Construction and Operations Plan

Lease Area OCS-A 0534

Volume III Text

February 2024

Submitted by
Park City Wind LLC

Submitted to
Bureau of Ocean Energy Management
45600 Woodland Rd
Sterling, VA 20166

Prepared by
Epsilon Associates, Inc.

New England Wind Construction and Operations Plan for Lease Area OCS-A 0534

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Submitted to:
BUREAU OF OCEAN ENERGY MANAGEMENT
45600 Woodland Rd
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Submitted by:
Park City Wind LLC

Prepared by:
Epsilon Associates Inc.

In Association with:

Baird & Associates
Biodiversity Research Institute
Capitol Air Space Group
Geo SubSea LLC
Geraldine Edens, P.A.
Gray & Pape
JASCO Applied Sciences
Public Archaeology Laboratory, Inc.
RPS
Saratoga Associates
SEARCH, Inc.
Wood Thilsted Partners Ltd

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LIST OF ACRONYMS

°C	Celsius
°F	Fahrenheit
μg/L	Microgram per liter
μm	Micromolar
AC	Advisory Circular
ACK	Nantucket Memorial Airport
ACS	American Community Survey
ADLS	Aircraft Detection Lighting System
AGL	Above Ground Level
AHTS	Anchor handling tug supply
AIS	Automatic Identification System
AMAPPS	Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution
AMSL	Above Mean Sea Level
APE	Area of Potential Effect
API	Apparent Productivity Index
ASMFC	Atlantic States Marine Fisheries Commission
ASSRT	Atlantic Sturgeon Status Review Team
ATFA	Air Traffic Flow Analysis
ATON	Aids to Navigation
BA	Biological Assessment
BACT	Best Available Control Technology
BIA	Biologically Important Area
BIWF	Block Island Wind Farm
BLS	Bureau of Labor Statistics
BMP	Best Management Practices
BOEM	Bureau of Ocean Energy Management
BWEA	British Wind Energy Association
CAA	Clean Air Act
CAD	Confined Aquatic Disposal

LIST OF ACRONYMS (CONTINUED)

CBD	Convention on Biological Diversity
CBP	County Business Patterns
CCAT	Connecticut Center for Advanced Technology
CCEA	Connecticut Center for Economic Analysis
CCS	Center for Coastal Studies
CeTAP	Cetacean and Turtle Assessment Program, University of Rhode Island
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	Methane
CLs	Carapace Lengths
CMP	Construction Management Plan
COA	Corresponding Onshore Area
COP	Construction and Operations Plan
CRESLI	Coastal Research and Education Society of Long Island
CRMC	Rhode Island Coastal Resources Management Council
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CT DEEP	Connecticut Department of Energy and Environmental Protection
CTV	Crew transfer vessel
CV	Coefficient of variation
CVA	Certified Verification Agent
CZM	Massachusetts Office of Coastal Zone Management
dB	Decibels
DEI	Diversity, Equity, and Inclusion
DEIS	Draft Environmental Impact Statement
DMA	Dynamic Management Areas
DNREC	Delaware Department of Natural Resources and Environmental Control
DoC	Department of Commerce
DoD	Department of Defense
DoI	Department of the Interior
DoN	Department of the Navy
DP	Dynamic positioning
DPS	Distinct Population Segments
DPW	Department of Public Works
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
eGRID	Environmental Protection Agency's Emissions & Generation Resource Integrated Database

LIST OF ACRONYMS (CONTINUED)

EJ	Environmental Justice
EMF	Electromagnetic field
EPA	Environmental Protection Agency
ERG	Eastern Research Group
ERP	Environmental Results Program
ESA	Endangered Species Act
ESP	Electrical service platform
FAA	Federal Aviation Administration
FCP	Fisheries Communication Plan
FDR	Facilities Design Report
FFWCC	Florida Fish and Wildlife Conservation Commission
FHWG	Fisheries Hydroacoustic Working Group
FL	Fisheries Liaisons
FNP sub	Federal Navigation Project
ft	Feet
ft^2	Square feet
FTE	Full-time Equivalent
GARFO	National Marine Fisheries Service Greater Atlantic Regional Fisheries Office
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HAP	Hazardous Air Pollutant
HCP	Host Community Payment
HDD	Horizontal directional drilling
HESS	High Energy Seismic Survey
HF	High Frequency
HLVs	Heavy lift vessels
HMS	Highly Migratory Species
HSE	Health, safety, and environmental
HTV	Heavy transport vessels
HVAC	Heating Ventilation and Air Condition
HVAC	High voltage alternating current
Hz	Hertz
IMO	International Maritime Organization
in	Inches
IPF	Impact Producing Factors
ISO-NE	ISO New England
IWC	International Whaling Commission

LIST OF ACRONYMS (CONTINUED)

kJ	Kilojoules
kHz	Kilohertz
km	Kilometers
km^2	Square kilometers
kV	Kilovolt
L	Liters
LAER	Lowest Achievable Emission
lbs	Pounds
LF	Low Frequency
LMA	Lobster Management Area
LMEs	Large Marine Ecosystems
LOA	Letter of Authorization
LRR	Long Range Radar
m	Meters
m^2	Square meters
m/hr	Meters per hour
MA DMF	Massachusetts Division of Marine Fisheries
MA EOEEA	Massachusetts Executive Office of Energy and Environmental Affairs
MA WEA	Massachusetts Wind Energy Area
MAFMC	Mid-Atlantic Fishery Management Council
MARCO	Mid-Atlantic Council on the Ocean
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
MassCEC	Massachusetts Clean Energy Center
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MATL	Massachusetts Trip Level
MDAT	Marine-life Data and Analysis Team
MF	Mid Frequency
mg/L	Milligram per liter
MHC	Massachusetts Historical Commission
MHHW	Mean Higher High Water
mi	Miles
MLLW	Mean Lower Low Water
mm	Millimeter
MMIS	BOEM Marine Minerals Information System
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service

LIST OF ACRONYMS (CONTINUED)

MMT	Million metric tons
MRASS	Mariner Radio Activated Sound Signals
MVA	Minimum Vectoring Altitudes
MVY	Martha's Vineyard Airport
MW	Megawatt
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification
NARW	North Atlantic right whale
NARWC	North Atlantic Right Whale Consortium
NBDC	National Data Buoy Center
NCCOS	National Centers for Coastal Ocean Science
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFMC	New England Fisheries Management Council
NEFSC	Northeast Fisheries Science Center
NEI	National Emissions Inventory
NEODP	Northeast Ocean Data Portal
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHESP	Natural Heritage and Endangered Species Program
NHPA	National Historic Preservation Act
NJDEP	New Jersey Department of Environmental Protection
NM	Nautical miles
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen Oxide
NODEs	Navy Operations Area Density Estimates
NOI	Notice of Intent
NPCC	Northeast Power Coordinating Council
NPDES	National Pollutant Discharge Elimination System
NROC	Northeast Regional Ocean Council
NSF	National Science Foundation
NSRA	Navigation Safety Risk Assessment
NTMs	Notices to Mariners
NTU	Nephelometric Turbidity Unit
NWS	National Weather Service

LIST OF ACRONYMS (CONTINUED)

NY WEA	New York Wind Energy Area
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
O_3	Ozone
O&M	Operations and Maintenance Facilities
OBIS-SEAMAP	Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations
OCS	Outer Continental Shelf
OE&AA	Obstruction Evaluation and Airspace Analysis
OECC	Offshore Export Cable Corridor
OMP	Ocean Management Plan
OPAREAS	Operating Areas
OSP	Optimum Sustainable Population
OTR	Ozone Transport Region
PAL	Public Archaeology Laboratory
PAM	Passive acoustic monitoring
PANYNJ	Port Authority of New York and New Jersey
PATON	Private Aid to Navigation
Pb	Lead
PBR	Potential Biological Removal
PEP	Population Estimates Program
PIANC	World Association for Waterborne Transport Infrastructure
PK	Peak Pressure
PPA	Power Purchase Agreement
ppm	Parts per million
ProvPort	Port of Providence
PSOs	Protected Species Observers
PST	Preliminary Screening Tool
psu	Practical Salinity Units
PTS	Permanent Threshold Shift
PVD	Providence
REMI	Regional Economic Model Inc.
RI DEM	Rhode Island Department of Environmental Management
RI/MA WEA	Rhode Island/Massachusetts Wind Energy Area
RLOS	Radar line-of-sight
ROSA	Responsible Offshore Science Alliance
ROW	Right-of-way

LIST OF ACRONYMS (CONTINUED)

RSD	Ripple scour depressions
RSE	Regional Science Entity
RSZ	Rotor swept zone
SAP	Site Assessment Plan
SAR	Search and rescue
SATVs	Service accommodation vessels
SCADA	Supervisory control and data acquisition
SEL	Sound Exposure Level
SF_6	Sulfur hexafluoride
SFV	Sound Field Verification
SHPO	State Historic Preservation Office
SL	Source level
SMAST	University of Massachusetts Dartmouth School of Marine Science and Technology
SMRU	Sea Mammal Research Unit
SO_2	Sulfur dioxide
SOV	Service operation vessel
SPL	Sound Pressure Level
SRA	Statistical Reporting Areas
STSSN	Sea Turtle Stranding and Salvage Network
SWDA	Southern Wind Development Area
TCP	Traditional cultural property
TEWG	Turtle Expert Working Group
THPO	Tribal Historic Preservation Offices
TMP	Traffic Management Plan
tpy	Tons per year
TRACON	Terminal Radar Approach
TS	Threshold Shift
TSHD	Trailing suction hopper dredge
TSS	Traffic Separation Schemes
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
UK	United Kingdom
ULSD	Ultra-low sulfur diesel
UME	Unusual Mortality Event
US	United States
USACE	United States Army Corps of Engineers

LIST OF ACRONYMS (CONTINUED)

USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
VIA	Visual Impact Assessment
VGP	Vessel General Permit
VHF	Very High Frequency
VMS	Vessel Monitoring System
VOC	Volatile Organic Compound
VTR	Vessel Trip Reports
WDA	Wind Development Area
WNS	White-nose syndrome
WQI	Water Quality Index
WTG	Wind turbine generator

1.0 APPLICANT'S PURPOSE AND NEED

The purpose of New England Wind is to generate commercially sustainable offshore wind energy from Lease Area OCS-A 0534 located in the federally designated Massachusetts Wind Energy Area (MA WEA) to meet New England's need for clean, renewable energy and the Biden Administration's target of 30 gigawatts (GW) of offshore wind by 2030. New England Wind will be developed in two phases that will deliver over 2,000 MW of clean energy to New England.

Prior to the submission of the COP in July 2020, New England Wind entered into a Power Purchase Agreement (PPA) with electric distribution companies in Connecticut and, following COP submission, with electric distribution companies in Massachusetts; these PPAs totaled 2,036 MW. The Proponent has agreed with the electric distribution companies in Connecticut and Massachusetts to terminate the Phase 1 and Phase 2 PPAs to enable New England Wind to participate in future offshore wind solicitations by Northeast states including, but not limited to, recent multi-state solicitations issued by Massachusetts, Rhode Island, and Connecticut in Fall 2023. These actions are necessary to address global circumstances beyond New England Wind's control that have significantly increased costs.

The Proponent remains committed to the development and permitting of both phases of New England to enable the projects to assist the federal government and the states of Connecticut, Massachusetts, and Rhode Island to meet climate and renewable energy/offshore wind goals. Massachusetts, Connecticut, and Rhode Island have all issued solicitations in Fall 2023 for additional offshore wind capacity that collectively total 6.8 GW. These three states have also signed a memorandum of understanding to allow developers to submit multi-state bids, and for the states to collaborate on their procurement decisions. The Proponent intends to submit one or more proposals for this, and if necessary, future solicitation(s).

New England Wind will make an important contribution to meeting established renewable energy targets, enhancing energy security by increasing the reliability and diversity of the energy supply, reducing greenhouse gas emissions, and achieving significant health and environmental benefits. It will also generate large numbers of well-paying jobs and provide significant economic benefits the New England region.

2.0 SUMMARY OF NEW ENGLAND WIND FACILITIES AND ACTIVITIES

2.1 Overview

New England Wind is the proposal to develop offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0534 along with associated offshore and onshore cabling, onshore substations, and onshore operations and maintenance (O&M) facilities. Lease Area OCS-A 0534 is within the Massachusetts Wind Energy Area identified by BOEM, following a public process and environmental review, as suitable for wind energy development. Park City Wind LLC, a wholly owned subsidiary of Avangrid Renewables, LLC, is the Proponent of this Construction and Operations Plan (COP) and will be responsible for the construction, operation, and decommissioning of New England Wind.

New England Wind's offshore renewable wind energy facilities are located immediately southwest of Vineyard Wind 1, which is located in Lease Area OCS-A 0501. New England Wind will occupy all of Lease Area OCS-A 0534 and potentially a portion of Lease Area OCS-A 0501 in the event that Vineyard Wind 1 does not develop "spare" or extra positions included in Lease Area OCS-A 0501 and Vineyard Wind 1 assigns those positions to Lease Area OCS-A 0534. For the purposes of the COP, the Southern Wind Development Area (SWDA) is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501, as shown in Figure 1.1-1 of COP Volume I.

New England Wind will be developed in two Phases with a maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions. Phase 1, which includes Park City Wind, will be developed immediately southwest of Vineyard Wind 1. Phase 2, which includes Commonwealth Wind, will be located southwest of Phase 1 and occupy the remainder of the SWDA. Each Phase of New England Wind will be developed and permitted using a Project Design Envelope (the "Envelope"). This allows the Proponent to properly define and bracket the characteristics of each Phase for the purposes of environmental review while maintaining a reasonable degree of flexibility with respect to the selection of key components (e.g. WTGs, foundations, submarine cables, and ESPs). To assess potential impacts and benefits to various resources, a "maximum design scenario," or the design scenario with the maximum impacts anticipated for that resource, is established (see Section 3).

The SWDA may be 411–453 square kilometers (km^2) (101,590–111,939 acres) in size depending upon the final footprint of the Vineyard Wind 1 project. At this time, the Proponent does not intend to develop the two positions in the separate aliquots located along the northeastern boundary of Lease Area OCS-A 0501 as part of New England Wind. The SWDA (excluding the two separate aliquots that are closer to shore) is just over 32 kilometers (km) (20 miles [mi]) from the southwest corner of Martha's Vineyard and approximately 38 km (24 mi) from Nantucket.[1] In accordance with US Coast Guard (USCG) recommendations, the WTGs and ESP(s) in the SWDA will be oriented in fixed east-to-west rows and north-to-south columns with one nautical mile (1.85 km) spacing between positions. This uniform grid layout provides 1 NM wide corridors in the east-west and north-south directions as well as 0.7 NM (1.3 km) wide corridors in the northwest-southeast and northeast-southwest directions.

