applicable federal regulations and International Convention for the Prevention of Pollution from Ships (MARPOL) requirements.

- **Oil and chemicals on the WTGs:** The WTGs are large pieces of mechanical/electrical equipment that require chemical products to function properly and reliably. Table 6.3-2 provides a list of oils and chemical products that may be used on the WTGs. The expected frequency of replacement and treatment, discharge, or disposal methods for each chemical type is also provided in Table 6.3-2.

- **Oil and chemicals on the ESP(s) and booster station:** The ESP(s) and booster station (if used) include several complex mechanical and electrical systems that require oil and chemical products. Table 6.3-3 provides a list of oils and chemical products that may be used on the ESP(s) and booster station as well as the expected frequency of replacement and treatment, discharge, or disposal methods.

- **Oil and chemicals on vessels, equipment, vehicles, and aircraft:** The vessels, equipment, vehicles, and aircraft used during the offshore and onshore construction and operation of Vineyard Northeast (see Sections 3.10 and 4.4) may contain fuel, hydraulic fluid, lubricants, and other chemicals.

- **Drilling fluids and drill cuttings:** As described in Section 3.7.3, HDD (and potentially other trenchless crossing methods described in Section 3.8.3.3) will require the use of a drilling fluid, which is expected to be a slurry of bentonite and water. Non-reusable excess drilling fluids and drill cuttings are typically classified as clean fill and will be transported to an appropriate disposal site (see Table 6.3-1). Filtered water may be released if it meets water quality requirements.

- **Chemical products at the onshore substations:** Chemical products used at the onshore substations could include, but are not limited to, dielectric fluid (i.e., essentially a high-grade mineral oil), lead acid batteries, sulfur hexafluoride (SF_6), and possibly lubricating oil.

All solid and liquid wastes will be carefully handled, stored, treated, and/or disposed of or recycled in accordance with applicable regulations. The Proponent will require vessel operators, employees, and contractors who engage in offshore activities to participate in a marine trash and debris prevention training program. Where possible, hazardous substances will be substituted with environmentally friendlier alternatives.

As described in Section 6.2, the Proponent has or will develop spill response plans for the offshore and onshore facilities, which will describe spill prevention, containment, removal, and mitigation measures.

Table 6.3-1 Wastes Expected to be Produced During Construction and Operations

Type of Waste and Composition	Approximate Total Amount Discharged	Maximum Discharge Rate	Means of Storage or Discharge Method
Domestic water	114-151 liters (L)/person/day (30-40 gallons [gal]/person/day)	N/A	Tanks or discharged overboard after treatment
Uncontaminated bilge water	Volume subject to vessel type	Rate subject to vessel size and equipment	Tanks or discharged overboard after treatment (if needed)
Uncontaminated ballast water	Volume subject to vessel type	Rate subject to vessel size and equipment	Discharged overboard
Deck drainage	Volume subject to vessel type	Rate subject to vessel size and equipment	Discharged overboard after treatment
Sewage from vessel	95-114 L/person/day (25-30 gal/person/day)	N/A	Tanks/sewage treatment plant
Uncontaminated fresh or seawater used for vessel air conditioning	N/A	N/A	Discharged overboard
Solid trash or debris (e.g., food waste, paper waste, cable trimmings, equipment packaging, protective wrappings)	As generated	As generated	Onshore landfill (location to be determined [TBD])
Oils, paints, varnishes, cleaners, solvents, and adhesives	Volume subject to vessel type	Rate subject to vessel size and equipment	Incineration or onshore landfill (location TBD)
Drilling fluids and cuttings	Dependent on final selection of trenchless crossing techniques	N/A	Clean fill disposal site (location TBD)

Table 6.3-2 List of Potential Chemicals Used on the WTGs

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge, or Disposal Options
Grease	Pinion & main bearing lubrication	Nacelle	1,875 L (495 gals) per WTG	To be included at time of WTG installation During O&M, vessels will transfer cans to site	Approximately 525 L (139 gals) expected annually	To be brought to port and disposed of according to applicable regulations and guidelines
Ester oil	Biodegradable transformer oil	Nacelle (within transformer)	15,000 L (3,963 gals) per WTG	To be included at time of WTG installation During O&M, vessels will transfer the oil to the WTGs, 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 to port and disposed of according to applicable regulations and guidelines
Water/glycol	Cooling liquid for heating, ventilation, and air conditioning (HVAC) unit, air handling unit	Nacelle or Tower (top)	30,000 L (7,925 gals) per WTG	To be included at time of WTG installation	Expected to be topped up annually (if needed) and replaced every 5–8 years	To be brought to port and disposed of according to applicable regulations and guidelines

Table 6.3-2 List of Potential Chemicals Used on the WTGs (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge, or Disposal Options
Hydraulic oil	Oil used for hydraulic system (pitch, low-speed brake, cranes, & winches)	Nacelle or tower	2,500 L (660 gals) per WTG	To be included at time of WTG installation During O&M, vessels will transfer the oil to the WTGs, 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 to be topped up annually (if needed) and replaced every 5–8 years	To be brought to port and disposed of according to applicable regulations and guidelines
Gearbox oil	Lubrication for gearboxes, including yaw drive; not applicable to direct drive WTG concepts	Nacelle	5,625 L (1,486 gals) per WTG	To be included at time of WTG installation	Expected to be topped up annually (as needed); frequency of replacement depends on an oil analysis	To be brought to port and disposed of according to applicable regulations and guidelines
Tower Damper Fluid	Water/anti-biofouling agent	Tower (top)	21,579 L (5,700 gals) per WTG	To be included at time of WTG installation	Not replaced	To be brought to port and disposed of according to applicable regulations and guidelines
Pressurized nitrogen	Drives pitch system during power failure	Hub	113 kg (249 lbs) per WTG	To be included at time of WTG installation	Expected annually	To be brought to port and disposed of according to applicable regulations and guidelines

Table 6.3-2 List of Potential Chemicals Used on the WTGs (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge, or Disposal Options
SF_6[1]	Insulates switchgear	Tower Base (within switchgear)	25 kg (55 lbs) per WTG	To be included at time of WTG installation	Not replaced	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing Agents	Inert gases (e.g., NOVEC, nitrogen, carbon dioxide [CO_2], or similar)	Various locations	To be defined during detailed design	To be included at time of WTG installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing Agents	Powder	Various locations	To be defined during detailed design	To be included at time of WTG installation	Depends on fabrication	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing Agents	Water/foam	Various locations	To be defined during detailed design	To be included at time of WTG installation	Depends on fabrication	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing Agents	Other types of extinguishers (if any)	Various locations	To be defined during detailed design	To be included at time of WTG installation	Not anticipated; Only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines

Table 6.3-2 List of Potential Chemicals Used on the WTGs (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge, or Disposal Options
Paints & coatings	Corrosion protection of steel structure, paints (including anti-fouling paint), & varnishes	Steel structure, various locations	To be defined during detailed design	To be included at time of WTG installation; additional paint only needed for repairs	Only for repairs	To be brought to port and disposed of according to applicable regulations and guidelines
Grout	For connection between foundation components	Foundation, various locations	Up to 241 cubic meters (m^3) (315 cubic yards [yd^3]) per WTG	To be included at time of WTG installation	Not anticipated; Only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines

Note:

1. For all SF_6-containing equipment, the Proponent will follow manufacturer-recommended maintenance and removal procedures and best industry practices to avoid any potential leakage. The Proponent will also consider alternatives to the use of SF_6 gas in switchgear, only if such alternatives are technically feasible and commercially available.