Five offshore export cables—two cables for Phase 1 and three cables for Phase 2—will transmit electricity from the SWDA to shore. Unless technical, logistical, grid interconnection, or other unforeseen issues arise, all New England Wind offshore export cables will be installed within a shared Offshore Export Cable Corridor (OECC) that will travel from the northwestern corner of the SWDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then head northward along the eastern side of Muskeget Channel toward landfall sites in the Town of Barnstable (see Figure 2.3-1 of COP Volume I).[2] The OECC for New England Wind is largely the same OECC proposed in the approved Vineyard Wind 1 COP, but it has been widened to the west along the entire corridor and to the east in portions of Muskeget Channel. The two Vineyard Wind 1 offshore export cables will also be installed within the New England Wind OECC. To avoid cable crossings, the Phase 1 cables are expected to be located to the west of the Vineyard Wind 1 cables and, subsequently, the Phase 2 cables are expected to be installed to the west of the Phase 1 cables.

Each Phase of New England Wind will have a separate onshore transmission system located in the Town of Barnstable.[3] The Phase 1 onshore facilities will ultimately include one of two potential landfall sites, one of two potential Onshore Export Cable Routes, one new onshore substation, and one of two potential Grid Interconnection Routes, which are identified in Figure 2.4-1 of COP Volume I. Phase 2 will include one or two landfall sites, one or two Onshore Export Cable Routes, , and one or two Grid Interconnection Routes. The Proponent has considered two site options for the Phase 2 substation. The potential landfall sites, Onshore Export Cable Routes, onshore substation site options, and Grid Interconnection Routes are illustrated on Figure 2.4-1 of COP Volume I.

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[1] Within the SWDA, the closest WTG is approximately 34 km (21 mi) from Martha's Vineyard and 40 km (25 mi) from Nantucket.

[2] As described further in Section 4.1.3 of COP Volume I, the Proponent has identified two variations of the Phase 2 OECC in the event that technical, logistical, grid interconnection, or other unforeseen issues arise during the COP review and engineering processes that preclude one or more Phase 2 offshore export cables from being installed within all or a portion of the OECC.

[3] One or more Phase 2 offshore export cables may deliver power to a second grid interconnection point if technical, logistical, grid interconnection, or other unforeseen issues arise. Under this scenario, Phase 2 could include one onshore transmission system in Barnstable and/or an onshore transmission system(s) in proximity to the second grid interconnection point (see Section 4.1.4 of COP Volume I).

New England Wind has significant environmental benefits. The electricity generated by the WTGs, which do not emit air pollutants, will displace electricity generated by fossil fuel power plants and significantly reduce emissions from the ISO New England (ISO-NE) electric grid over the lifespan of New England Wind. New England Wind is expected to reduce carbon dioxide equivalent (CO_2e) emissions from the ISO-NE electric grid by approximately 3.93 million tons per year (tpy), or the equivalent of taking 775,000 cars off the road.[4] New England Wind will significantly decrease the region's reliance on fossil fuels and enhance the reliability and diversity of regional energy supply. In addition to these important environmental and energy reliability benefits, New England Wind is expected to result in significant long-term economic benefits and high-quality jobs.

2.2 Phase 1 of New England Wind

Phase 1 of New England Wind, which includes Park City Wind, will deliver power to one or more Northeastern states and/or to other offtake users. Assuming the necessary permits are issued and financial close is achieved, construction of Phase 1 would likely begin in late 2024 onshore and 2026 offshore. The Envelope for Phase 1 is summarized in Table 2.2-1.

2.2.1 Phase 1 Construction and Installation

2.2.1.1 Wind Turbine Generators

Phase 1 will consist of 41–62 WTGs oriented in a 1 x 1 NM layout. The potential footprint of Phase 1 within the SWDA includes a portion of Lease Area OCS-A 0501 (see Figure 3.1-4 of COP Volume I) in the event that Vineyard Wind 1 does not develop some or all of its 10 spare positions and Vineyard Wind 1 assigns those positions to Lease Area OCS-A 0534. Similarly, the potential footprint of Phase 1 overlaps with the potential footprint of Phase 2 to account for the range in the number of WTGs that may be developed for Phase 1 (see Figure 3.1-4 of COP Volume I).

The WTG parameters for Phase 1 are provided in Table 2.2-1 and shown on Figure 3.2-1 of COP Volume I. The WTGs will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color; the Proponent anticipates that the WTGs will be painted off-white/light grey to reduce their visibility against the horizon. The WTGs will include one or two levels of red flashing aviation obstruction lights in accordance with Federal Aviation Administration (FAA) and/or BOEM requirements. The Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights when aircraft approach

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[4] The avoided emissions analysis assumes a minimum total capacity for both Phases of New England Wind of approximately 2,000 MW and is based on Northeast Power Coordinating Council (NPCC) New England 2018 emission rates from EPA's Emissions & Generation Resource Integrated Database eGRID2018(v2) released in March 2020. See Section 5.1.2.2 for additional details.

Table 2.2-1 Phase 1 of New England Wind Design Envelope Summary

Layout and Size of Phase 1	WTGs	WTG Foundations
• 41–62 wind turbine generators (WTGs) installed • One or two electrical service platforms (ESPs) installed • Windfarm layout in E-W & N-S grid pattern with 1 NM (1.85 km) spacing between WTG/ESP positions • Area of Phase 1 SWDA: 150–231 km^2 (37,066–57,081 acres)	• 41–62 WTGs • Maximum rotor diameter of 285 m (935 ft) • Maximum tip height of 357 m (1,171 ft) • Minimum tip clearance of 27 m (89 ft) • Installation with a jack-up vessel, anchored vessel, or dynamic positioning (DP) vessel and components likely supplied by feeder vessels	• Each WTG installed on a monopile or piled jacket foundation • Scour protection may be used around all foundations • Maximum pile driving energy of 6,000 kJ for monopiles and 3,500 kJ for jackets • Installation with a jack-up vessel, anchored vessel, or DP vessel and components potentially supplied by feeder vessels

ESPs (Topside and Foundation)	Inter-Array & Inter-Link Cables	Offshore Export Cables
• One or two ESP(s) • Each ESP installed on a monopile or jacket foundation (ESPs installed on monopiles may be co-located) • Maximum pile driving energy of 6,000 kJ for monopiles and 3,500 kJ for jackets • Scour protection may be installed around the foundations • Installation with a jack-up vessel, anchored vessel, or DP vessel	• 66–132 kV inter-array cables buried beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft) • Maximum total inter-array cable length of ~225 km (~121 NM) • Up to one 66–275 kV inter-link cable buried at a target depth of 1.5–2.5 m (5–8 ft) • Maximum total inter-link cable length of ~20 km (~11 NM) • Example layout identified, not finalized • Pre-lay grapnel run and pre-lay survey • Typical installation techniques include jetting (e.g. jet plow or jet trenching) and mechanical plow • Use of cable protection (rock, gabion rock bags, concrete mattresses, half-shell pipes [or similar]) on areas of minimal cable burial	• Two 220–275 kV offshore export cables buried beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft) • Maximum total offshore export cable length of ~202 km (~109 NM) • Cables installed in one Offshore Export Cable Corridor • Pre-lay grapnel run, pre-lay survey, and possibly boulder clearance • Typical installation techniques include jetting (e.g. jet plow or jet trenching) and mechanical plow, possibly with dredging in some locations to achieve burial depth • Use of cable protection (rock, gabion rock bags, concrete mattresses, half-shell pipes [or similar]) on areas of minimal cable burial

Note: Elevations are relative to Mean Lower Low Water (MLLW).

the Phase 1 WTGs, subject to BOEM approval. Each WTG will be maintained as a Private Aid to Navigation (PATON) and will contain marine navigation lighting and marking in accordance with the USCG's PATON marking guidance for offshore wind facilities in First District-area waters.

The WTGs will be installed using jack-up vessels, anchored vessels, or dynamic positioning (DP) vessels along with necessary support vessels and supply vessels. The tower will first be erected followed by the nacelle and finally the hub, inclusive of the blades. Alternatively, the nacelle and hub could be installed in a single operation followed by the installation of individual blades.

2.2.1.2 Wind Turbine Generator Foundations

At this time, the Proponent expects to use all monopiles for the Phase 1 WTG foundations. However, a combination of monopiles and/or piled jackets may be used, pending the outcome of a foundation feasibility analysis. The monopiles will have a maximum diameter of 12 m (39 ft) and will be driven into the seabed to a maximum penetration depth of 55 m (180 ft). The dimensions for each Phase 1 WTG foundation type are shown on Figures 3.2-2 and 3.2-3 of COP Volume I. Scour protection consisting of rock material will be used for the larger diameter monopiles, but may or may not be needed for the smaller diameter piles used for jacket foundations.

The foundations are expected to be installed by one or two DP, anchored, or jack-up vessels, along with necessary support vessels and supply vessels. Pile driving would begin with a "soft-start" (i.e. the hammer energy level will be gradually increased) to ensure the pile remains vertical and allow any motile marine life to leave the area before pile driving intensity is increased. It is anticipated that a maximum of two monopiles or one complete piled jacket (3–4 piles) can be driven into the seabed per day.

2.2.1.3 Electrical Service Platforms

One or two ESP(s) will serve as the common interconnection point(s) for the Phase 1 WTGs. The ESP(s) will be supported by either a monopile or piled jacket foundation (with 3–12 piles) that may be surrounded by scour protection, if needed. If two ESPs are used, they may be located at two separate positions or co-located at one of the potential ESP positions shown on Figure 3.1-4 of COP Volume I (co-located ESPs would be smaller structures installed on monopile foundations). The approximate size and design of the ESP topside and foundation are depicted in Figures 3.2-6 and 3.2-7 of COP Volume I. If necessary, the ESP(s) will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements, which would be activated by ADLS, subject to BOEM approval. The ESP(s) will include marine navigation lighting and marking similar to the lighting and marking described for the WTGs. ESP foundation and topside installation may be performed by a DP, anchored, or jack-up vessel. ESP foundation installation is similar to WTG foundation installation described above. Following topside installation, the ESP(s) will be commissioned.

2.2.1.4 Offshore Export Cables

Phase 1 includes two offshore export cables, which will transmit electricity from the Phase 1 ESP(s) to the selected landfall site. Each offshore export cable is expected to be comprised of a three-core 220–275 kV high voltage alternating current (HVAC) cable and one or more fiber optic cables. Between the Phase 1 ESP(s) and the northwestern corner of the SWDA, the offshore export cables may be installed in any area of the SWDA. From the northwestern corner of the SWDA, the Phase 1 offshore export cables will be installed within the OECC to reach either the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site (see Figure 3.1-6 of COP Volume I). The maximum length of offshore export cables (assuming two cables) is ~202 km (~109 NM).

Prior to cable laying, a pre-lay grapnel run and pre-lay survey will be performed to clear obstructions and inspect the route. Large boulders along the route may need to be relocated and some dredging of the upper portions of sand waves may be required prior to cable laying to achieve sufficient burial depth below the stable sea bottom. Each offshore export cable will be installed beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft). Offshore export cable laying is expected to be performed primarily via simultaneous lay and bury using jetting techniques or mechanical plow. However, other specialty techniques may be used in certain areas to ensure sufficient burial depth (see Section 3.3.1.3.6 of COP Volume I). To facilitate cable installation, anchored vessels may be used along the entire length of the offshore export cables. While the Proponent intends to avoid or minimize the need for cable protection to the greatest extent feasible, it is conservatively estimated that approximately 6% of the offshore export cables within the OECC could require cable protection.

2.2.1.5 Inter-Array and Inter-Link Cables

Strings of multiple WTGs will be connected to the Phase 1 ESP(s) via 66–132 kV inter-array cables. The maximum anticipated length of the Phase 1 inter-array cables is approximately 225 km (121 NM). In addition, if two ESPs are used, the ESPs may be connected together by an up to ~20 km (~11 NM) long 66–275 kV inter-link cable. The Phase 1 inter-array and inter-link cable layout will be designed and optimized during the final design of Phase 1.

The inter-array and inter-link cables will be buried beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft), likely using jetting techniques. However, in some cases, a mechanical plow may be better suited to certain site-specific conditions and other specialty techniques may be used more rarely. The Proponent conservatively estimates that up to 2% of the total length of the inter-array and inter-link cables could require cable protection.

2.2.1.6 Landfall Site and Onshore Export Cables

The offshore export cables will make landfall within paved parking areas at either the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site in the Town of Barnstable. The ocean to land transition at either landfall site will be made using horizontal directional drilling (HDD), which will avoid or minimize impacts to the beach, intertidal zone, and nearshore areas and achieve a burial significantly deeper than any expected erosion. From the landfall site, the onshore export cables would follow one of two approximately 6.5–10.5 km (4.0–6.5 mi) potential Onshore Export Cable Routes (with variants) in the Town of Barnstable to the new onshore substation (see Figure 3.2-11 of COP Volume I).

The onshore export cables will be primarily installed in an underground duct bank (i.e. an array of plastic conduits encased in concrete) along the selected Onshore Export Cable Route; the duct bank will typically be within public roadway layouts although portions of the duct bank may be within existing utility rights-of-way (ROWs).

2.2.1.7 Onshore Substation and Grid Interconnection

Phase 1 will require the construction of a new onshore substation on a 0.027 km^2 (6.7 acre) privately-owned parcel located at 8 Shootflying Hill Road. From the onshore substation, grid interconnection cables will be installed within an underground duct bank along one of two potential Grid Interconnection Routes (with variants) to the grid interconnection point at Eversource's existing West Barnstable Substation. The Proponent may construct an access road to the onshore substation site on 6 Shootflying Hill Road, which is adjacent the onshore substation site. The Proponent may also use an approximately 0.011 km^2 (2.8 acre) parcel of land, assessor map parcel #214-001 ("Parcel #214-001"), located immediately southeast of the West Barnstable Substation for a segment of the grid interconnection cables (see Figure 3.1-2 of COP Volume I).

2.2.1.8 Port Facilities

The Proponent has identified several port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for frequent crew transfer, offloading/loading shipments of components, storage, preparing components for installation, and potentially some component fabrication and assembly. In addition, some components, materials, and vessels could come from Canadian and European ports. See Section 3.2.2.5 of COP Volume I for a complete list of possible ports that may be used for major construction staging. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.

2.2.2 Phase 1 Operations and Maintenance

The Phase 1 WTGs will be designed to operate without attendance by any operators. Continuous monitoring will be conducted remotely using a supervisory control and data acquisition (SCADA) system. Routine preventive maintenance and proactive inspections (e.g. multi-beam echosounder inspections, side scan sonar inspections, magnetometer inspections, depth of burial inspections, etc.) will be performed for all offshore facilities.

To execute daily O&M activities offshore, the Proponent expects to use a service operation vessel (SOV) to provide offshore accommodations and workspace for O&M workers. Daughter craft and/or crew transfer vessels (CTVs) would be used to transfer crew to and from shore. Although less likely, if an SOV is not used, several CTVs and helicopters would be used to frequently transport crew to and from the offshore facilities. In addition to the SOV, CTVs, and/or daughter craft, other larger support vessels (e.g. jack-up vessels) may be used infrequently to perform some routine maintenance and repairs (if needed).

The Proponent expects to use one or more facilities in support of Phase 1 O&M activities. For Phase 1, the Proponent will likely establish a long-term SOV O&M base in Bridgeport, Connecticut. Current plans anticipate that CTVs and/or the SOV's daughter craft would operate out of Vineyard Haven on Martha's Vineyard and/or New Bedford Harbor. Although the Proponent plans to locate the Phase 1 O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor, the Proponent may use other ports listed in Table 3.2-8 of COP Volume I to support O&M activities.

2.2.3 Phase 1 Decommissioning

As currently envisioned, the decommissioning process for Phase 1 is essentially the reverse of the installation process. Decommissioning of the offshore facilities is broken down into several steps:

- Retirement in place (if authorized by BOEM) or removal of the offshore cable system (i.e. inter-array, inter-link, and offshore export cables) and any associated cable protection.
- Dismantling and removal of WTGs. Prior to dismantling the WTGs, they would be properly drained of all lubricating fluids and chemicals, which would be brought to port for proper disposal and/or recycling.
- Cutting and removal of foundations and removal of scour protection. In accordance with BOEM's removal standards (30 CFR § 585.910(a)), the foundations would likely be cut at least 4.5 m (15 ft) below the mudline; the portion below the cut will likely remain in place.
- Removal of ESP(s). The ESP(s) and their foundations will be disassembled in a similar manner as the WTGs. Before removing the ESP(s), the offshore export cables, inter-array cables, and inter-link cables would be disconnected.

The onshore facilities could be retired in place or retained for future use. The extent of onshore decommissioning is subject to discussions with the Town of Barnstable on the approach that best meets the Town's needs and has the fewest environmental impacts.

2.3 Phase 2 of New England Wind

Phase 2 of New England Wind, which includes Commonwealth Wind, will deliver power to one or more Northeastern states and/or to other offtake users. It is likely that a portion of Phase 2 construction could begin immediately following Phase 1[5] with the remainder following by a number of years. The Envelope for Phase 2 is summarized in Table 2.3-1.

2.3.1 Phase 2 Construction and Installation

2.3.1.1 Wind Turbine Generators

Phase 2 will occupy the remainder of the SWDA that is not developed for Phase 1. As described in Section S-3.1.1, the potential footprint of Phase 2 within the SWDA overlaps with the potential footprint of Phase 1 to account for the range in the number of WTGs that may be developed for Phase 1 (see Figure 4.1-4 of COP Volume I). Depending on the final footprint of Phase 1, the total number of WTG/ESP positions expected to be available for Phase 2 ranges from 64 to 88. Up to 88 of those positions may be used for WTGs. The Phase 2 WTGs will be oriented in a 1 x 1 NM layout. The WTG parameters for Phase 2 are provided in Table 2.3-1 and shown on Figure 4.2-1 of COP Volume I.

Unless BOEM and FAA guidance is modified before Phase 2 proceeds, the WTGs will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color; the Proponent anticipates that the WTGs will be painted off-white/light grey to reduce their visibility against the horizon. Unless current guidance is modified by the FAA and BOEM, the WTGs will include one or two levels of red flashing aviation obstruction lights. The Proponent expects to use the same or similar approaches used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS that is activated automatically by approaching aircraft. Each WTG will be maintained as a PATON and will contain marine navigation lighting and marking in accordance with the USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The WTGs are expected to be installed using jack-up vessels, anchored vessels, or DP vessels along with necessary support vessels and supply vessels. The tower will first be erected followed by the nacelle and finally the hub, inclusive of the blades. Alternatively, the nacelle and hub could be installed in a single operation followed by installation of individual blades.

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[5] In this scenario, each major construction activity would be sequential for the two Phases (e.g. Phase 2 foundation installation would immediately follow Phase 1 foundation installation). However, there could be some overlap of different offshore activities between Phase 1 and Phase 2 (e.g. Phase 2 foundation installation could occur at the same time as Phase 1 WTG installation). There will be no concurrent/simultaneous pile driving of foundations.

Table 2.3-1 Phase 2 of New England Wind Design Envelope Summary

Layout and Size of Phase 2	WTGs	WTG Foundations

• 64–88 total wind turbine generator (WTG) and electrical service platform (ESP) positions expected to be available
  ○ Up to 88 WTGs installed
  ○ Up to 3 ESPs installed
• Windfarm layout in E-W & N-S grid pattern with 1 NM (1.85 km) spacing between positions
• Area of Phase 2 SWDA: 222–303 km^2 (54,857–74,873 acres)
	• Up to 88 WTGs
	• Maximum rotor diameter of 285 m (935 ft)
	• Maximum tip height of 357 m (1,171 ft)
	• Minimum tip clearance of 27 m (89 ft)
	• Installation likely with a jack-up vessel, anchored vessel, or dynamic positioning (DP) vessel and components potentially supplied by feeder vessels
		• Each WTG installed on a monopile, jacket, or bottom-frame foundation
		• Scour protection may be used around all foundations
		• Maximum pile driving energy of 6,000 kJ for monopiles and 3,500 kJ for jackets and bottom-frames
		• Installation likely with a jack-up vessel, anchored vessel, or DP vessel and components potentially supplied by feeder vessels

ESP(s) (Topside and Foundation)	**Inter-Array & Inter-Link Cables**	**Offshore Export Cables**
• Up to 3 ESPs • Each ESP installed on a monopile or jacket foundation (ESPs installed on monopiles may be co-located) • Maximum pile driving energy of 6,000 kJ for monopiles and 3,500 kJ for jackets • Scour protection may be installed around the foundations • Installation likely with a jack-up vessel, anchored vessel, or DP vessel	• 66–132 kV inter-array cables buried beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft) • Maximum total inter-array cable length of ~325 km (~175 NM) • 66–345 kV inter-link cables buried at a target depth of 1.5–2.5 m (5–8 ft) • Maximum total inter-link cable length of ~60 km (~32 NM) • Example layout identified, not finalized • Pre-lay grapnel run and pre-lay survey • Typical installation techniques include jetting (e.g. jet plow or jet trenching) and mechanical plow • Use of cable protection (rock, gabion rock bags, concrete mattresses, half-shell pipes [or similar]) on areas of minimal cable burial	• Two or three 220–345 kV high voltage alternating current (HVAC) cables buried beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft) • Cables installed in an Offshore Export Cable Corridor (OECC) with potential variations • Maximum total offshore export cable length of ~356 km (~192 NM) • Pre-lay grapnel run, pre-lay survey, and possibly boulder clearance • Typical installation techniques include jetting (e.g. jet plow or jet trenching) and mechanical plow, possibly with dredging in some locations to achieve burial depth • Use of cable protection (rock, gabion rock bags, concrete mattresses, half-shell pipes [or similar]) on areas of minimal cable burial

Note: Elevations are relative to Mean Lower Low Water (MLLW).

2.3.1.2 Wind Turbine Generator Foundations

Commercial and technical considerations at the time Phase 2 is ready to proceed will determine the types of WTG foundations used for Phase 2. Monopiles, jackets (with piles or suction buckets), bottom-frame foundations (with piles or suction buckets), or a combination of those foundation types may be used for Phase 2 pending the outcome of a foundation feasibility analysis.

If used, monopiles would have a maximum diameter of 13 m (43 ft) and would be driven into the seabed to a maximum depth of 55 m (180 ft). The dimensions for each Phase 2 WTG foundation type are shown on Figures 4.2-2 through 4.2-6 of COP Volume I. Scour protection consisting of rock material may be placed around the foundations; it is anticipated that scour protection will be needed for the larger diameter monopiles and suction buckets, but may or may not be needed for the smaller diameter piles used for jacket and bottom-frame foundations.

The foundations are expected to be installed by one or two DP, anchored, or jack-up vessels, along with necessary support vessels and supply vessels. Pile driving will begin with a "soft-start" to ensure the pile remains vertical and allow any motile marine life to leave the area before pile driving intensity is increased. It is anticipated that a maximum of two monopiles, one complete piled jacket (3–4 piles), or one complete piled bottom-frame (3 piles) can be driven into the seabed per day. If suction buckets are used, pumps attached to the top of each bucket would pump water and air out of the space between the suction buckets and seafloor, pushing the buckets down into the seafloor.

2.3.1.3 Electrical Service Platforms

Up to three ESP(s) will serve as the common interconnection point(s) for the Phase 2 WTGs. The ESP(s) would be supported by a monopile, piled jacket (with 3–12 piles), or suction bucket jacket foundation, which may be surrounded by scour protection, if needed. 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 ESP positions shown on Figure 4.1-4 of COP Volume I (co-located ESPs would be smaller structures installed on monopile foundations). The approximate size and design of the ESP(s) are depicted in Figures 4.2-10 through 4.2-12 of COP Volume I. The ESP(s) will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements in effect at the time Phase 2 proceeds, if necessary. The aviation obstruction lights would be activated by ADLS (or similar), subject to BOEM approval. Marine navigation lighting and marking on each ESP will follow USCG and BOEM regulations and guidance in effect at the time Phase 2 proceeds. ESP foundation and topside installation may be performed by a DP, anchored, or jack-up vessel. ESP foundation installation is similar to WTG foundation installation described above. Following topside installation, the ESP(s) will be commissioned. As an alternative to installing separate ESP(s) situated on their own foundation(s), the Phase 2 ESP(s) could potentially be integrated onto a WTG foundation, which entails placing ESP equipment on one or more expanded WTG foundation platforms (see Figure 4.2-9 of COP Volume I).

2.3.1.4 Offshore Export Cables

Three 220–345 kV HVAC offshore export cables will transmit electricity from the Phase 2 ESP(s) to the selected landfall site(s). Between the Phase 2 ESP(s) and the northwestern corner of the SWDA, the offshore export cables may be installed in any area of the SWDA. The Proponent intends to install all Phase 2 offshore export cables within the OECC that travels from the northwestern corner of the SWDA to the Dowses Beach Landfall Site and/or Wianno Avenue Landfall Site in the Town of Barnstable (see Figure 4.1-6 of COP Volume I). Under this scenario, the maximum length of Phase 2 offshore export cables is ~356 km (~192 NM). However, as described further in Section 4.1.3 of COP Volume I, the Proponent has also identified two variations of the Phase 2 OECC in the event that technical, logistical, grid interconnection, or other unforeseen issues arise during the COP review and engineering processes that preclude one or more Phase 2 offshore export cables from being installed within all or a portion of the OECC.

Prior to cable laying, a pre-lay grapnel run and pre-lay survey are expected to be performed to clear obstructions and inspect the route. Large boulders along the route may need to be relocated and some dredging of the upper portions of sand waves may be required prior to cable laying to achieve sufficient burial depth below the stable sea bottom. Each offshore export cable will be installed beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft). Offshore export cable laying is expected to be performed primarily via simultaneous lay and bury using jetting techniques (e.g. jet plow or jet trenching) or mechanical plow. However, other specialty techniques may be used in certain areas to ensure sufficient burial depth (see Section 4.3.1.3.6 of COP Volume I). To facilitate cable installation, anchored vessels may be used along the entire length of the offshore export cables. While the Proponent intends to avoid or minimize the need for cable protection to the greatest extent feasible, it is conservatively estimated that approximately 6% of the offshore export cables within the OECC could require cable protection.

2.3.1.5 Inter-Array and Inter-Link Cables

Strings of multiple WTGs will be connected to the Phase 2 ESP(s) via 66–132 kV inter-array cables. The maximum anticipated length of the Phase 2 inter-array cables is approximately 325 km (175 NM). In addition, the Phase 2 ESPs may be connected to each other (if two or three ESPs are used) or to a Phase 1 ESP by 66–345 kV inter-link cables. The maximum total length of inter-link cables for Phase 2 is ~60 km (~32 NM). The Phase 2 inter-array and inter-link cable layout is highly dependent upon the final number of Phase 2 WTGs and the 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 Phase 2.

The inter-array and inter-link cables will be buried beneath the seafloor at a target depth of 1.5–2.5 m (5–8 ft). Based on currently available technologies, the inter-array and inter-link cables will likely be installed using jetting techniques. However, in some cases, a mechanical plow may be better suited to certain site-specific conditions and other specialty techniques may be used more rarely. The Proponent conservatively estimates that up to 2% of the total length of the inter-array and inter-link cables could require cable protection.

2.3.1.6 Landfall Site(s), Onshore Cable Route(s), Onshore Substation, and Grid Interconnection

The Phase 2 offshore export cables will come ashore at the Dowses Beach Landfall Site and/or Wianno Avenue Landfall Site in Barnstable, unless technical, logistical, grid interconnection, or other unforeseen issues arise that preclude the Proponent from installing one or more Phase 2 offshore export cables within the OECC and a second grid interconnection point is needed (see Section 4.1.3.3 of COP Volume I). The ocean to land transition at the Dowses Beach Landfall Site will be made using HDD, which will avoid or minimize impacts to the beach, intertidal zone, and nearshore areas and achieve a burial significantly deeper than any expected erosion. HDD or open trenching may be used at the Wianno Avenue Landfall Site.

Upon making landfall, the onshore export cables would follow one or two Onshore Export Cable Routes to a new onshore substation.

In the event that one or more Phase 2 offshore export cables deliver power to a second grid interconnection point, Phase 2 could include one onshore transmission system in Barnstable (using either the Dowses Beach Landfall Site or Wianno Avenue Landfall Site) and/or an onshore transmission system(s) in proximity to the second grid interconnection point. See Section 4.1.4 of COP Volume I for additional details.

2.3.1.6.1 Onshore Substation and Grid Interconnection

The Phase 2 onshore export cables will connect to a new onshore substation in the Town of Barnstable. A new onshore substation is required for Phase 2 to step up power from 275-kV to 345-kV for interconnection with the regional power grid at the existing 345-kV West Barnstable Substation. The Proponent has considered two options for the Phase 2 substation site. The preferred option is the Clay Hill site, and an alternate option is the Old Falmouth Road site (see Figure 3.1-2). The largest parcel, or combination of parcels, currently under consideration for each substation is 0.12 km^2 (29 acres) in size.

Onshore Substation - Clay Hill Site

The Clay Hill Site is located west of Oak Street near the Oak Street Bridge overpass of Route 6, approximately 0.4 km (0.25 mi) west of the interconnection location at the existing Eversource West Barnstable Substation. The Proponent has site control over eight contiguous privately owned parcels totaling approximately 0.12 km^2 (29 acres), which allows the Proponent to optimize the substation layout and secure additional access rights.

The Clay Hill Site generally meets the siting considerations for the proposed substation and, importantly, the Proponent was able to secure an option to purchase the parcels and thus has site control. Therefore, the Clay Hill Site is the proposed location for the Phase 2 substation.

Onshore Substation - Old Falmouth Road Site

The Old Falmouth Road substation site consists of four parcels of varying size which together total approximately 0.07 km^2 (18.5 acres). Developed portions of the parcels include several existing structures, internal roadways, and a contractor yard(s). Undeveloped portions of the site are wooded. The Old Falmouth Road site is located over 4.0 km (2.5 mi) from the West Barnstable Substation.

Of the four parcels that comprise the site, only two were available to the Proponent through option agreements, and those two alone would not provide enough space to accommodate the proposed substation. Based on this, the Proponent would need to secure additional option agreements to allow for use of the Old Falmouth Road site as the location for the Phase 2 onshore substation.