Table 6.3-3 List of Potential Chemicals Used on the ESP(s) and Booster Station

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Transformer oil	Mineral/ naphthenic or ester oils	Topside (within power transformers, auxiliary/ earthing transformers, and reactors)	816,200 L (215,617 gals) per ESP; 671,616 L (177,422 gals) for booster station	To be included at time of installation During O&M, vessels will transfer the oil to the ESP(s)/booster station, 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 to port and disposed of according to applicable regulations and guidelines
Lubrication oil	Lubricates machinery	Crane Emergency Generator	Crane: To be defined during detailed design Emergency generator: 96 L (25 gals) per ESP; 79 L (21 gals) for booster station	During O&M, vessels will transfer the oil to the ESP(s)/booster station, 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 to port and disposed of according to applicable regulations and guidelines

Table 6.3-3 List of Potential Chemicals Used on the ESP(s) and Booster Station (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Hydraulic oil	Transfers energy, lubricates, and/or seals	Crane	2,154 L (569 gals) per ESP	To be included at time of installation During O&M, vessels will transfer the oil to the ESP(s), 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 to port and disposed of according to applicable regulations and guidelines
General oil	Various uses	Various locations	2,310 L (610 gals) per ESP; 1,267 L (335 gals) for booster station	To be included at time of installation During O&M, vessels will transfer the oil to the ESP(s)/booster station, 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 to port and disposed of according to applicable regulations and guidelines

Table 6.3-3 List of Potential Chemicals Used on the ESP(s) and Booster Station (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Diesel fuel	Fuel for generator	Diesel generator/ diesel day tank/diesel storage tank	75,460 L (19,934 gals) per ESP; 31,046 L (8,201 gals) for booster station	To be included at time of installation or potentially transferred via hose from a vessel or container placed on the ESP(s)/booster station	Only as required	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing Agents	Inert gases (e.g., NOVEC, nitrogen, CO_2, or similar)	Various locations	To be defined during detailed design	To be included at time of installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing Agents	Powder	Various locations	To be defined during detailed design	To be included at time of installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing agents	Foam/water	Various locations	19,250 L (5,085 gals) foam per ESP; 16,500 L (4,359 gals) for booster station	To be included at time of installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines
Fire extinguishing Agents	Other types of extinguishers (if any)	Various locations	To be defined during detailed design	To be included at time of installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines

Table 6.3-3 List of Potential Chemicals Used on the ESP(s) and Booster Station (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Portable fire extinguisher	Various types	Various locations	To be defined during detailed design	To be included at time of installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines
SF_6[1]	Insulates switchgear	Topside (within switchgear)	7,210 kg (15,895 lbs) per ESP; 2,630 kg (5,798 lbs) for booster station	To be included at time of installation	Not replaced	To be brought to port and disposed of according to applicable regulations and guidelines
Water/ glycol	Cooling liquid for HVAC unit, air handling unit	HVAC unit, air handling unit	14,000 L (3,698 gals) per ESP; 12,000 L (3,170 gals) for booster station	To be included at time of installation	Expected every 5–8 years	To be brought to port and disposed of according to applicable regulations and guidelines
Anti-biofouling additives	Prevent marine growth (e.g., sodium hypochlorite)	Intake of high voltage direct current (HVDC) seawater cooling system	115 kg/day (254 lb/day) per ESP	Produced onsite via electrolysis of water	N/A	Discharged with cooling water

Table 6.3-3 List of Potential Chemicals Used on the ESP(s) and Booster Station (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Paints & Coatings	Corrosion protection of steel structure, paints (including anti-fouling paint), & varnishes	Steel structure, various locations	To be defined during detailed design	To be included at time of installation; additional paint only needed for repairs	Only for repairs	To be brought to port and disposed of according to applicable regulations and guidelines
Grout	For connections between foundation components	Foundation, various locations	Up to 613 m^3 (802 yd^3) per ESP/booster station	To be included at time of installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines
Diesel Exhaust Fluid (urea)	Injected into exhaust to scrub nitrogen oxides (NOx), if necessary	Topside	To be defined during detailed design	To be included at time of installation	Only changed when needed; genset only used during commissioning, servicing, and grid faults	To be brought to port and disposed of according to applicable regulations and guidelines
Lead–acid	Batteries	Topside	To be defined during detailed design	To be included at time of installation	Expected every 5-8 years	To be brought to port and disposed of according to applicable regulations and guidelines

Table 6.3-3 List of Potential Chemicals Used on the ESP(s) and Booster Station (Continued)

Chemical Type	Product Description	Source/ Location	Maximum Volume/ Weight	Method of Bringing Onsite	Number of Transfers	Treatment, Discharge or Disposal Options
Refrigerant gas R134a or R407C	Auxiliary cooling systems	Topside	To be defined during detailed design	To be included at time of installation	Not anticipated; only changed if needed	To be brought to port and disposed of according to applicable regulations and guidelines

Note:

1. For all SF_6-containing equipment, the Proponent will follow manufacturer-recommended maintenance and removal procedures and best industry practices to avoid any potential leakage.

7 Permitting and Regulatory Framework

7.1 Permits and Approvals

Vineyard Northeast's offshore renewable wind energy facilities are located in federal waters on the Outer Continental Shelf (OCS). The Bureau of Ocean Energy Management (BOEM) has jurisdiction under the Outer Continental Shelf Lands Act to issue leases, easements, and rights-of-way for the development of wind energy facilities on the OCS. BOEM authorizes the development of such facilities through its review and approval of a Construction and Operations Plan (COP) pursuant to 30 CFR Part 585. As such, the Proponent is submitting this COP to BOEM in accordance with 30 CFR Part 585, the stipulations in Lease OCS-A 0522, and applicable guidance.

In reviewing the COP, BOEM will comply with its obligations under the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), the Magnuson-Stevens Fishery Conservation and Management Act, and the Endangered Species Act (ESA). To fulfill these obligations, BOEM will coordinate and consult with numerous other federal agencies during the review process, including the Bureau of Safety and Environmental Enforcement (BSEE), National Marine Fisheries Service (NMFS), United States Coast Guard (USCG), US Fish and Wildlife Service (USFWS), Environmental Protection Agency (EPA), Department of Defense (DoD), Federal Aviation Administration (FAA), and US Army Corps of Engineers (USACE). BOEM will also conduct government-to-government consultations with federally recognized Tribes/Tribal Nations that may be affected by Vineyard Northeast.

BOEM will be the lead federal agency for Vineyard Northeast and will be responsible for the development of the Environmental Impact Statement (EIS) under NEPA. Several other federal agencies (e.g., NMFS, USACE, and EPA) will issue permits for Vineyard Northeast, but will rely on BOEM's EIS and/or consultations to support their decision-making.

Vineyard Northeast is a covered project under Title 41 of the Fixing America's Surface Transportation Act (FAST-41). FAST-41 is designed to improve the timeliness, predictability, and transparency of the federal environmental permitting process for covered infrastructure projects. Under FAST-41, the Federal Permitting Improvement Steering Council (FPISC) will be responsible for overseeing interagency coordination during the environmental review and decision-making process for Vineyard Northeast.

Vineyard Northeast's onshore facilities and a portion of the offshore export cables (within approximately 3 nautical miles [5.6 kilometers] of shore) will be located in Massachusetts, Connecticut, and/or New York. These portions of Vineyard Northeast that are within state jurisdiction will require review and/or permits from several state, regional, and local agencies. The Proponent will also seek concurrence from the Massachusetts Office of Coastal Zone Management (MA CZM), the Rhode Island Coastal Resources Management Council (RI CRMC), the Connecticut Department of Energy and Environmental Protection (CT DEEP), and the New York State Department of State (NYSDOS) that Vineyard Northeast is consistent with the states' coastal zone management plans under the Coastal Zone Management Act (CZMA).

Table 7.1-1 provides the status of the federal, state, regional (county), and local permits and approvals that are expected to be required for Vineyard Northeast. The table below does not include permits that vessel operators or construction companies will need to obtain.

Throughout the permitting process, the Proponent will continue to consult with federal, state, and local agencies (as well as Native American tribes and stakeholders, as described in Sections 8.2 through 8.5) regarding the status of Vineyard Northeast, planned filings, planned studies, issues of concern, and related matters. The Proponent's consultations with agencies are described in Section 8.1 and Appendix I-G.

Table 7.1-1 Required Permits/Approvals for Vineyard Northeast

Agency/Regulatory Authority	Permit/Approval	Status
Federal Permits/Approvals		
Bureau of Ocean Energy Management (BOEM)	Site Assessment Plan (SAP) Approval	Initially filed with BOEM on March 6, 2020. Approved on July 1, 2022.
	Construction and Operations Plan (COP) Approval	COP initially filed with BOEM in July 2022.
	National Environmental Policy Act (NEPA) Review and Record of Decision (ROD)	To be initiated by BOEM.
	Consultation under Section 106 of the NHPA, consultation with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act, consultation under Section 7 of the ESA with NMFS and USFWS, and government-to-government tribal consultations	To be initiated by BOEM.
Bureau of Safety and Environmental Enforcement (BSEE)	Facility Design Reports (FDRs) and Fabrication and Installation Reports (FIRs)	To be filed (TBF)
US Environmental Protection Agency (EPA)	National Pollutant Discharge Elimination System (NPDES) Permit(s) (if needed)	TBF
	OCS Air Permit	TBF

Table 7.1-1 Required Permits/Approvals for Vineyard Northeast (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
Federal Permits/Approvals (Continued)		
US Army Corps of Engineers (USACE)	Clean Water Act (CWA) Section 404 Permit (for discharge of dredged material and installation of offshore export cables and associated cable protection within state territorial limits) Rivers and Harbors Act of 1899 Section 10 Individual Permit (for all offshore structures) Section 408 permission pursuant to Section 14 of the Rivers and Harbors Act of 1899 (required if Vineyard Northeast affects a USACE civil works project)	TBF
US National Marine Fisheries Service (NMFS)	Incidental Take Regulation and an associated Letter of Authorization (LOA)	TBF
US Coast Guard (USCG)	Private Aid to Navigation (PATON) Permits	TBF
Federal Aviation Administration (FAA)	No Hazard Determination (for activities at staging ports, vessel transits, and overhead transmission lines, if required)	TBF
Massachusetts – State, Regional, and Local Permits/Approvals (As Needed)[1]		
Massachusetts Office of Coastal Zone Management (MA CZM)	Federal Consistency Concurrence under the CZMA	Draft federal consistency certification included in Appendix II-M.
Massachusetts Environmental Policy Act (MEPA) Office	Certificate of the Secretary of Energy and Environmental Affairs on the Final Environmental Impact Report	TBF

Table 7.1-1 Required Permits/Approvals for Vineyard Northeast (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
Massachusetts – State, Regional, and Local Permits/Approvals (As Needed, Continued)[1]		
Massachusetts Energy Facilities Siting Board (EFSB)	G.L. ch. 164, § 69J Approval	TBF
Massachusetts Department of Public Utilities (DPU)	G.L. ch. 164, § 72, Approval to Construct G.L. ch. 40A, § 3 Zoning Exemption (if needed)	TBF
Massachusetts Department of Environmental Protection (MassDEP)	Chapter 91 Waterways License Water Quality Certification (under Section 401 of the CWA)	Joint application TBF
	Approval of Easement (Drinking Water Regulations)[2]	TBF (If needed)
Massacshusetts Legislature	Article 97 Approval	TBF
Massachusetts Division of Marine Fisheries (DMF)	Letter of Authorization and/or Scientific Permit (for surveys and pre-lay grapnel run)	TBF
Massachusetts Department of Transportation (MassDOT)	Non-Vehicular Access Permits	TBF
	Rail Division Use and Occupancy License (if needed)	TBF (if needed)
Massachusetts Board of Underwater Archaeological Resources (MBUAR)	Special Use Permit	Permit application filed March 3, 2022. Permit approved March 31, 2022.
Natural Heritage and Endangered Species Program (NHESP)	Conservation and Management Permit (if needed)	TBF (if needed)
Massachusetts Historical Commission (MHC)	Archaeological Investigation Permits (950 CMR § 70.00)	TBF
Westport, Fall River, and/or Somerset Conservation Commissions	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	TBF
Westport Town Board, Fall River City Council, and/or Somerset Highway Department	Street Opening Permits/Grants of Location	TBF

Table 7.1-1 Required Permits/Approvals for Vineyard Northeast (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
Massachusetts – State, Regional, and Local Permits/Approvals (As Needed, Continued)[1]		
Westport, Fall River, and/or Somerset Planning/Zoning Department	Zoning approvals as necessary	TBF
Rhode Island – State Approvals (As Needed)[1]		
Rhode Island Coastal Resources Management Council (RI CRMC)	Federal Consistency Concurrence under the CZMA	Draft federal consistency certification included in Appendix II-M.
Connecticut – State, Regional, and Local Permits/Approvals (As Needed)[1]		
Connecticut Department of Energy and Environmental Protection (CT DEEP)–Land & Water Resources Division (LWRD)	Federal Consistency Concurrence under the CZMA	Draft federal consistency certification included in Appendix II-M.
	Structures, Dredging and Fill Permit Water Quality Certification (under Section 401 of the CWA and Connecticut Water Quality Standards) Tidal Wetlands Permit (if needed)	Joint application TBF
	Flood Management Certification (if needed)	TBF (if needed)
CT DEEP–Bureau of Natural Resources Wildlife Division	Natural Diversity Data Base (NDDB) State Listed Species Review	TBF
CT DEEP–Water Permitting and Enforcement Division	General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities	TBF
Connecticut Siting Council	Certificate of Environmental Compatibility and Public Need	TBF
Connecticut Department of Transportation (CT DOT)	Encroachment Permit (if needed)	TBF (If needed)