Grid Interconnection

Grid interconnection cables installed along one or two Grid Interconnection Routes would connect the Phase 2 onshore substation to the grid interconnection point at Eversource's existing 345 kV West Barnstable Substation. The onshore export and grid interconnection cables are expected to be installed underground within public roadway layouts and utility ROWs. From each landfall site to the grid interconnection point, the maximum combined length of the Phase 2 Onshore Export Cable Route and Grid Interconnection Route is up to 17 km (10.6 mi).

2.3.1.7 Port Facilities

The Proponent has identified several port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for frequent crew transfer, offloading/loading shipments of components, storage, preparing components for installation, and potentially some component fabrication and assembly. In addition, some components, materials, and vessels could come from Canadian and European ports. See Section 4.2.2.5 of COP Volume I for a complete list of possible ports that may be used for major Phase 2 construction staging activities. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.

2.3.2 Phase 2 Operations and Maintenance

The Phase 2 WTGs will be designed to operate without attendance by any operators. Continuous monitoring is typically conducted remotely using a SCADA system. Routine preventive maintenance and proactive inspections (e.g. multi-beam echosounder inspections, side scan sonar inspections, magnetometer inspections, depth of burial inspections, etc.) will be performed for all offshore facilities.

Once Phase 2 becomes operational, the Proponent expects to use an SOV to provide offshore accommodations and workspace for O&M workers. Under this scenario, daughter craft and/or CTVs would be used to transfer crew to and from shore. If an SOV or similar accommodation vessel is not used, several CTVs and helicopters could be used to frequently transport crew to and from the offshore facilities. In addition to the SOV, CTVs, and/or daughter craft, other larger support vessels (e.g. jack-up vessels) may be used infrequently to perform some routine maintenance and repairs (if needed).

In support of O&M activities for Phase 2, the Proponent will likely use O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor. The O&M facilities may include management and administrative team offices, a control room, office and training space for technicians and engineers, warehouse space for parts and tools, and/or pier space for vessels used during O&M. The Proponent may use any of the ports listed in Table 4.2-8 of COP Volume I to support O&M activities.

2.3.3 Phase 2 Decommissioning

As currently envisioned, the decommissioning process for Phase 2 is essentially the reverse of the installation process. Decommissioning of the offshore facilities is broken down into several steps:

1. Retirement in place (if authorized by BOEM) or removal of the offshore cable system (i.e. inter-array, inter-link, and offshore export cable[s]) and any associated cable protection.

2. Dismantling and removal of WTGs. Prior to dismantling the WTGs, they would be properly drained of all lubricating fluids and chemicals, which would be brought to port for proper disposal and/or recycling.

3. Cutting and removal of foundations and removal of scour protection. In accordance with BOEM's removal standards (30 CFR § 585.910(a)), the foundations would likely be cut at least 4.5 m (15 ft) below the mudline; the portion below the cut will likely remain in place. Suction buckets (if used) are anticipated to be removed by injecting water into the space between the suction bucket and seafloor to reduce the suction pressure that holds the foundation in place.

4. Removal of ESP(s). The ESP(s) and their foundations are expected to be disassembled in a similar manner as the WTGs. Before removing the ESP(s), the offshore export cables, inter-array cables, and inter-link cables would be disconnected.

The onshore facilities could be retired in place or retained for future use. The extent of onshore decommissioning is subject to discussions with the Town of Barnstable on the approach that best meets the Town's needs and has the fewest environmental impacts.

3.0 MAXIMUM DESIGN SCENARIO FOR RESOURCE ASSESSMENTS

Potential impacts to physical, biological, and socioeconomic resources from New England Wind are assessed using a "maximum design scenario," or the design scenario with the maximum impacts anticipated for that resource. The maximum design scenario for resource assessments considers the following:

- New England Wind will be developed in two Phases with a maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions. The WTGs and ESPs will be located in Lease Area OCS-A 0534 and potentially a portion of Lease Area OCS-A 0501 in the event that Vineyard Wind 1 does not develop "spare" or extra positions included in Lease Area OCS-A 0501 and Vineyard Wind 1 assigns those positions to Lease Area OCS-A 0534. For the purposes of the Construction and Operations Plan (COP), the Southern Wind Development Area (SWDA) is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (see Figure 3.0-1).

- Each Phase of New England Wind is being developed and permitted in accordance with the Bureau of Ocean Energy Management's (BOEM's) Project Design Envelope Guidance with each Phase having its own Project Design Envelope ("Envelope"). See Section 2 for a summary of each Phase's Envelope.

- The Proponent intends to install five offshore export cables—two cables for Phase 1 and three cables for Phase 2—within a shared Offshore Export Cable Corridor (OECC) that travels from the northwestern corner of the SWDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then heads northward along the eastern side of Muskeget Channel toward landfall sites in the Town of Barnstable (see Figure 3.0-1). At approximately 2–3 kilometers (km) (1–2 miles [mi]) from shore, the OECC will diverge for each Phase to reach separate landfall sites in the Town of Barnstable.

- Each Phase of New England Wind will have a separate onshore transmission system, but the Proponent intends to connect both Phases into the ISO New England (ISO-NE) electric grid at the same grid interconnection point (i.e. Eversource's West Barnstable Substation).

The Proponent has also identified two variations of the Phase 2 OECC in the event that technical, logistical, grid interconnection, or other unforeseen issues arise during the COP review and engineering processes that preclude one or more Phase 2 offshore export cables from being installed within all or a portion of the OECC. These variations of the Phase 2 OECC—the Western Muskeget Variant and the South Coast Variant—are shown on Figure 3.0-2. In addition, if the South Coast Variant is employed and electricity generated by Phase 2 is delivered to a second grid interconnection point, Phase 2 could include one onshore transmission system in Barnstable and/or an onshore transmission system(s) within the "Phase 2 South Coast Variant Onshore Routing Envelope" shown on Figure 3.0-2.

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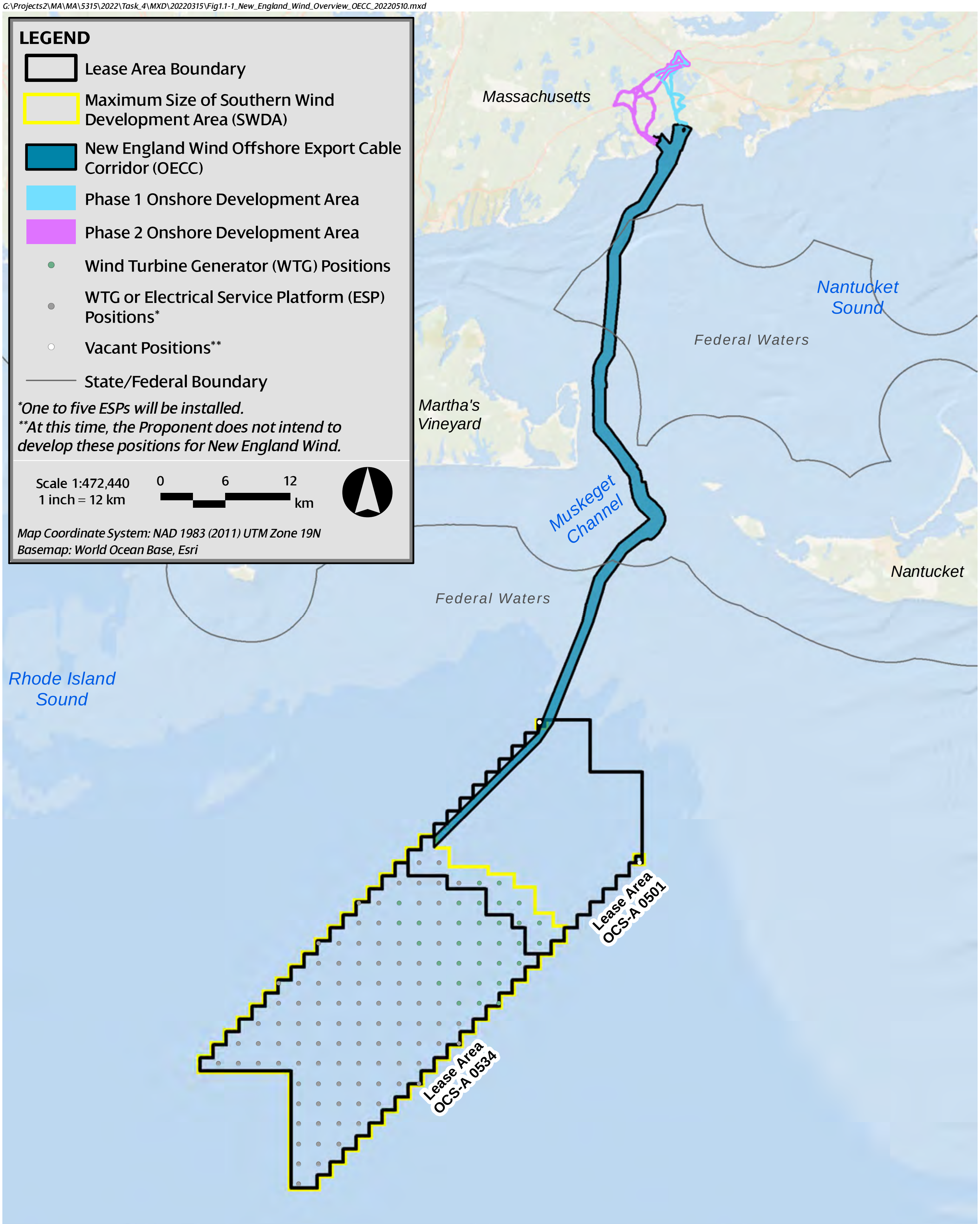
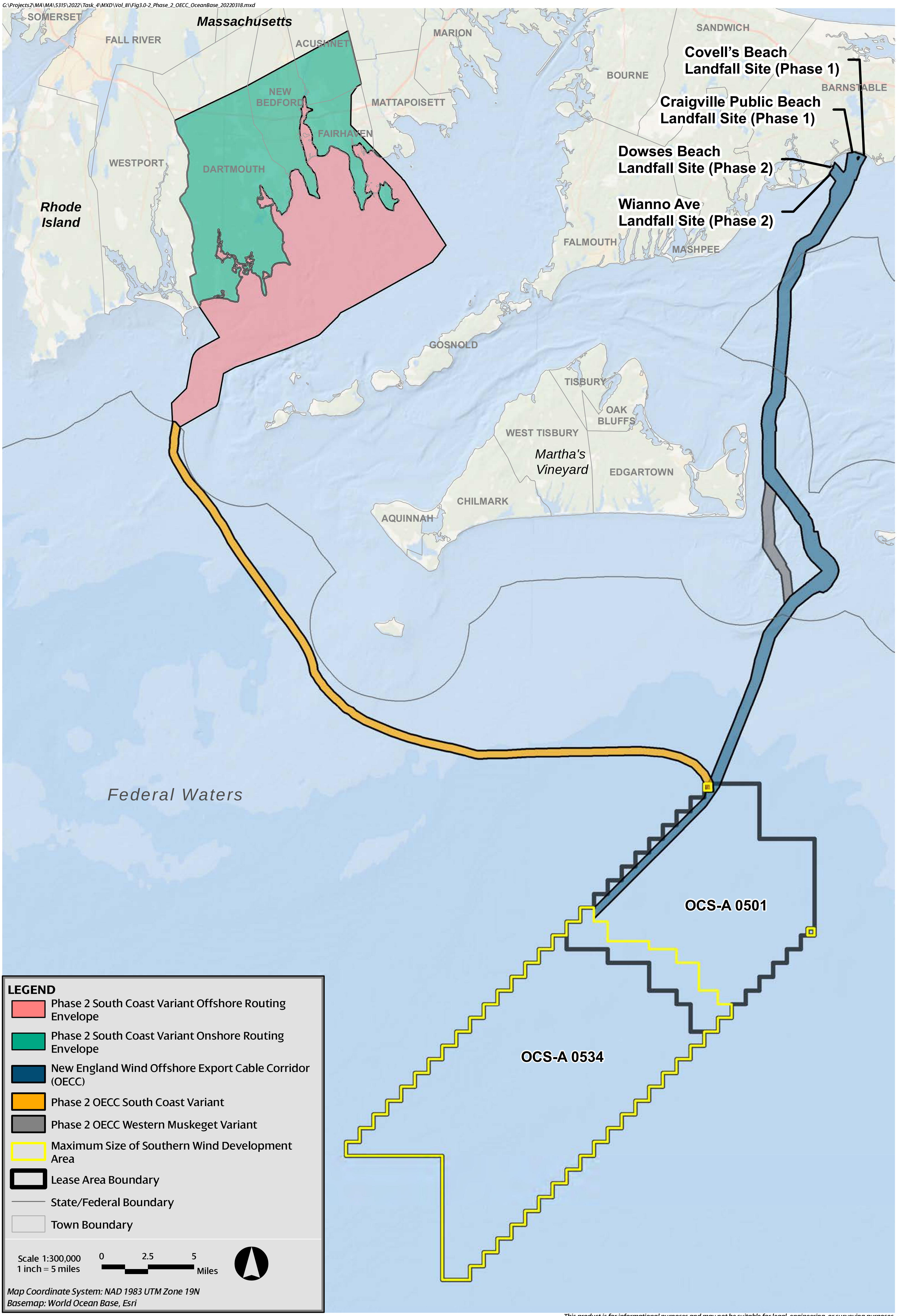


New England Wind
AVANGRID RENEWABLES

Figure 3.0-1
New England Wind Overview



New England Wind
AVANGRID RENEWABLES

Figure 3.0-2
Phase 2 Offshore Export Cable Corridor Variants

The resource assessments in Volume III analyze the potential impacts associated with the Western Muskeget Variant, but do not include the potential impacts associated with the South Coast Variant. The Proponent provided the data and analysis supporting the South Coast Variant in federal waters in the COP Addendum (Section 2.0). If it becomes necessary to employ the South Coast Variant and a second grid interconnection point is secured, the Proponent understands that BOEM would conduct a supplemental review of those portions of the South Coast Variant not otherwise considered in the Final Environmental Impact Statement.

The remainder of this section describes how the maximum design scenario is identified for each resource, which is described generally for offshore and onshore resources in Section 3.1 and more specifically for each resource in Section 3.2. Section 3.3 describes the approach used to describe the offshore affected environment.

3.1 Approach to Defining the Maximum Design Scenario for Each Resource

3.1.1 Offshore Resources

New England Wind's facilities and activities within the SWDA and along the OECC have the potential to impact offshore resources. Because New England Wind is being developed in two Phases, with each Phase having its own Envelope, and because the northern boundary of the SWDA cannot be determined until the footprint of Vineyard Wind 1 is established, the maximum design scenario for each resource takes into consideration the maximum potential buildout for New England Wind as well as the maximum footprint and parameters for each Phase. This conservative approach likely overestimates the potential impacts of New England Wind and each of its Phases but ensures that all potential impacts are evaluated. More specifically, the maximum design scenario for each offshore resource considers one or more of the following:

- **The Maximum Potential Size of the SWDA:** The maximum size of the SWDA is 130 WTG/ESP positions within a footprint of 453 square kilometers (km^2) (111,939 acres). The maximum size of the SWDA assumes that Vineyard Wind 1 will not develop the 10 "spare" or extra positions included in Lease Area OCS-A 0501. The maximum size of the SWDA is used in all resource assessments.