Table 7.1-1 Required Permits/Approvals for Vineyard Northeast (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
Connecticut – State, Regional, and Local Permits/Approvals (As Needed, Continued)[1]		
Groton, Ledyard, New London, Montville, Waterford, and/or East Lyme Conservation Commission, Planning and Zoning Department, or other Inland Wetlands Agency	Inland Wetlands and Watercourses Permit (if needed)	TBF (if needed)
Groton, Ledyard, New London, Montville, Waterford, and/or East Lyme Planning and Zoning Department/ Commission	Zoning approvals (as necessary) Coastal Site Plan Review	TBF
Groton, Ledyard, New London, Montville, Waterford, and/or East Lyme Department of Public Works and/or Town Council	Street Opening Permits/Encroachment Permit	TBF
New York – State Permits/Approvals (As Needed)[1]		
New York State Department of State (NYSDOS) Division of Coastal Resources	Federal Consistency Concurrence under the CZMA	Draft federal consistency certification included in Appendix II-M.
New York State Office of General Services (NYSOGS) Bureau of Land Management	Easement to Use New York State Lands Underwater	TBF
New York State Public Service Commission (NYSPSC)/New York State Department of Public Service (NYSDPS)	Certificate of Environmental Compatibility and Public Need (CECPN) under Article VII of the New York State Public Service Law Water Quality Certification (under Section 401 of the CWA)	TBF

Table 7.1-1 Required Permits/Approvals for Vineyard Northeast (Continued)

Agency/Regulatory Authority	Permit/Approval	Status
Interconnection Authorizations		
ISO New England (ISO-NE)	Interconnection Authorization	Interconnection requests are under review.

Notes:

1. Required state, regional, and local permits/approvals will be based upon the final design of Vineyard Northeast and the associated effects on regulated resources.
2. An Approval of Easement from MassDEP may be required for the limited sections of the Massachusetts onshore cable routes which pass through Zone I areas.

7.2 Commercial Lease Stipulations and Compliance

Table 7.2-1 demonstrates how the Proponent is currently or will comply with the stipulations in Lease OCS-A 0522.

Table 7.2-1 Commercial Lease Stipulations and Compliance

Lease Stipulation	Compliance
Section 2(b): The rights granted to the Lessee herein are limited to those activities described in any SAP or COP approved by the Lessor. The rights granted to the Lessee are limited by the lease-specific terms, conditions, and stipulations required by the Lessor per Addendum "C."	The Proponent will adhere to the applicable lease-specific terms, conditions, and stipulations required per Addendum "C" of the Lease, unless granted a waiver by BOEM.
Section 2(c): This lease does not authorize the Lessee to conduct activities on the Outer Continental Shelf (OCS) relating to or associated with the exploration for, or development or production of, oil, gas, other seabed minerals, or renewable energy resources other than those renewable energy resources identified in Addendum "A."	The Proponent will only conduct activities relating to or associated with the renewable energy resources identified in Addendum "A" of the Lease.
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" of the Lease.
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, as specified in Addendum "B" of the Lease.

Table 7.2-1 Commercial Lease Stipulations and Compliance (Continued)

Lease Stipulation	Compliance
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 in accordance with the approved SAP and COP (except as provided in applicable regulations in 30 CFR Part 585).
Section 7: The Lessee must conduct, and agrees to conduct, all activities in the leased area and project easement(s) in accordance with an approved SAP or COP, and with all applicable laws and regulations. The Lessee further agrees that no activities authorized by this lease will be carried out in a manner that: a) could unreasonably interfere with or endanger activities or operations carried out under any lease or grant issued or maintained pursuant to the Act, or under any other license or approval from any Federal agency; b) could cause any undue harm or damage to the environment; c) could create hazardous or unsafe conditions; or d) could adversely affect sites, structures, or objects of historical, cultural, or archaeological significance, without notice to and direction from the Lessor on how to proceed.	The Proponent will conduct all activities in the Lease Area and offshore export cable corridors (OECCs) in accordance with the approved SAP and COP as well as all applicable laws and regulations. The Proponent will not conduct activities that could unreasonably interfere with or endanger the permitted activities of other users of the OCS, cause undue harm or damage to the environment, create hazardous or unsafe conditions, or adversely affect sites, structures, or objects of historical, cultural, or archaeological significance without notice and direction from the Lessor on how to proceed.
Section 9: The Lessee hereby agrees to indemnify the Lessor for, and hold the Lessor harmless from, any claim caused by or resulting from any of the Lessee's operations or activities on the leased area or project easement(s) or arising out of any activities conducted by or on behalf of the Lessee or its employees, contractors (including Operator, if applicable), subcontractors, or their employees, under this lease, including claims for: (a) loss or damage to natural resources, (b) the release of any petroleum or any Hazardous Materials, (c) other environmental injury of any kind, (d) damage to property, (e) injury to persons, and/or (f) costs or expenses incurred by the Lessor.	The Proponent will indemnify and hold the Lessor harmless from any claim caused by or resulting from any of the Proponent's operations or activities in the Lease Area or OECCs, including activities conducted by or on behalf of the Proponent or its employees, contractors, subcontractors, or their employees.

Table 7.2-1 Commercial Lease Stipulations and Compliance (Continued)

Lease Stipulation	Compliance
Except as provided in any addenda to this lease, the Lessee will not be liable for any losses or damages proximately caused by the activities of the Lessor or the Lessor's employees, contractors, subcontractors, or their employees. The Lessee must pay the Lessor for damage, cost, or expense due and pursuant to this Section within 90 days after written demand by the Lessor. Nothing in this lease will be construed to waive any liability or relieve the Lessee from any penalties, sanctions, or claims that would otherwise apply by statute, regulation, operation of law, or could be imposed by the Lessor or other government agency acting under such laws.	The Proponent will pay the Lessor for damage, cost, or expense due and pursuant to this Section within 90 days after written demand by the Lessor, except as provided in any addenda to the Lease.
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." As required by the applicable regulations in 30 CFR Part 585, if, at any time during the term of this lease, the Lessor requires additional financial assurance, then the Lessee must furnish the additional financial assurance required by the Lessor in a form acceptable to the Lessor within 90 days after receipt of the Lessor's notice of such adjustment.	The Proponent will provide the necessary financial assurances as described in Section 5.3.
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 and project easement(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.	The facilities will be decommissioned in accordance with the stipulations in Lease OCS-A 0522, the Decommissioning Application (see Section 5.1), and the applicable regulations. The general decommissioning concept is described in Section 5.2.

Table 7.2-1 Commercial Lease Stipulations and Compliance (Continued)

Lease Stipulation	Compliance
Section 14(a): The Lessee must 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.	The Proponent has and will continue to maintain all places of employment for activities authorized under the Lease in compliance with applicable occupational safety and health standards.
Section 14(b): The Lessee must maintain all operations within the leased area and project easement(s) 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.	The Proponent will maintain all operations within the Lease Area and OECCs in compliance with applicable regulations.
Section 14(c): The Lessee must 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.	The Proponent will provide any requested documents and records that are pertinent to occupational or public health, safety, or environmental protection, and will allow prompt access to the site of activities conducted under the Lease to authorized inspectors.
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 Proponent will comply with the applicable Department of Interior non-procurement debarment and suspension regulations.
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. Paragraphs (1) through (7) of Section 202 of Executive Order 11246, as amended, are incorporated in this lease by reference.	The Proponent will 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

7.3 Guide to Location of Required Information for the COP

This COP demonstrates that the Proponent is prepared to conduct the proposed activities in accordance with all applicable regulations and that Vineyard Northeast is safe, does not unreasonably interfere with other uses of the OCS, does not cause undue harm or damage to the environment or cultural resources, and will use the best available technology.

The COP has been developed in accordance with 30 CFR Part 585, the stipulations in Lease OCS-A 0522, BOEM's (2020) *Information Guidelines for a Renewable Energy Construction and Operations Plan (COP)*, BOEM's (2023) *FINAL Information Needed for Issuance of a Notice of Intent (NOI) Under the National Environmental Policy Act (NEPA) for a Construction and Operations Plan (COP)*, and other relevant guidance. Table 7.3-1 lists all pending information that will be submitted to BOEM. Table 7.3-2 identifies where in this COP the Proponent satisfies BOEM's requirements for a COP pursuant to 30 CFR Part 585.

Table 7.3-1 Information to Be Provided

Information	Description of Changes	Expected Submission Date
Prior to the Draft Environmental Impact Statement		
2024 Geotechnical Survey Technical Memo	Technical memo that provides information on the technical feasibility of installing foundations at each WTG/ESP position based on 2024 geotechnical survey data and prior survey campaigns.	October 31, 2024
Project Design Envelope (PDE) Refinements	PDE refinements may include, but are not necessarily limited to, modifications to the number and/or dimensions of the piled jacket foundations.	October 31, 2024
Final Marine Site Investigation Report (Appendix II-B)	Updated based on geotechnical data collected in 2024 and to include the final Foundation Feasibility Assessment and Pile Drivability Assessment (Appendix II-B27) as well as the final ground model (Appendix II-B25).	March 31, 2025
Prior to the ROD		
Final Vineyard Northeast Easements Request (Appendix I-A2)	Final easement request(s) per 30 CFR §§ 585.200, .620(a), and .622(b).	Timing to be determined in consultation with BOEM

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d)

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 2 of COP Volume I Section 3 of COP Volume I Section 6 of COP Volume I Section 7.2 of COP Volume I Appendix I-C Appendix I-D Appendix I-E Appendix I-F Section 3 of COP Volume II Section 4 of COP Volume II Section 7 of COP Volume II Appendix II-D Appendix II-E Appendix II-N
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 6 of COP Volume I Section 3.12 of COP Volume I Section 7.2 of COP Volume I Section 7.3 of COP Volume I Appendix I-C
b) The project will be safe.	Section 3.12 of COP Volume I Section 6 of COP Volume I Appendix I-E
c) The project will not unreasonably interfere with other uses of the OCS, including those involved with National security or defense.	Appendix I-I Section 5.3 of COP Volume II Section 5.4 of COP Volume II Section 5.6 of COP Volume II Section 5.7 of COP Volume II Section 5.8 of COP Volume II Appendix II-F Appendix II-G Appendix II-H

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.621(a-g) (Continued)	
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 3 of COP Volume II Section 4 of COP Volume II Section 5 of COP Volume II Section 6 of COP Volume II Appendix II-A Appendix II-D Appendix II-E Appendix II-G Appendix II-H Appendix II-J Appendix II-K Appendix II-L Appendix II-N Appendix II-O Appendix II-Q
e) The project will use the best available and safest technology.	Section 2 of COP Volume I Section 3.12 of COP Volume I Appendix I-C Appendix I-E
f) The project will use best management practices.	Section 3 of COP Volume II Section 4 of COP Volume II Section 5 of COP Volume II Section 6 of COP Volume II Section 7 of COP Volume II Appendix II-D Appendix II-E Appendix II-G Appendix II-J
g) The project will use properly trained personnel.	Section 6 of COP Volume I Appendix I-E
30 CFR §585.626(a)	
(1) Shallow Hazards	
(i) Shallow faults;	Section 3.2 (Table 3.2-1) of Appendix II-B
(ii) Gas seeps or shallow gas;	Section 3.2 (Table 3.2-1) of Appendix II-B
(iii) Slump blocks or slump sediments;	Section 3.2 (Table 3.2-1) of Appendix II-B
(iv) Hydrates; or	Section 3.2 (Table 3.2-1) of Appendix II-B
(v) Ice scour of seabed sediments.	Section 3.2 (Table 3.2-1) of Appendix II-B

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.626(a) (Continued)	
(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 Appendix II-B
(ii) Fault zones;	Section 4.1 (Table 4.1-1) of Appendix II-B
(iii)The possibility and effects of seabed subsidence; and	Section 4.1 (Table 4.1-1) of Appendix II-B
(iv) The extent and geometry of faulting attenuation effects of geological conditions near your site.	Section 4.1 (Table 4.1-1) of Appendix II-B
(3) Biological	
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 4 of COP Volume II Section 5 of Appendix II-B Appendix II-C Appendix II-D Appendix II-E
(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 Appendix II-B[1] Appendix II-B25[1] Appendix II-B27[1]
(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 Appendix II-B[1] Appendix II-B25[1] Appendix II-B27[1]
(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 Appendix II-B[1] Appendix II-B25[1] Appendix II-B27[1]
(5) Archaeological Resources	
A description of the historic and prehistoric archaeological resources, as required by the National Historic Preservation Act (NHPA) (16 U.S.C. 470 et. seq.), as amended.	Section 6 of COP Volume II Appendix II-K Appendix II-L Appendix II-Q