- The Maximum Size of Each Phase:

- Phase 1: The maximum potential size of Phase 1 is 62 WTGs and two ESPs within a footprint of 231 km^2 (57,081 acres).

  - Phase 2: The maximum potential size of Phase 2 is 88 WTG/ESP positions within a footprint of 303 km^2 (74,873 acres).

Since Vineyard Wind 1 may assign some or all of its 10 spare positions to Lease Area OCS-A 0534, the potential footprint of Vineyard Wind 1 overlaps with the potential footprint of Phase 1. Similarly, the potential footprint of Phase 2 within the SWDA overlaps with the potential footprint of Phase 1 to account for the range in the number of WTGs that may be developed for Phase 1. Figure 3.1-1 illustrates the variable and overlapping footprints of Phase 1, Phase 2, and Vineyard Wind 1. It is important to note that, due to the range of buildout scenarios for Phases 1 and 2 where certain parts of the SWDA could be included in either Phase 1 or Phase 2, the sum of the maximum design scenarios for Phase 1 and Phase 2 does not equal the total maximum design scenario of New England Wind.

- **The Maximum Envelope Proposed for Each Phase:** The maximum Envelope parameters for each Phase are summarized in Section 3.2; the details of the Envelope for each Phase are provided in Sections 3 and 4 of COP Volume I and summarized in Section 2 of COP Volume III. The primary difference between the Phase 1 and Phase 2 Envelopes is that Phase 2 will likely include a greater number of WTGs and ESPs and be geographically larger than Phase 1, with greater associated installation and operations and maintenance-related activities. Accordingly, potential impacts associated with the Phase 2 Envelope are generally greater than potential impacts associated with the Phase 1 Envelope.

- **The Maximum Area of Seafloor Disturbance Within the SWDA and OECC:** Table 1 of Appendix III-T presents the maximum area of seafloor disturbance during construction for a total buildout of the SWDA, assuming the minimum size of Phase 1 and the maximum size of Phase 2. This approach conservatively assumes the smallest area for Phase 1 and the largest possible area for Phase 2, given that the Phase 2 Envelope has greater seafloor impacts than the Phase 1 Envelope. Table 4 of Appendix III-T presents the maximum seafloor disturbance within the OECC (which travels along the eastern side of Muskeget Channel) for both Phases combined. Table 7 of Appendix III-T compares the total maximum seafloor disturbance within the OECC for both Phases with and without the use of the Phase 2 OECC Western Muskeget Variant.

3.1.2 Onshore Resources

Each Phase of New England Wind will have a separate onshore transmission system, but the Proponent intends to connect both Phases into the ISO-NE electric grid at the same grid interconnection point (i.e. West Barnstable Substation).[6] The Onshore Development Area for each Phase includes the potential landfall sites, the Onshore Export Cable Routes from the landfall sites to the new onshore substations, the onshore substation sites, the Grid Interconnection Routes from the onshore substations to the grid interconnection point, and the grid interconnection point.

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[6] As described more fully in Sections 4.1.3 and 4.1.4 of COP Volume I, one or more Phase 2 offshore export cables may deliver power to a second grid interconnection point via the South Coast Variant if technical, logistical, grid interconnection, or other unforeseen issues arise. Under this scenario, Phase 2 could include one onshore transmission system in Barnstable and/or an onshore transmission system(s) in proximity to the second grid interconnection point.

G:\Projects2\MA\MA\5315\2022\Task_4\MXD\Fig3.1-4_Phase_1_Portion_of_SWDA_20220420.mxd

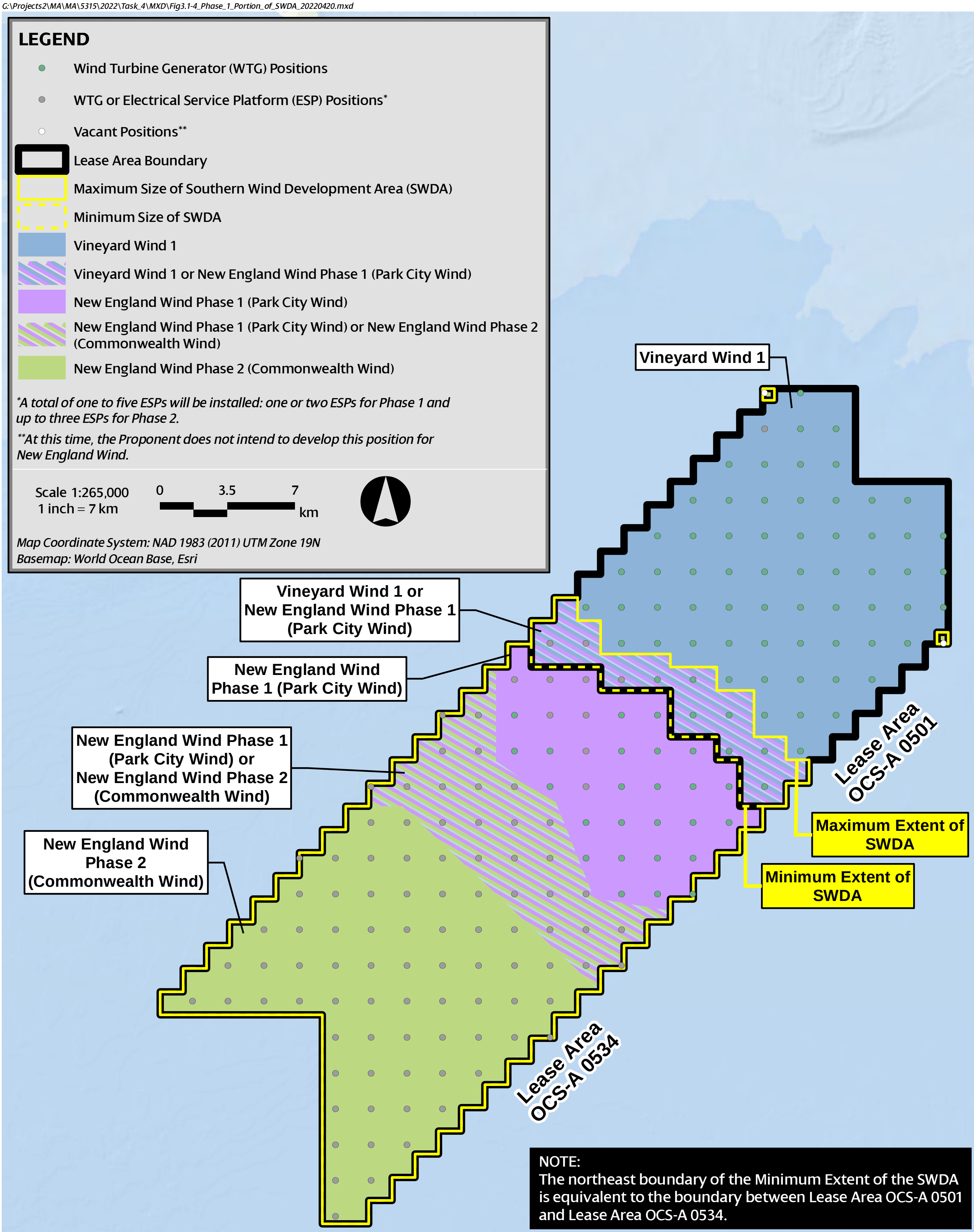


Figure 3.1-1
Phase 1 and Phase 2 Overlay

- Phase 1 Onshore Development Area: The Phase 1 onshore facilities will ultimately include one of two potential landfall sites, one of two potential Onshore Export Cable Routes, one new onshore substation site, and one of two potential Grid Interconnection Routes, which are illustrated in Figure 3.1-2.

- Phase 2 Onshore Development Area: Phase 2 will include one or two landfall sites, one or two Onshore Export Cable Routes, , and one or two Grid Interconnection Routes. The Proponent has considered two site options for the Phase 2 substation. The potential landfall sites, Onshore Export Cable Routes, onshore substation site options, and Grid Interconnection Routes are illustrated on Figure 3.1-2.

3.2 The Maximum Design Scenario for Each Resource

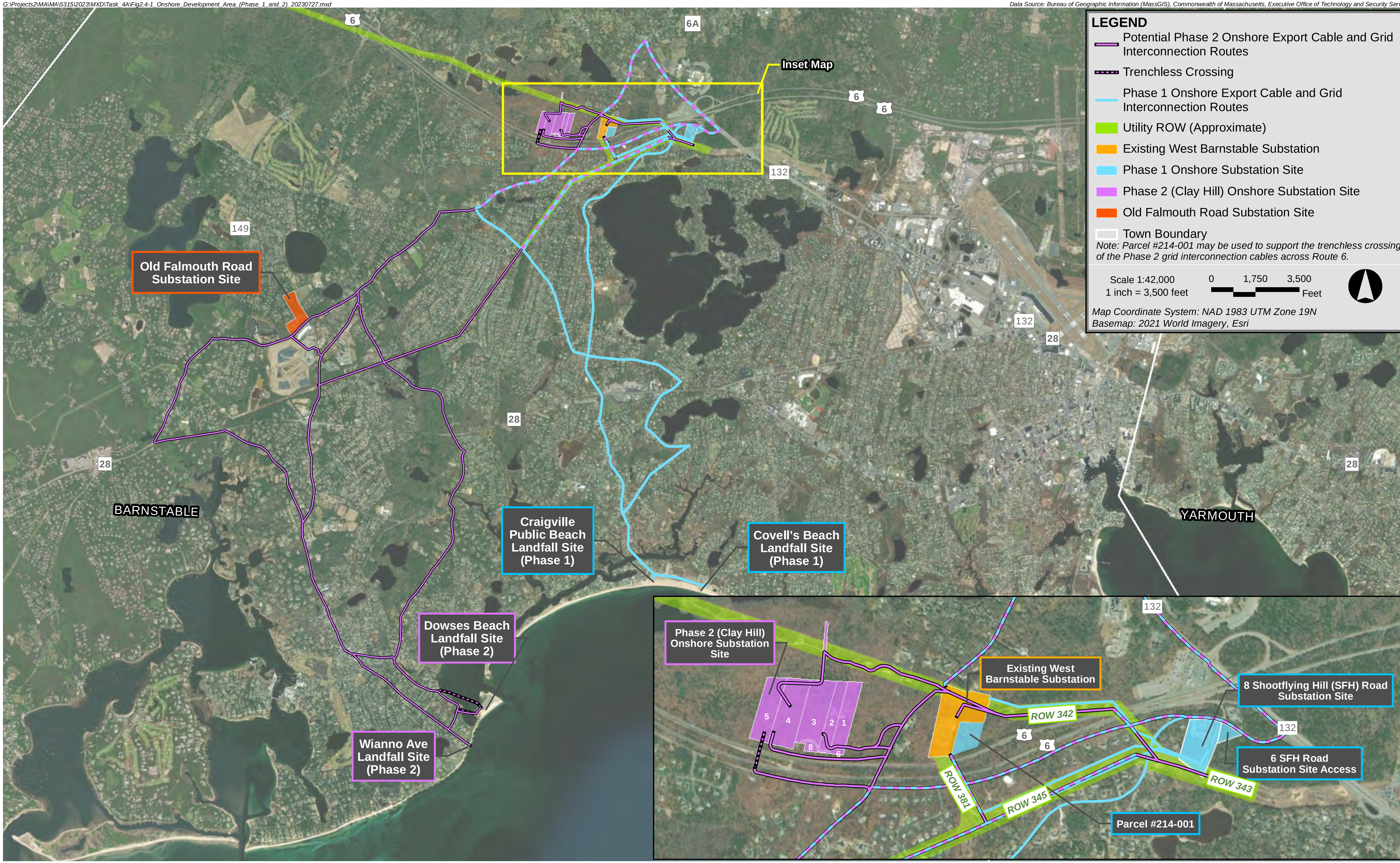
The maximum design scenario for each resource is described in more detail below. Table 3.2-1 at the end of this section identifies how the considerations described in Section 3.1 were applied to determine the maximum design scenario for each resource. The maximum Envelope parameters used to assess the maximum design scenario for New England Wind (Phases 1 and 2 combined) and each Phase individually are summarized in Table 3.2-2 at the end of this section.

3.2.1 Air Quality, Water Quality, Bats, Socioeconomic Resources, and Low Probability Events

For Air Quality,[7] Water Quality, Bats, most socioeconomic resources (Demographics, Employment, and Economics; Environmental Justice; Recreation and Tourism; and Land Use and Coastal Infrastructure), and Low Probability Events, potential impacts are most closely related to New England Wind offshore and onshore development as a whole, are not as dependent on the specific sizes of offshore components, and/or are similar for each Phase. The maximum design scenario considers a total buildout of the SWDA of 130 WTG/ESP positions, the installation of five cables for Phases 1 and 2 within the OECC (with and without the Phase 2 OECC Western Muskeget Variant), and onshore development within the Onshore Development Areas for Phases 1 and 2.

[7] Section 5.1 and Appendix III-B provide an estimate of New England Wind's air emissions for the maximum design scenario of both Phases of New England Wind combined (i.e. for all 130 WTG/ESP positions). In addition, based on the maximum design scenario for each Phase, the total air emissions of New England Wind were apportioned to develop an estimate of air emissions for each Phase separately.

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



New England Wind

AVANGRID RENEWABLES

Figure 3.1-2

Onshore Development Areas for Phases 1 and 2

3.2.2 Marine Archaeology, Commercial Fisheries, Navigation and Vessel Traffic

For the Marine Archaeology, Commercial Fishing, and Navigation and Vessel Traffic assessments, potential impacts are most closely related to New England Wind offshore development as a whole (including the planned 1 x 1 NM WTG/ESP layout throughout the SWDA) and are not as dependent on the specific sizes of offshore components. The maximum design scenario for these resources is simply a total buildout of 130 WTG/ESP positions within the SWDA without a specific focus on the sizes of offshore components. The maximum design scenario for these assessments also considers impacts from installation of five cables within the OECC (with and without the Phase 2 OECC Western Muskeget Variant).

3.2.3 Benthic Resources, Finish and Invertebrates, Marine Mammals, Sea Turtles, and Visual Impact Assessment

For the Benthic Resources, Finish and Invertebrates, Marine Mammals, Sea Turtles, and Visual Impact assessments, potential impacts are closely related to the specific sizes of offshore components and the portion of the seafloor occupied. The maximum design scenario for a total buildout of 130 WTG/ESP positions within the SWDA is assessed considering the <u>minimum</u> size of Phase 1 and the <u>maximum</u> size of Phase 2 because potential effects associated with the Phase 2 Envelope are generally greater than potential effects associated with the Phase 1 Envelope. See Figure 3.1-1 and Section 3.1.1 for a description of the maximum size of each Phase and the maximum Envelope for each Phase.

- **Benthic and Finfish and Invertebrates:** Seafloor impacts are presented for the total buildout of the SWDA assuming the smallest area for Phase 1 and the largest possible area for the greater potential seafloor disturbance associated with the Phase 2 Envelope (e.g. larger areas of scour protection and larger areas of cable installation impacts). Seafloor impacts are also presented for installation of five cables within the OECC (with and without the Phase 2 OECC Western Muskeget Variant). Finally, these sections also present the maximum amount of seafloor disturbance associated with the maximum size of each individual Phase.