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.626(a) (Continued)	
(6) Overall Site Investigation	
(i) Scouring of the seabed;	Section 3.2 of Appendix II-B Section 4.1 (Table 4.1-1) of Appendix II-B
(ii) Hydraulic instability;	Section 4.1 (Table 4.1-1) of Appendix II-B
(iii) The occurrence of sand waves;	Section 3.2 of Appendix II-B Section 4.1 (Table 4.1-1) of Appendix II-B
(iv) Instability of slopes at the facility location;	Section 3.2 of Appendix II-B Section 4.1 (Table 4.1-1) of Appendix II-B
(v) Liquefaction, or possible reduction of sediment strength due to increased pore pressures;	Section 4.1 (Table 4.1-1) of Appendix II-B
(vi) Degradation of subsea permafrost layers;	Section 4.1 (Table 4.1-1) of Appendix II-B
(vii) Cyclic loading;	Section 4.1 (Tables 4.1-1 and 4.2-1) of Appendix II-B
(viii) Lateral loading;	Section 4.1 (Tables 4.1-1 and 4.2-1) of Appendix II-B
(ix) Dynamic loading;	Section 4.1 (Table 4.1-1) of Appendix II-B
(x) Settlements and displacements;	Section 4.1 (Table 4.1-1) of Appendix II-B
(xi) Plastic deformation and formation collapse mechanisms; and	Section 4.1 (Table 4.1-1) of Appendix II-B
(xii) Sediment reactions on the facility foundations or anchoring systems.	Section 4.1 (Table 4.1-1) of Appendix II-B
30 CFR §585.626(b)	
(1) Contact information.	Section 1.4.1 of COP Volume I
(2) Designation of operator, if applicable.	Section 1.4.2 of COP Volume I
(3) The construction and operation concept.	Section 3 of COP Volume I Section 4 of COP Volume I
(4) Commercial lease stipulations and compliance.	Section 7.2 of COP Volume I
(5) A location plat.	Section 2.2 of COP Volume I Appendix I-A
(6) General structural and project design, fabrication, and installation.	Section 3 of COP Volume I Appendix I-D

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.626(b) (Continued)	
(7) All cables and pipelines, including cables on project easements.	Section 3.5 of COP Volume I Section 3.6 of COP Volume I Section 3.7 of COP Volume I Section 3.8 of COP Volume I Section 4 of COP Volume I Section 5 of COP Volume I
(8) A description of the deployment activities.	Section 3 of COP Volume I Section 6 of COP Volume I
(9) A list of solid and liquid wastes generated.	Section 6.3 of COP Volume I
(10) A listing of chemical products used (if stored volume exceeds Environmental Protection Agency Reportable Quantities).	Section 6.3 of COP Volume I
(11) A description of any vessels, vehicles, and aircraft you will use to support your activities.	Section 3.10 of COP Volume I Section 4.4 of COP Volume I Section 5.6 of COP Volume II Appendix II-A Appendix II-G
(12i) A general description of the operating procedures and systems under normal conditions.	Section 4 of COP Volume I Appendix I-E
(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 of COP Volume I Appendix I-E Appendix I-F Section 7 of COP Volume II
(13) Decommissioning and site clearance procedures.	Section 5 of COP 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. The list should include 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).	Section 7.1 of COP Volume I

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.626(b) (Continued)	
(14ii) A listing of all Federal, State, and local authorizations, approvals, or permits that are required to conduct the proposed activities, including commercial operations. This list should include a statement indicating whether you have applied for or obtained such authorization, approval, or permit.	Section 7.1 of COP Volume I
(15) Your proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts.	Section 2 of COP Volume II Section 3 of COP Volume II Section 4 of COP Volume II Section 7 of COP Volume II Appendix II-D Appendix II-E Appendix II-R
(16) Information you incorporate by reference.	Section 9 of COP Volume I Section 8 of COP Volume II
(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 8 of COP Volume I Appendix I-G
(18) Reference.	Section 9 of COP Volume I Section 8 of COP Volume II
(19) Financial assurance.	Section 4.3 of COP Volume I
(20) CVA nominations for reports required in subpart G of this part.	Section 3.12 of COP Volume I Appendix I-D
(21) Construction schedule.	Section 3.1 of COP Volume I
(22) Air quality information.	Section 3.1 of COP Volume II Appendix II-A
(23) Other information.	Section 1 of COP Volume I Section 8 of COP Volume I Appendix I-H Appendix I-I Appendix II-O Appendix II-T

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.627(a)	
(1) Hazard information.	Section 3 of Appendix II-B Section 4 of Appendix II-B Appendix II-B3 Appendix II-P
(2) Water quality.	Appendix I-F Section 3.2 of COP Volume II Appendix II-P
(3) Biological resources (benthic communities).	Section 4.5 of COP Volume II Section 5 of Appendix II-B Appendix II-B11 Appendix II-B20 Appendix II-D Appendix II-R
(3) Biological resources (marine mammals).	Section 4.7 of COP Volume II Appendix II-E
(3) Biological resources (sea turtles).	Section 4.8 of COP Volume II Appendix II-E
(3) Biological resources (coastal and marine birds).	Section 4.2 of COP Volume II Appendix II-C
(3) Biological resources (fish and shellfish).	Section 4.5 of COP Volume II Section 4.6 of COP Volume II Appendix II-D Appendix II-E Appendix II-N Appendix II-O
(3) Biological resources (plankton).	Section 4.6 of COP Volume II Appendix II-D Appendix II-N
(3) Biological resources (seagrasses).	Section 4.4 of COP Volume II Section 5.2.2 of Appendix II-B Appendix II-B11 Appendix II-B20 Appendix II-D
(3) Biological resources (plant life).	Section 4.1 of COP Volume II
(4) Threatened or endangered species.	Section 4 of COP Volume II Appendix II-C Appendix II-E

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.627(a) (Continued)	
(5) Sensitive biological resources or habitats.	Section 4 of COP Volume II Section 5.2 of Appendix II-B Appendix II-B11 Appendix II-B20 Appendix II-C Appendix II-D Appendix II-E Appendix II-M Appendix II-N Appendix II-R
(6) Archaeological resources.	Section 6 of COP Volume II Appendix II-L Appendix II-K Appendix II-Q
(7) Social and economic resources.	Section 2 of COP Volume II Section 5.1 of COP Volume II Section 5.2 of COP Volume II Section 5.3 of COP Volume II Section 5.4 of COP Volume II Section 5.5 of COP Volume II Section 5.8 of COP Volume II Section 6 of COP Volume II Appendix II-F Appendix II-J Appendix II-M Appendix II-S
(8) Coastal and marine uses.	Appendix I-I Section 5.3 of COP Volume II Section 5.4 of COP Volume II Section 5.5 of COP Volume II Section 5.6 of COP Volume II Section 5.7 of COP Volume II Section 5.8 of COP Volume II Appendix II-F Appendix II-G
(9) Consistency certification.	Appendix II-M

Table 7.3-2 COP Information Requirements Pursuant to 30 CFR §585.105(a), 621(a-g), 626(a) and (b), 627(a-d) (Continued)

Requirement	Location in COP
30 CFR §585.627(a) (Continued)	
(10) Other resources, conditions, and activities.	Section 3.1 of COP Volume II Section 4.3 of COP Volume II Section 5.8 of COP Volume II Appendix II-A Appendix II-H Appendix II-I Appendix II-O Appendix II-T
30 CFR §585.627(b)	
Consistency certification	Appendix II-M
30 CFR §585.627(c)	
Oil spill response plan	Appendix I-F
30 CFR §585.627(d)	
Safety management system	Appendix I-E1

Notes:

1. As noted in Table 7.3-1, the Proponent will submit a final Marine Site Investigation Report (MSIR) containing additional geotechnical information.

8 Agency, Tribal, and Stakeholder Outreach

Vineyard Northeast LLC is committed to being a good neighbor both onshore and offshore. As detailed in Section 2, the Proponent has sited and designed Vineyard Northeast's facilities based on feedback from multiple agencies and stakeholders. Throughout the development, construction, operational, and decommissioning periods, the Proponent will continue to actively engage with agencies, Native American tribes, and stakeholders to identify and discuss their interests and concerns regarding Vineyard Northeast.

The Proponent's staff and consultants have extensive experience in the development of offshore wind projects, including Vineyard Wind 1 (see Section 1.4). As Vineyard Wind 1 progressed through the permitting process and began construction, the Proponent's team members formed strong collaborative relationships with regulators and a diverse array of stakeholders. This experience developing the first commercial-scale offshore wind project in the United States (US) is reflected in the permitting and outreach strategy for Vineyard Northeast.

Section 8.1 provides a description of the Proponent's consultations with federal, state, and local agencies. Tribal outreach is discussed in Section 8.2. The Proponent's outreach to fisheries stakeholders and mariners are described in Sections 8.3 and 8.4. The Proponent's other community engagement efforts are discussed in Section 8.5.

8.1 Consultations with Agencies

The Proponent proactively consults with federal, state, and local agencies to discuss the development of Vineyard Northeast, planned studies, issues of concern, and avoidance, minimization, and mitigation strategies.

The Proponent's team members have extensive experience working with many of the relevant permitting authorities and local officials through previous projects, which will facilitate the permitting of Vineyard Northeast. One of the key lessons learned from previous projects was to engage with agencies well before starting the permitting process. Consequently, the Proponent began agency outreach specific to Vineyard Northeast well before the submission of this Construction and Operations Plan (COP) in fall 2021. The Proponent's frequent and early engagement with agencies during the COP planning process enabled the Proponent to incorporate agency feedback into the siting and design of the facilities, the methodologies for resources assessments, survey strategies, and proposed avoidance, minimization, and mitigation measures. In particular, consultations with numerous federal and state agencies, including the Bureau of Ocean Energy Management (BOEM), multiple divisions of the National Marine Fisheries Service, US Army Corps of Engineers (USACE), US Coast Guard (USCG), the Department of Homeland Security (DHS), the Massachusetts Office of Coastal Zone Management (MA CZM), the Rhode Island Coastal Resources Management Council (RI CRMC), the Connecticut Department of Energy and Environmental Protection (CT DEEP), and the New

York State Office of Parks, Recreation and Historic Preservation, as well as stakeholders, heavily informed the siting of the offshore export cable corridors (OECCs) (see Section 2.8). Meetings held with federal and state agencies are described further in Appendix I-G.

The Proponent also recognizes the importance of early engagement with local municipalities and leaders to gain their input with respect to the siting and design of the facilities, potential environmental effects, local workforce development, coordination with planned infrastructure and economic development projects, and other opportunities. Meetings held between the Proponent and local agencies and elected officials are detailed in Appendix I-G.

8.2 Outreach to Native American Tribes

The Proponent understands and respects that the Offshore Development Area and Onshore Development Area are part of Native American tribes'[80] cultural heritage and their traditional bonds to the past and that these areas are important to their cultural identity, sense of self, and future well-being. Open communication, early coordination, and information sharing are therefore essential, given the potential for the development of Vineyard Northeast to affect tribal communities' historical and cultural properties.

The Proponent has gained considerable experience engaging and communicating with tribal communities both informally and through the National Historic Preservation Act's Section 106 consultation process for previous projects. The Proponent is fostering relationships with or has previously been in contact with the Narragansett Indian Tribe, the Mashpee Wampanoag Tribe, the Wampanoag Tribe of Gay Head (Aquinnah), the Mashantucket Pequot Tribal Nation, the Mohegan Tribe of Connecticut, the Delaware Tribe of Nations, and the Shinnecock Indian Nation. Meetings held with tribal representatives regarding Vineyard Northeast, including pre-survey meetings, are listed in Appendix I-G.

To facilitate coordination with Native American tribes, the Proponent has developed a Native American Tribes Communication Plan, provided as Appendix I-H, which describes the Proponent's strategies for communicating with tribal communities and outlines specific methods for engaging with and disseminating information to tribal communities with cultural and/or historical ties to the Offshore Development Area and Onshore Development Area. As further described in the plan, the Proponent has a Tribal Lead who serves as the Proponent's primary point of contact for tribal communities. The Tribal Lead focuses on building and maintaining collaborative relationships with tribal governments and members of Native American tribes. The Tribal Lead is also responsible for coordinating pre-survey meetings as well as regular check-ins with Native American tribes either by text, email, phone calls, or meetings (in-person or virtual). The Tribal Lead will provide timely notice to tribal communities

[80] Throughout the COP, "Native American tribes" generally refers to both federally recognized Tribes/Tribal Nations and other Native American communities. Where appropriate, consultations or communications with federally recognized Tribes/Tribal Nations will be identified.

on critical development milestones and public comment opportunities during the permitting process. The Tribal Lead also regularly participates in local, state, and national tribal events and conferences, including the National Congress of American Indians.

The Proponent will work with each Native American tribe individually to develop communication and information sharing protocols that reflect their preferred method(s) and frequency of communication. These approaches could include, but are not limited to, one-on-one and group meetings, conference calls, text messages, listening sessions, e-mail updates, certified letters, virtual and in-person vessel tours and site visits, and social media updates. To ensure that tribal communities have ready and timely access to data and information, the Proponent has developed a dedicated tribal webpage. This public "Tribal Nations" webpage will be updated, as needed, to provide information and documents on topics relevant to tribal communities, such as the Section 106 process, survey activities, fisheries science, and, eventually, construction updates. The Proponent also expects to create a separate non-public, log-in-only page for Tribal Historic Preservation Officers. This log-in-only page would host sensitive and confidential information that would not be available to the public, such as archaeology reports. The Proponent will also collaborate with other offshore wind developers, as well as federal agencies (where appropriate), to identify opportunities to streamline communication and information sharing efforts to reduce the demand for limited tribal resources to participate in offshore wind project development processes.

8.3 Fisheries Communication

The Proponent's team has over a decade of experience engaging with commercial and recreational fishermen, vessel owners, fishing advocacy organizations, shore support services, and fisheries research institutions. The Proponent has translated that experience to develop a robust fisheries communication strategy for Vineyard Northeast. During the early planning stages of Vineyard Northeast, particularly in relation to siting the OECCs (see Section 2.8), the Proponent consulted with numerous fishermen. The Proponent will continue to engage with fisheries stakeholders throughout the development, construction, operations, and decommissioning of Vineyard Northeast.

The Proponent has developed a Fisheries Communication Plan (FCP) to facilitate effective and regular engagement with fisheries stakeholders throughout the life of Vineyard Northeast (see Appendix I-I). The communication protocols outlined in the FCP are designed to help avoid interactions with fishing vessels and fishing gear. The FCP aligns with the Vineyard Wind 1 FCP, which was first drafted in 2011 to improve communication with fishermen during that offshore wind project and was subsequently refined with over 10 years of input from fisheries stakeholders. The Vineyard Northeast FCP is regularly updated, in response to stakeholder feedback and to incorporate lessons learned, to ensure that the communication protocols and tools remain relevant and effective.