- **Marine Mammals and Sea Turtles:** To assess hydroacoustic impacts to marine mammals and sea turtles, the largest foundations included in the Envelope for each Phase were assessed. The Phase 1 Envelope includes up to a 12 meter (m) (39.4 foot [ft]) diameter monopile foundation whereas the maximum Phase 2 monopile foundation is 13 m (42.7 ft) in diameter. The maximum jacket foundation pile size included in both Phases (4 m [13 ft]) was also assessed. Additional details on the number of each foundation type modeled are provided in Section 6.7. The maximum design scenario for the Marine Mammals and Sea Turtles assessments also considers impacts from installation of five cables within the OECC.

- **Visual Impact Assessment:** For visual simulations of the offshore facilities, Phases 1 and 2 are modeled together assuming the maximum WTG height. For the onshore facilities, visual simulations are provided for the Phase 1 substation site and the Phase 2 Clay Hill onshore substation site.

3.2.4 Coastal and Marine Birds and Aviation

For the Coastal and Marine Birds and Aviation assessments, potential impacts are also closely related to the specific sizes of offshore components. The maximum design scenario for a total buildout of 130 WTG/ESP positions within the SWDA is assessed by applying the maximum Phase 1 and Phase 2 Envelope parameters to the entire SWDA (i.e. all 130 positions).

- **Coastal and Marine Birds:** A ranking of relative vulnerability to operation was developed for displacement and collision. The ranking was performed for the maximum dimensions (tip height and rotor diameter) of the WTGs, along with the minimum tip clearance. For all species, the assessment is inclusive of the maximum Envelope of both Phases.[8] The maximum design scenario for the Coastal and Marine Birds assessment also considers temporary construction period impacts from installation of five cables within the OECC (with and without the Phase 2 OECC Western Muskeget Variant).

- **Aviation:** The maximum Phase 1 WTG Envelope (i.e. the tallest Phase 1 WTGs) and maximum Phase 2 WTG Envelope (i.e. the tallest Phase 2 WTGs) are each individually assessed throughout the entire SWDA.[9]

3.2.5 Coastal Habitats

For Coastal Habitats, potential impacts are related to the landfall sites and the OECC. The maximum design scenario for this resource is installation of five cables within the OECC (with and without the Phase 2 OECC Western Muskeget Variant), as well as one landfall site in the Town of Barnstable for Phase 1 and up to two landfall sites in Barnstable for Phase 2.

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[8] Prior to the April 2022 COP revision that updated the Phase 1 WTG dimensions to match the Phase 2 WTG dimensions, the vulnerability rankings were performed separately for the Phase 1 WTGs and the Phase 2 WTGs. For all species, the range in maximum WTG dimensions included in the Phase 1 and Phase 2 Envelopes did not change the vulnerability rankings because the minimum tip clearance (distance between the water and lowest blade position) was the same for both Phases (27 m [89 ft]).

[9] Prior to the April 2022 COP revision that updated the Phase 1 WTG dimensions to match the Phase 2 WTG dimensions, the aviation assessments were performed separately for the Phase 1 WTGs and the Phase 2 WTGs. Given that the Phase 1 and Phase 2 WTGs now have equivalent heights, the assessments performed for the SWDA using the Phase 2 WTG heights are now representative of both Phases.

3.2.6 Terrestrial Fauna and Terrestrial Archaeology

For the Terrestrial Fauna and Terrestrial Archaeology assessments, the maximum design scenario is onshore development within all areas included in the Phase 1 Onshore Development Area as well as all areas included the Phase 2 Onshore Development Area. The Onshore Development Area for each Phase includes the potential landfall sites, the Onshore Export Cable Routes, the onshore substation sites, the Grid Interconnection Routes, and the grid interconnection point.

- **Terrestrial Fauna:** A discussion of potential impacts is presented for the Onshore Development Area of each Phase.

- **Terrestrial Archaeology:** The Onshore Development Area for each Phase is assessed individually.

3.3 Description of the Affected Environment for Offshore Resources

As described in Section 3.1.1, there is variability in the specific size and geographic location of Phase 1 and Phase 2 within the SWDA. Considering the overlap between areas that may be developed for a given Phase as shown on Figure 3.1-1, the resource assessments in Volume III present an overview of the Affected Environment for the entire SWDA, without attempting to distinguish geographically between Phase 1 and Phase 2. However, if a significant difference is observed between geographical areas specific to Phase 1 or Phase 2, such a distinction is noted in the text.

Similarly, since both Phases share an OECC to within approximately 2–3 km (1–2 mi) from shore, the Affected Environment is presented for the entire OECC without distinguishing between Phases, except where the Phase 2 OECC Western Muskeget Variant is described.

Table 3.2-1 Maximum Design Scenario for Resource Assessments

Resource	New England Wind Offshore Development					New England Wind Onshore Development		New England Wind Development (Onshore and Offshore Combined)		
	Maximum Buildout of the SWDA, with Minimum Size Phase 1 and Maximum Size Phase 2	Maximum Buildout of the SWDA, with Maximum Phase 1 Parameters	Maximum Buildout of the SWDA, with Maximum Phase 2 Parameters	Maximum Buildout of the SWDA	Maximum Impacts within OECC	Phase 1 Development	Phase 2 Development	Total Development	Phase 1 Development	Phase 2 Development
5.1 Air Quality								•	•	•
5.2 Water Quality								•		
6.1 Terrestrial Fauna and Inland Birds						•	•			
6.2 Coastal and Marine Birds		•	•		•					
6.3 Bats								•		
6.4 Coastal Habitats					•					
6.5 Benthic Resources	•				•					
6.6 Finfish and Invertebrates	•				•					
6.7 Marine Mammals	•				•					
6.8 Sea Turtles	•				•					
7.1 Demographics, Employment, and Economics								•	•	•
7.2 Environmental Justice								•	•	•
7.3 Cultural, Historical, and Archaeological Resources				•		•	•			
7.4 Visual Resources		•	•			•				
7.5 Recreation and Tourism								•		
7.6 Commercial Fisheries & For Hire Recreational Fishing				•	•					
7.7 Land Use and Coastal Infrastructure								•		
7.8 Navigation and Vessel Traffic				•	•					
7.9 Other Uses (Includes Aviation)		•	•		•					
8.0 Non-Routine & Low Probability Events								•		

Table 3.2-2 New England Wind Offshore Maximum Envelope Parameters

LAYOUT/PERMITTED POSITIONS	PHASE 1	PHASE 2	BOTH PHASES[1]
Maximum Total Number of WTG and ESP Positions	64	88	130
Area	231 km^2 (57,081 acres)	303 km^2 (74,873 acres)	453 km^2 (111,939 acres)
WIND TURBINE GENERATORS			
Maximum Number of WTGs	62	88	129
Maximum Tip Height above Mean Lower Low Water (MLLW)[2]	357 meters (m) (1,171 feet [ft])	357 m (1,171 ft)	357 m (1,171 ft)
Maximum Top of The Nacelle Height[3] above MLLW	221 m (725 ft)	221 m (725 ft)	221 m (725 ft)
Maximum Rotor Diameter	285 m (935 ft)	285 m (935 ft)	285 m (935 ft)
Minimum Tip Clearance above MLLW	27 m (89 ft)	27 m (89 ft)	27 m (89 ft)
WTG FOUNDATIONS			
WTG Foundation Concept Envelope	Most likely: • Monopiles (with or without transition pieces) • Other Foundation Options: • Piled jackets • Any combination of the above foundation types	• Monopiles (with or without transition pieces) • Jackets (with piles or suction buckets) • Bottom-frame foundations (with piles or suction buckets) • Any combination of the above foundation types	• Any combination of the Phase 1 and Phase 2 foundation types[4]

Table 3.2-2 New England Wind Offshore Maximum Envelope Parameters (Continued)

WTG FOUNDATIONS	PHASE 1	PHASE 2		BOTH PHASES[1]
Monopile Foundations				
Maximum Scour Protection Height	3 m (9.8 ft)	3 m (9.8 ft)		3 m (9.8 ft)
Maximum Area of Scour Protection per Monopile	4,072 square meters (m^2) (1.0 acres)	4,778 m^2 (1.2 acres)		See Table 1 of Appendix III-T for the maximum area of scour protection for New England Wind[5]
Maximum Number of Monopiles Installed per Day (24 hours)	2	2		2
Maximum Monopile Diameter at Base[4]	12 m (39 ft)	13 m (43 ft)		**Phase 1:** 12 m **Phase 2:** 13 m
Jacket Foundations	**Piled (3-4 Piles)**	**Piled (3-4 Piles)**	**Suction Bucket (3 Buckets)**	
Maximum Scour Protection Height	3 m (9.8 ft)	3 m (9.8 ft)	3 m (9.8 ft)	3 m (9.8 ft)
Maximum Area of Scour Protection per Jacket	4,624 m^2 (1.1 acres)	4,624 m^2 (1.1 acres)	6,369 m^2 (1.6 acres)	See Table 1 of Appendix III-T for the maximum area of scour protection for New England Wind[5]
Maximum Number of Piled Jackets Installed per Day (24 hours)	1 (up to 4 pin piles)	1 (up to 4 pin piles)	N/A	1 piled jacket (up to 4 pin piles)
Maximum Pile Diameter at Base	4 m (13 ft)	4 m (13 ft)	N/A	4 m (13 ft)[4]

Table 3.2-2 New England Wind Offshore Maximum Envelope Parameters (Continued)

WTG FOUNDATIONS	PHASE 1	PHASE 2		BOTH PHASES[1]
Bottom-Frame Foundations	**N/A**	**Piled (3 Piles)**	**Suction Bucket (3 Buckets)**	
Maximum Scour Protection Height	N/A	3 m (9.8 ft)	3 m (9.8 ft)	**Phase 2 only:** 3 m (9.8 ft)
Maximum Area of Scour Protection per Bottom-Frame	N/A	6,862 m^2 (1.7 acres)	9,754 m^2 (2.4 acres)	See Table 1 of Appendix III-T for the maximum area of scour protection for New England Wind[5]
Maximum Number of Piled Bottom-Frame Foundations Installed per Day (24 hours)	N/A	1 (up to 3 pin piles)	N/A	**Phase 2 only:** 1 piled bottom-frame foundation (up to 3 pin piles)
Maximum Pile Diameter at Base	N/A	4 m (13 ft)	N/A	**Phase 2 only:** 4 m (13 ft)
ELECTRICAL SERVICE PLATFORMS				
Maximum Number of ESPs	2	3		5
Maximum Height of Topside above MLLW[6]	70 m (230 ft)	70 m (230 ft)		70 m (230 ft)
ESP FOUNDATIONS				
ESP Foundation Concept Envelope	Monopiles or piled jackets	Monopiles or jackets (piled or suction bucket)		Monopiles, piled jackets, or suction bucket jackets (Phase 2 only)
Monopile Foundations				
Maximum Scour Protection Height	3 m (9.8 ft)	3 m (9.8 ft)		3 m (9.8 ft)
Maximum Area of Scour Protection per Foundation	4,072 m^2 (1.0 acres)	5,027 m^2 (1.2 acres)		See Table 1 of Appendix III-T for the maximum area of scour protection for New England Wind[5]

Table 3.2-2 New England Wind Offshore Maximum Envelope Parameters (Continued)

ESP FOUNDATIONS	PHASE 1	PHASE 2		BOTH PHASES[1]
Maximum Number of Monopiles Installed per Day (24 hours)	2 (up to 2 total monopiles for WTGs and ESPs)	2 (up to 2 total monopiles for WTGs and ESP)		2 (up to 2 total monopiles for WTGs and ESPs)
Maximum Monopile Diameter at Base	12 m (39 ft)	13 m (43 ft)		**Phase 1:** 12 m for 2 ESPs **Phase 2:** 13 m for 3 ESPs[4]
Jacket Foundations	**Piled (3-12 Piles)**	**Piled (3-12 Piles)**	**Suction Bucket (3-6 Buckets)**	
Maximum Scour Protection Height	3 m (9.8 ft)	3 m (9.8 ft)	3 m (9.8 ft)	3 m (9.8 ft)
Maximum Area of Scour Protection per Jacket	6,023 m^2 (1.5 acres)	9,953 m^2 (2.5 acres)	21,316 m^2 (5.3 acres)	See Table 1 of Appendix III-T for the maximum area of scour protection for New England Wind[5]
Maximum Number of Piled Jackets Installed per Day (24 hours)	1 (up to 4 pin piles)	1 (up to 4 pin piles)	N/A	1 piled jacket (up to 4 pin piles)
Maximum Pile Diameter at Base	4 m (13 ft)	4 m (13 ft)	N/A	4 m (13 ft)[4]
INTER-ARRAY AND INTER-LINK CABLES				
Maximum Length of Inter-array Cables	~225 km (~121 nautical miles [NM])	~325 km (~175 NM)		~475 km (~256 NM)
Maximum Length of Inter-link Cables[7]	~20 km (~11 NM)	~60 km (~32 NM)		~80 km (~43 NM)
Maximum Area of Cable Protection	0.04 km^2 (11 acres)	0.07 km^2 (17 acres)		0.10 km^2 (25 acres)

Table 3.2-2 New England Wind Offshore Maximum Envelope Parameters (Continued)

OFFSHORE EXPORT CABLES	PHASE 1	PHASE 2	BOTH PHASES[1]
Maximum Number of Export Cables	2	3	5
Maximum Total Length of Offshore Export Cables	For two cables: ~202 km (~109 NM)	For three cables:[8] ~356 km (~192 NM)	For five cables:[8] ~558 km (~301 NM)
Maximum Area of Cable Protection[9]	For two cables: 0.10 km^2 (24 acres)	For three cables (with and without Phase 2 OECC Western Muskeget Variant): 0.15–0.17 km^2 (37–43 acres)	For five cables (with and without Phase 2 OECC Western Muskeget Variant): 0.25–0.27 km^2 (61–67 acres)

Notes:

1. Due to the range of buildout scenarios for Phases 1 and 2, the sum of the maximum size of Phase 1 and Phase 2 does not equal the total maximum size of New England Wind.
2. MLLW is the average height of the lowest tide recorded at a tide station each day during the recording period. Elevations relative to Mean Higher High Water (MHHW) are approximately 1 m (3 ft) lower than those relative to MLLW.
3. Height includes aviation lights and other appurtenances.
4. See Section 6.7 for details on the number of each foundation type modeled in the hydroacoustic impact assessment for marine mammals and sea turtles.
5. The maximum area of scour protection for New England Wind is based on the combination of WTG and ESP foundation types that gives the largest potential area of scour protection throughout New England Wind.
6. Maximum height of ESP topside includes possible helideck but does not include antennae.
7. Inter-link cables may not be needed.
8. Based on the installation of all offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable. Should any Phase 2 cables be installed within the Western Muskeget Variant, the total length of offshore export cables would be shorter.
9. The maximum area of cable protection for the offshore export cables within both the SWDA and OECC.

4.0 SUMMARY OF POTENTIAL BENEFITS, IMPACTS, AND MITIGATION MEASURES

4.1 New England Wind Benefits

As described in Section 1, the purpose of New England Wind is to generate commercially sustainable offshore wind energy from Lease Area OCS-A 0534 located in the federally designated Massachusetts Wind Energy Area (MA WEA) to meet New England's need for clean, renewable energy and the Biden Administration's target of 30 gigawatts (GW) of offshore wind by 2030. New England Wind will be developed in two phases that will deliver over 2,000 MW of clean energy to New England.

New England Wind will reduce greenhouse gas emissions, enhance energy security by increasing the reliability and diversity of the regional energy supply, and achieve significant health and environmental benefits. New England Wind will also generate large numbers of well-paying jobs and other economic benefits in the Northeastern US. These benefits, which are discussed in greater detail below, will extend across the development period, the construction period, the multi-decade operating period, and the future decommissioning effort.

4.1.1 Energy Reliability and Diversity Benefits

New England Wind will decrease reliance on fossil fuels and enhance the reliability and diversity of the energy supply in the Northeastern US. This is particularly important given that several power plants have recently retired or are slated for retirement, including:

- Mount Tom Station (Holyoke, MA): 147 MW, shut down in 2014;
- Vermont Yankee Nuclear Power Plant (Vernon, VT): 604 MW, shut down in 2014
- Salem Harbor Station (Salem, MA): ~750 MW, shut down in 2014
- Brayton Point Power Plant (Somerset, MA): ~1,600 MW, shut down in 2017;
- Pilgrim Nuclear Power Plant (Plymouth, MA): ~670 MW, shut down in 2019;
- Bridgeport Harbor Station (Bridgeport, CT): 170 MW retired in 2012 and 410 MW retired in 2021; and
- Mystic Station (Everett, MA): ~2,000 MW, planned for closure in 2024.

In addition, other plants are approaching their normal end of life, making it important for other energy generation alternatives to fill the gap. ISO-NE has identified over 5,000 MW of oil and coal capacity "at risk" for retirement in the coming years (ISO 2020).

New England Wind will be a major source of clean, renewable electric power. Each Phase's wind turbine generators (WTGs) will be among the most efficient renewable energy generators commercially available for offshore use at the time of construction. Accordingly, each Phase is expected to operate at an annual capacity factor of approximately 50%. The Proponent's engineers have estimated that Phase 1 will deliver at least some energy from the WTGs more than 95% of the time. Summer offshore wind patterns will allow New England Wind to produce substantial power during summer afternoons/early evenings, which are typical peak power demand periods. New England Wind will also reduce winter electricity price spikes because of the WTGs' high and stable winter capacity factor.

New England Wind will enhance energy supply diversity, and as a wind energy resource, will not be affected by possible cold weather gas limitations or supply shortages.

4.1.2 Economic and Community Benefits

New England Wind is expected to generate numerous economic and community benefits across the Northeastern US. New England Wind will be developed in two phases that will deliver over 2,000 MW of clean energy to New England.

Prior to the submission of the COP in July 2020, New England Wind entered into a Power Purchase Agreement (PPA) with electric distribution companies in Connecticut and, following COP submission, with electric distribution companies in Massachusetts; these PPAs totaled 2,036 MW. The Proponent has agreed with the electric distribution companies in Connecticut and Massachusetts to terminate the Phase 1 and Phase 2 PPAs to enable New England Wind to participate in future offshore wind solicitations by Northeast states including, but not limited to, recent multi-state solicitations issued by Massachusetts, Rhode Island, and Connecticut in Fall 2023. These actions are necessary to address global circumstances beyond New England Wind's control that have significantly increased costs.

The Proponent remains committed to the development and permitting of both phases of New England to enable the projects to assist the federal government and the states of Connecticut, Massachusetts, and Rhode Island to meet climate and renewable energy/offshore wind goals. Massachusetts, Connecticut, and Rhode Island have all issued solicitations in Fall 2023 for additional offshore wind capacity that collectively total 6.8 GW. These three states have also signed a memorandum of understanding to allow developers to submit multi-state bids, and for the states to collaborate on their procurement decisions. The Proponent intends to submit one or more proposals for this, and if necessary, future solicitation(s).

The economic estimates presented below for Phase 1 and Phase 2 are based on the previous awards and are considered representative of potential benefits that will occur as a result of new Power Purchase Agreement(s). Further, development of additional renewable energy capacity within New England Wind (i.e., beyond the 2,036 MW previously awarded) would result in economic and workforce benefits that would be additive to those described below.

To determine the anticipated economic benefits for Phase 1 of New England Wind, the Proponent relied on a comprehensive analysis conducted by the University of Connecticut's Connecticut Center for Economic Analysis (CCEA). To determine the anticipated economic benefits of Phase 2, the Proponent relied on a comprehensive analysis conducted by Daymark Energy Advisors. These analyses are provided in Appendix III-L.

Economic and community benefits from New England Wind will occur throughout the pre-construction, construction, operations and maintenance (O&M), and decommissioning period and include:[10]

1. **Existing Employment Opportunities (Phases 1 and 2):** The Proponent currently operates offices in Bridgeport, Connecticut and Boston, Massachusetts and has many full-time professionals working on design, permitting, and financing efforts. The Proponent has already engaged a number of environmental consultants, engineers, and attorneys to support elements of the design effort, licensing, and permitting (see Section 7.1.2). In addition, the Proponent's extensive offshore survey campaigns over the past several years have drawn on support services from across the southeastern Massachusetts region, including services such as vessel maintenance and repair, fuel and provisioning, protected species observers, inspection and health, safety, and environmental (HSE) consulting, and pilotage.

2. **New Employment Opportunities (Phases 1 and 2):** Based on comprehensive analyses described in Appendix III-L, the buildout of Phase 1 and Phase 2 of New England Wind is estimated to support a minimum of 3,366 direct full-time equivalent (FTE) job years[11] during pre-construction and construction. Associated spending during these periods for Phase 1 and Phase 2 is estimated to generate and support at least 4,920 indirect and induced jobs from direct payroll and non-payroll expenditures. Construction of Phase 1 and Phase 2 is also estimated to generate at least ~$826 million in total Direct Labor Income and at least ~$1.2 billion in total Direct Expenditures (other than payroll).

   A minimum buildout of Phase 1 and Phase 2 of New England Wind will create a number of well-paying, long-term jobs and generate tens of millions of dollars per year in economic development opportunities. Based on the analysis in Appendix III-L, O&M[12] of New England Wind's offshore facilities are projected to generate at least 131 direct FTEs annually for a total of 3,930 FTE job years assuming a 30-year operational life. Direct and

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[10] All funding commitments for Phase 1 (e.g. the Supply Chain Network Initiative and the Connecticut Windward Workforce Initiative) are subject to Park City Wind achieving financial close unless other arrangements are made between the Proponent and potential project partners.

[11] One FTE job is the equivalent of one person working full time for 1 year (2,080 hours).

[12] The numbers cited here are a summation of the O&M impacts for Phase 1 and Phase 2.

indirect impacts are expected to support at least 239 indirect and induced jobs annually (7,170 FTE job years) during operations of Phase 1 and Phase 2. New England Wind is also estimated to generate at least ~$35 million in Annual Labor Income and at least ~$40 million in Annual Expenditures during O&M of both Phases combined. See Section 7.1.2 and Appendix III-L for further discussion of the workforce benefits from New England.

3. **Sourcing Local Goods and Using Local Facilities (Phases 1 and 2):** New England Wind will utilize existing port facilities or port facilities developed by other entities with the capacity to host construction and O&M activities under the Phase 1 or Phase 2 schedule (see Sections 3.2.2.5, 3.2.2.6, 4.2.2.5, and 4.2.2.6 of COP Volume I). For Phase 1, the Proponent will likely establish a long-term service operation vessel O&M base in Bridgeport, Connecticut. The Proponent has also worked with its local partner, Vineyard Power, and the communities of Martha's Vineyard with the intention to base certain O&M activities on Martha's Vineyard.

   New England Wind will create opportunities for new market growth in sectors servicing the offshore wind industry along the US East Coast. Construction and operation will create opportunities for area marine trades industries (e.g. tug charters, other vessel charters, dockage, fueling, inspection/repairs, provisioning, etc.). The Proponent also expects that it will expend significant funds procuring materials and services from suppliers in the Northeastern US to support the development and construction of New England Wind. To the extent feasible, construction materials and other supplies, including vessel provisioning and servicing, will be sourced from within the region. Some New England Wind components may also be fabricated in the Northeastern US. Additionally, New England Wind anticipates sourcing many goods and services throughout the multi-decade O&M period from local and regional providers.

4. **Nantucket Offshore Wind Community Fund (Phases 1 and 2):** The Proponent's Good Neighbor Agreement with the Town and County of Nantucket, the Maria Mitchell Association, and the Nantucket Preservation Trust (collectively the "Nantucket Parties") establishes a long-term relationship with the Nantucket Parties and more generally, the Nantucket community, to support and promote the parties' mutual interests in renewable energy development, combating the effects of global climate change, enhancing coastal resiliency, and protecting, restoring, and preserving cultural and historic resources. In accordance with the agreement, the Nantucket Parties will establish the Nantucket Offshore Wind Community Fund, which will support projects and initiatives related to protecting, restoring, and preserving cultural and historic resources, coastal resiliency, climate adaptation, and renewable energy. Phase 1 and Phase 2 of New England Wind will each contribute $3 million to the Nantucket Offshore Wind Community Fund at financial close.

   Host Community Agreement (HCA) with the Town of Barnstable: In May 2022, the Town of Barnstable and the Proponent entered into an HCA for Park City Wind. As part of the agreement, the Proponent will pay the Town $16 million as a host community fee, above and beyond the applicable commercial taxes that will be assessed by the Town. Additionally, the Proponent will limit construction at the beach and along roadways to the non-summer months and will restore the parking lot used for temporary staging to its existing condition. The Proponent has also committed to taking extra measures, above and beyond standard engineering practice, to protect groundwater in Barnstable.

The Town of Barnstable will support electric transmission cables from the project from the landfall site and underground along Town roads to the new substation site. The Proponent will coordinate with the planned installation of a municipal sewer line along the onshore route to minimize disruption and defray some of the Town's sewer line roadwork costs.

For Commonwealth Wind, the Proponent expects to negotiate and ultimately execute an HCA with the Town of Barnstable to provide funding to the Town to offset potential impacts associated with hosting the onshore facilities. The Proponent anticipates that this HCA will contain similar terms to those in the HCA for Park City Wind.

5. **Tax Benefits and Payments (Phases 1 and 2):** New economic activity generated by New England Wind can reasonably be expected to result in a substantial positive impact on state and local tax receipts. Impacts include increased personal income tax, payroll tax, sales tax, property tax, corporate tax, and other fee and tax revenues paid by the Proponent, its employees, and contractors (direct impacts) and taxes generated through the economic activities created in other areas of the economy through indirect and induced impacts. Phase 1 is projected to bolster Connecticut state and local tax revenues by $238 million during O&M. Commonwealth Wind is expected to generate $98.8 million in tax benefits to governments within Massachusetts over the capital expenditure and 30-year operation period.

   In accordance with the stipulations in Lease OCS-A 0534, the Proponent will make substantial annual lease and operating fee payments to the Federal Treasury. Prior to commercial operations, the Proponent makes annual lease payments of $304,770 to the federal government. Once operations begin, the Proponent will make annual operating fee payments in accordance with the terms of the Lease.

   In addition, the Proponent will pay several permitting fees associated with permitting New England Wind. For example, the Proponent has proposed a minimum Ocean Development Mitigation Fee of $287,500 for Park City Wind, subject to adjustment based on final as-built impact calculations. This fee will be finalized during Massachusetts Environmental Policy Act review at the state level. As an element of New England Wind's Massachusetts Chapter 91 License, the Proponent will also pay a Tidelands Occupation Fee to Massachusetts (for reference, the fee for Vineyard Wind 1 was $1,978,980, subject to adjustment based on final as built impact calculations).

6. **Partnerships with Educational Institutions (Phases 1 and 2):** The Proponent is committed to working cooperatively with Connecticut educational institutions, including the University of Bridgeport and the Connecticut State Colleges and Universities. The Proponent will also continue to work cooperatively with southeastern Massachusetts educational institutions, such as the Massachusetts Maritime Academy, University of Massachusetts Dartmouth, Bristol Community College, Cape Cod Community College, and others to maintain and further evolve training and educational opportunities for their students and faculty throughout each Phase of New England Wind (see Section 7.1.2.1).

7. **Supply Chain Network Initiative (Phase 1):** The Proponent is committing to invest up to $9 million in projects and initiatives to accelerate the development of the offshore wind supply chain and businesses. This initiative aims to develop and establish a Connecticut supply chain database and facilitate further development of the local offshore wind supply chain in Connecticut. In doing so, the Supply Chain Network Initiative supports the State's goals to expand the offshore wind economy, encourage local businesses to join the offshore wind supply chain, and create jobs in distressed communities. See Section 7.1.2 and Appendix III-O for additional details.

8. **Connecticut Windward Workforce Initiative (Phase 1):** The Proponent has committed up to $5 million to educate, recruit, mentor, and train residents of Connecticut, particularly Bridgeport, for careers in the offshore wind industry. These programs will ensure that Connecticut is able to provide the workforce needed for Phase 1 as well as all future offshore wind projects in the US. The experience gained from working on Phase 1 will be invaluable in launching careers in offshore wind for Connecticut residents. The ultimate objective of the Windward Workforce program is to ensure Connecticut has one of the best trained, most experienced offshore wind workforces in the country. The Connecticut Windward Workforce Initiative will be undertaken in partnership with vocational schools, community colleges, local businesses, unions, and others. See Section 7.1.2 and Appendix III-O for further details.

9. **Reduced Costs for Electricity Customers (Phase 1 and 2):** The Proponent engaged Leidos Engineering LLC, as Independent Transmission Consultant, to analyze the impact of Phase 1's offshore wind energy generating facility on the ISO-NE system and ISO-NE administered energy markets, including the potential demand cost savings. Based on the resulting study, Phase 1 is expected to reduce the load-weighted Locational Marginal Prices across ISO-NE, largely driven by the reduced generation by natural gas power plants in winter months when gas prices are highest. The lower Locational Marginal Prices will result in System Demand Cost savings for Load Serving Entities purchasing power from ISO-NE to serve demand. The annual Demand Cost Savings as a result of Phase 1 are estimated at $76 million across ISO-NE. Over the projected 30-year life of Phase 1, it will save the ISO-NE system approximately $2.28 billion. Phase 2 is likewise expected to result in a reduction in winter energy price spikes.

10. **Recreational Opportunities (Phases 1 and 2):** New England Wind may provide additional recreational opportunities. The WTG and electrical service platform (ESP) foundations may become popular fishing locations, and recreational fishing activities may increase. Angler's interest in visiting the Southern Wind Development Area (SWDA) may also lead to an increased number of fishing trips out of nearby ports, which could support an increase in angler expenditures at local bait shops, gas stations, and other shore side dependents (Kirkpatrick et al. 2017). New England Wind may become a popular tourist destination that could provide opportunities for sightseeing vessel operations. See Section 7.5.2.2 for additional information.