As described in the FCP, the Proponent's fisheries communication efforts are led by Fisheries Manager (FM) Crista Bank, a fisheries biologist with deep knowledge of fishing practices as well as an extensive network of personal relationships with fishermen and fishery organizations in the region. The fisheries team also includes a Fisheries Liaison (FL), Fisheries Representatives (FRs), Onboard Fisheries Liaisons (OFLs), and scout vessels. The FL is responsible for implementing the FCP and serves as a communication conduit between the Proponent and the fishing industry. FRs are individuals or organizations that represent a particular fishing community, organization, gear type, port, region, state, or sector(s). While FRs are compensated for their time and expenses by the Proponent, their duty is to the fishing region, industry, organization, gear type, or sector they represent. The Proponent engages with a network of FRs who represent a variety of gear types and homeports in Connecticut, Massachusetts, New York, and Rhode Island. The Proponent is also working closely with New Jersey-based fishermen. OFLs are experienced fishermen employed by the Proponent to assist geophysical and geotechnical survey vessel captains with communication and to document fishing gear in the area to help avoid interactions. Among other things, the OFL records observed fisheries activities, ensures survey vessel operations are compliant with the FCP and other fisheries-related policies, and seeks to avoid negative fisheries interactions by looking out for fixed gear and establishing communications with fishing vessels when appropriate. The Proponent also employs local fishing vessels to serve as scout vessels. The scout vessels work ahead of geophysical and geotechnical survey vessels and report fixed gear locations back to the OFL to avoid any gear interaction. The scout vessel identifies fishermen actively working in the area so the FL can reach out to them with detailed survey vessel information throughout the remainder of the survey activity. Additional information about the roles of the FM, FL, FRs, OFLs, and scout vessels is provided in the FCP (see Appendix I-I).

The Proponent maintains a webpage with information specifically for fishermen, including fisheries science information, charts, Offshore Wind Mariner Updates (see Section 8.4), and periodic information requests, which can be found at:

https://www.vineyardoffshore.com/fisheries-522

Fisheries communication is conducted through numerous other methods including email, SMS text message alerts, letter mailings, webinars, phone calls, meetings, and social media channels. When appropriate and weather permitting, the Proponent's FM and FL hold "port hours" at ports in New Bedford, Massachusetts; Narragansett, Rhode Island; Stonington, Connecticut; and Montauk, New York to provide information to fishermen who fish in or transit through the Offshore Development Area. These events are typically held jointly with FLs from other offshore wind developers to provide information to fishing vessel crews who fish in or transit through multiple lease areas. The Proponent also hosts information tables and attends regional trade shows and conferences for fishermen and mariners.

The Proponent is in regular contact with relevant federal and state agencies on fisheries-related matters (see Section 8.1). The Proponent also uses its membership and participation in fisheries-related technical working groups, advisory boards, councils, and commissions to provide project updates, better understand fisheries stakeholders' concerns, build relationships, and collaborate on research and education. The Proponent is a member of and/or actively participates in the following groups:

- International Council for the Exploration of the Sea (member of Working Group on Offshore Wind Development and Fisheries)
- Massachusetts Fisheries Working Group on Offshore Wind Energy
- Massachusetts Habitat Working Group on Offshore Wind Energy
- Mid-Atlantic Fishery Management Council
- New England Fishery Management Council
- New York State Energy Research and Development Authority's (NYSERDA's) Environmental Technical Working Group
- NYSERDA's Fisheries Technical Working Group
- American Clean Power New York Bight Fisheries Working Group
- Regional Wildlife Science Collaborative for Offshore Wind
- Responsible Offshore Science Alliance

8.4 Marine Coordination

The Proponent employs a Marine Liaison Officer who is responsible for safe marine operations and ensuring that the Proponent is a good neighbor while on the water. The Marine Liaison Officer currently serves as the Proponent's point of contact for all external maritime agencies, partners, and stakeholders, including USCG, US Navy, port authorities, state and local law enforcement, and commercial operators (e.g., ferry, tourist vessels, and other offshore wind developers). There is frequent interaction, information exchange, and coordination between the Marine Liaison Officer and the fisheries team regarding fisheries outreach (see Section 8.3).

The Marine Liaison Officer is responsible for coordinating and issuing Offshore Wind Mariner Updates to notify maritime stakeholders of the Proponent's offshore activities. The Offshore Wind Mariner Updates include a description of the planned activity, pictures of the vessel(s) and equipment to be deployed, a chart showing the location of the activity, vessel contact information, and the Proponent's OFL's contact information (if applicable). Depending on the activity, the Offshore Wind Mariner Update may request that mariners give a wide berth to the work site or construction and maintenance vessel(s). These updates are published on the Proponent's website, social media channels, and sent via email and SMS text alert to those who have opted-in to receive notifications from the Proponent. To help mariners and fishermen keep track of the various notifications that they receive, the Proponent distributes a weekly email to consolidate and recirculate active Offshore Wind Mariner Updates. The Proponent will also coordinate with the USCG to issue Notices to Mariners (NTMs) to notify recreational and commercial vessels of their planned offshore activities. To sign-up to receive Offshore Wind Mariner Updates and other Vineyard Northeast-related information, visit:

https://www.vineyardoffshore.com/fisheries-522

During construction, the Proponent expects to employ a dedicated Marine Coordinator to manage construction vessel logistics and implement communication protocols with external vessels at ports and offshore. During construction, the Marine Coordinator will be the primary point of contact with external maritime agencies, partners, and stakeholders for day-to-day offshore operations. The Marine Coordinator will operate from a marine coordination center that is established to control vessel movements throughout the Offshore Development Area. The Marine Coordinator will use tools such as radio communications and safety vessels to address vessels entering active work sites. The safety vessels would provide guidance to mariners and fishing vessels, explain the ongoing activities, and request that they give a wide berth to the work site or construction vessel(s), if necessary. These safety vessels would have no enforcement authority; the safety vessels would only assist mariners in navigating in the vicinity of the activity.

The Proponent may request that the USCG establish safety zones, per 33 CFR Part 147, around the wind turbine generators (WTGs), electrical service platform(s) (ESP[s]), and booster station (if used) during construction and certain maintenance activities. These temporary safety zones would extend 500 meters (m) (1,640 feet [ft]) around each structure. The safety zones would be enforced by USCG individually as construction progresses from one structure to the next. The USCG would make notice of each enforcement period via NTMs. When enforced, only attending vessels and those vessels specifically authorized by the USCG would be permitted to enter or remain in the temporary safety zones.

8.5 Community Outreach

The Proponent's outreach team regularly meets with community leaders and organizations that have an interest in or may be affected by Vineyard Northeast. The Proponent expects to hold information sessions, where team members exhibit information in a public space and are available for questions or comments on Vineyard Northeast. The Proponent will also sponsor and staff information tables at a variety of environmental, fisheries-related, and community events. To reach an array of stakeholders, these community outreach events will be advertised on the Proponent's dedicated community webpage, https://www.vineyardoffshore.com/local-communities, and in social media, press releases, emails, and other media outlets.

9 References and Incorporation by Reference

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