11. **Community Benefits Agreement with Vineyard Power (Phases 1 and 2):** The Proponent has a Community Benefits Agreement with Vineyard Power Cooperative (Vineyard Power), which is a community-owned 501(c)(12) non-profit based on the island of Martha's Vineyard. This partnership has enabled significant input into the New England Wind design process from members of the local community, such that the design addresses local concerns and enhances opportunities for local benefits.

12. **Furthering the Development of an Important Industry (Phases 1 and 2):** New England Wind will play an important role in further establishing a thriving, commercial-scale offshore wind sector in the US. The Proponent is committed to working with the Bureau of Ocean Energy Management (BOEM), the State of Connecticut, the Commonwealth of Massachusetts, local and regional officials, and other stakeholders to realize the tremendous potential economic benefits of the rapidly emerging offshore wind industry in Connecticut, Massachusetts, and elsewhere the Northeastern US.

13. **Investments in Diversity, Equity, and Inclusion (DEI) (Phase 2):** The DEI Plan for Commonwealth Wind includes $15 million to fund DEI, workforce, and supply chain initiatives that will support local content, increase diversity in the industry, and provide Environmental Justice (EJ) Population residents and other underrepresented populations real opportunities to join the offshore workforce and supply chain. To execute the DEI Plan, the Proponent has partnered with a diverse group of nonprofit partners located throughout Massachusetts. As part of the DEI Plan, the Proponent will also leverage its "buying power" through Commonwealth Wind's procurement process to ensure DEI is advanced by its industry partners and becomes a core value of the offshore wind sector as it is established in the U.S.

14. **Community Benefits, Environmental Benefits, and Innovation Initiatives (Phase 2):** Commonwealth Wind includes an investment of $20 million in education, innovation, and environmental initiatives to benefit local communities. The Proponent has developed meaningful partnerships, including several with local nonprofits, to provide wide-ranging economic and job opportunities as well as new opportunities for EJ Population residents to directly benefit from offshore wind.

15. **Transforming Coal-Fired Power Plants into Clean Energy Centers (Phase 2):** Commonwealth Wind includes two transformative initiatives that convert former coal-fired power plant sites into clean energy centers. The Proponent has partnered with Prysmian Group, a leading international subsea cable manufacturer which intends to build a state-of-the-art manufacturing facility for subsea transmission cables at Brayton Point, the former coal-fired power plant in Somerset, Massachusetts. Commonwealth Wind also enables Crowley Marine, in partnership with the City of Salem, to redevelop 42 acres surrounding Salem Harbor Station to serve as an offshore wind assembly and turbine staging port for the project. These ports will provide an anchor for building long-term jobs to service this new industry.

4.1.3 Environmental Benefits

New England Wind has significant environmental benefits:[13]

1. **Large Reductions in Greenhouse Gas and Other Pollutants Emissions (Phases 1 and 2):** New England Wind will be developed in two phases that will deliver approximately 2,600 MW of zero-carbon electric power to New England. The electricity generated by the WTGs, which do not emit air pollutants, will displace electricity generated by fossil fuel power plants and significantly reduce emissions from the ISO-NE electric grid over the lifespan of New England Wind. Based on air emissions data conservatively assessed for approximately 2,000 MW of New England power generation facilities,[14] New England Wind is expected to reduce carbon dioxide equivalent (CO_2e) emissions from the electric grid by approximately 3.93 million tons per year (tpy), or the equivalent of taking 775,000 cars off the road. Nitrogen oxide(NOx) and sulfur dioxide (SO_2) emissions are expected to be reduced by ~2,103 tpy and ~1,117 tpy, respectively. See Section 5.1.2.2 for additional discussion of New England Wind's air quality benefits.

   As noted in Section 4.1.1, New England Wind will significantly decrease the region's reliance on fossil fuels. Power from Phase 1 will enable Connecticut to meet the state's renewable energy requirements, including Connecticut Public Act No. 18-82, "An Act Concerning Climate Change Planning and Resiliency," which requires the state to reduce greenhouse gas emissions from 2001 levels 45% by 2020 and 80% by 2050. Power from Phase 2 will also contribute to Massachusetts' target of reducing carbon dioxide emissions

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13 All funding commitments for Phase 1 (e.g. the Offshore Wind Protected Marine Species Mitigation Fund, funding for Connecticut's Initiative on Environmental Research of Offshore Wind, and funds for Environmental, Fisheries, and Local Community Enhancement) are subject to Park City Wind achieving financial close unless other arrangements are made between The Proponent and potential project partners.

14 The avoided emissions analysis conservatively assumes a minimum total capacity for both Phases of New England Wind of approximately 2,000 MW; however, it is likely that benefits will be greater than those reported. The analysis is based on Northeast Power Coordinating Council (NPCC) New England 2018 emission rates from EPA's Emissions & Generation Resource Integrated Database eGRID2018(v2) released in March 2020.

by 50% by 2030. Additional capacity from New England Wind may also be available to assist one or more Northeastern states and/or other offtake users in meeting their renewable energy goals.

A reduction in carbon emissions and other greenhouse gas emissions that induce climate change will have wide-reaching benefits for terrestrial, avian, and marine life as well as the human environment. The effects of climate change on human health and the environment include sea level rise and population displacement, property damage from floods, shifts in species' distributions worldwide (Simmonds and Issac 2007), changes in agricultural productivity, increases in energy system costs (e.g. air conditioning costs), and impacts to water security, food security, and nutrition. By reducing regional reliance on fossil fuels, New England Wind will help mitigate additional climate change damages. Furthermore, New England Wind will reduce emissions that contribute to acid rain, ocean acidification, and ground level ozone/smog, which can damage sensitive ecosystems and other resources, as well as air contaminants (e.g. NOx and SO_2), which lead to early death, heart attacks, respiratory disorders, stroke, and exacerbation of asthma.

2. **Offshore Wind Protected Marine Species Mitigation Fund (Phase 1):** The Proponent has committed to provide up to $2.5 million to the Mystic Aquarium in Connecticut to continue evolving the understanding of underwater noise generated by offshore wind projects and the potential impacts on cetatcean and pinniped behavior, hearing, and physiology. In addition, this fund will further the investigation of best practices and advance technologies to reduce potential sound impacts and collision threats from offshore wind project development (see Section 7.1.2 and Appendix III-O).

3. **Connecticut's Initiative on Environmental Research of Offshore Wind (Phase 1):** The Proponent has committed to provide up to $2.5 million to support fisheries research and education as part of a new initiative launched by the University of Connecticut to improve the understanding of potential environmental impacts from offshore wind (see Section 7.1.2 and Appendix III-O).

4. **Environmental, Fisheries, and Local Community Enhancement (Phase 1):** The Proponent will allocate up to $7.5 million in funds to support environmental initiatives, assist Connecticut fishermen, and further bolster local communities where offshore wind development activities are taking place (see Section 7.1.2 and Appendix III-O).

5. **Potential Coordination of Onshore Construction with Barnstable Sewer Projects (Phase 1):** To the extent requested by the Town of Barnstable, the Proponent will work with the Town to coordinate the sequencing of Park City Wind's onshore cable installation with the Town's proposed sewer installation project. This collaboration would enable the Town to build necessary wastewater infrastructure alongside Phase 1's onshore facilities, which would result in significant cost savings for the Town and significantly reduce community disturbance. The Town's planned sewer expansion is an important tool to

address wastewater discharge and nutrient loading, which are among the most pressing local environmental issues on Cape Cod, and has the potential to greatly improve water quality in resources such as Wequaquet Lake. See Appendix III-O for additional details.

6. **Offshore Wind Challenge (Phases 1 and 2):** A previous partnership with Greentown Labs, North America's largest climate tech incubator, resulted in an accelerator program that advanced innovations in the responsible development of offshore wind energy, with support from MassCEC. The Offshore Wind Challenge focused on marine mammal monitoring, specifically for data collection and real-time transmission or data analysis. During the program, three companies—SICDRONE, Night Vision Technology Solutions, and Open Ocean Robotics—worked with the program partners to receive extensive mentoring, business training, and access to resources to advance their technological and commercial development.

7. **Other Resource Studies and Monitoring Programs (Phases 1 and 2):** The Proponent is committed to supporting scientific research focused on improving best practices and expanding fact-based understanding of the risks and benefits associated with offshore wind project development. The Proponent supports the concept of developers providing scientific, technical, and financial support for regional studies. In fact, the Proponent is actively participating in the Responsible Offshore Science Alliance (ROSA) as well as the Regional Wildlife Science Effort (RWSE).

   a. **Fisheries Studies:** The Proponent is committed to fisheries science and research as it relates to offshore wind energy development. Working with the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST), the Proponent is already collecting pre-construction fisheries data (via trawl and drop camera surveys) within the SWDA. The Proponent plans to develop a framework for during and post-construction fisheries studies within the SWDA. The Proponent expects the development of the fisheries studies will be undertaken in coordination with other offshore wind energy developers, BOEM, federal and state agencies, fisheries stakeholders, academic institutions, and other stakeholders. The Proponent is already engaging in collaboration with other developers, fishing industry representatives, and state and federal agencies through its participation in ROSA and the RWSE.

      In partnership with Vineyard Wind 1, the New England Aquarium's Anderson Cabot Center for Ocean Life studied highly migratory species presence across the Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) based on a desktop review and input from the pelagic recreational fleet. The study determined that recreational effort for highly migratory species is widespread throughout southern New England, with the highest levels of recreational fishing activity occurring to the west of the MA WEA and RI/MA WEA in the waters south and east of Montauk Point and Block Island (Kneebone and Capizzano 2020). This study resulted in an additional funding proposal from INSPIRE

Environmental in partnership with the New England Aquarium to the Massachusetts Clean Energy Center (MassCEC) to support a two-year acoustic tagging and tracking study of highly migratory species at recreational fishing hotspots in the MA WEA and RI/MA WEA that were identified in the initial study. The Proponent, in conjunction with other offshore wind developers, plans to further support this study effort by deploying additional receivers in their lease areas.

The survey and monitoring work that the Proponent will conduct will generate a substantial body of environmental, fisheries, and other data, all of which will be available in the public domain in a manner consistent with other academic research. Much of the data is publicly available through the federal and state permitting process, as well as reports or academic publications that may come out of the survey or monitoring work. The Proponent also plans to make all fisheries monitoring data generated publicly available on its website. For other environmental and fisheries data, the Proponent will explore cost-effective and appropriate ways to store and make data publicly available and easy to access. Through ROSA and the RWSE, the Proponent will work with fishermen, regulators, stakeholders, and neighboring developers to find ways to streamline and standardize available data across all offshore efforts.

b. **Avian Monitoring Program:** Biodiversity Research Institute conducted 16 (October 2018 to September 2019) monthly/bi-monthly boat surveys in the SWDA, from which detection corrected density estimates were calculated for each marine bird species encountered. Further details on each data set are available in Appendix III-C. The Proponent is also developing a framework for a post-construction monitoring program for birds. See Section 6.2 for additional details.

c. **Marine Mammal and Sea Turtle Monitoring:** Sections 6.7 and 6.8 describe the monitoring and mitigation measures that will be utilized for marine mammals and sea turtles. As practicable, monitoring, clearance, and/or exclusion zones will be established to minimize and avoid potential impacts of underwater sound on marine mammals during pile driving. A monitoring zone may be established during impact pile driving to monitor and record marine mammal occurrence and behavior. Monitoring zones are monitored for marine mammals, but marine mammal presence does not necessarily trigger shutdown or other actions. These monitoring zones are useful for observing potential approach by marine mammals to exclusion zones and can inform understanding of and adaptive management for potential behavioral disturbance. Monitoring of clearance, exclusion, and/or monitoring zones during pile driving will be conducted by National Marine Fisheries Service (NMFS)-approved protected species observers (PSOs) and the final requirements and data sharing will be determined in collaboration with BOEM and NMFS.

8. **Artificial Reef (Phases 1 and 2):** The addition of foundations and scour protection, as well as cable protection in some areas, may act as an artificial reef and provide rocky habitat previously absent from the area (see Sections 6.5 and 6.6). Increases in biodiversity and abundance of fish have been observed around WTG foundations due to attraction of fish species to new structural habitat (Raoux et al. 2017; Riefolo et al. 2016).

4.2 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures

The Proponent has thoroughly analyzed the potential impacts of New England Wind to physical, atmospheric, biological, economic, cultural, and historic resources and identified measures to avoid, minimize, and mitigate these impacts. In accordance with 30 CFR §585.621(d), New England Wind will not cause undue harm or damage to natural resources, human life or the human environment, wildlife, property, the marine environment, the coastal environment, or sites, structures, or objects with historical or archeological significance.

Table 4.2-1 summarizes New England Wind's potential impacts on these resources and environmental protection measures that are proposed to minimize adverse effects. Table 4.2-1 is not meant as an exhaustive description of the potential impacts. A more detailed discussion of New England Wind's potential impacts and associated avoidance, minimization, and mitigation measures can be found in Sections 5, 6, and 7. Low probability events are discussed in Section 8. The potential impacts of New England Wind summarized below should be considered in conjunction with New England Wind's energy reliability, economic, community, and environmental benefits described in Section 4.1.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Air Quality (Section 5.1)	Air emissions from the construction and operation of New England Wind will primarily come from the engines on marine vessels and will occur within the Southern Wind Development Area (SWDA), along the Offshore Export Cable Corridor (OECC), and along vessel routes to ports. Since the SWDA is located far offshore, the SWDA is situated to the southeast of the mainland, and prevailing winds are from the west, emissions within the SWDA are unlikely to affect any onshore areas. Vessel activities within the ports are within the realm of normal harbor activities and will likely contribute only a small fraction of air pollution that is already caused by marine vessel traffic within the ports. Air emissions during construction are temporary and will be quickly offset by reductions in emissions from the ISO New England (ISO-NE) electric grid during the operational period. The impacts of decommissioning on air quality are expected to resemble the impacts from construction, although equipment and vessels used for decommissioning will likely have lower-polluting engines (historically, emission standards for marine vessels have become increasingly stringent over time).	The electricity generated by the wind turbine generators (WTGs), which do not emit air pollutants, will displace electricity generated by fossil fuel power plants and significantly reduce emissions from the ISO-NE electric grid over the lifespan of New England Wind. New England Wind is expected to reduce carbon dioxide equivalent (CO_2e) emissions from the ISO-NE electric grid by ~3.93 million tons per year (tpy), or the equivalent of taking 775,000 cars off the road each year. Nitrogen oxide (NOx) and sulfur dioxide (SO_2) emissions are expected to be reduced by ~2,103 tpy and ~1,117 tpy, respectively. New England Wind will minimize emissions through the use of clean, low-sulfur fuels in compliance with applicable air pollution requirements. The engines and generators used for New England Wind will meet or emit less than the applicable on-road, non-road, and marine engine emission standards. Some offshore emissions from New England Wind are regulated through the Environmental Protection Agency's (EPAs) Outer Continental Shelf (OCS) Air Permit process. Emissions from OCS sources will likely need to meet applicable Massachusetts Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) limits. It is also expected that the Proponent will be required to offset applicable NOx and volatile organic compound (VOC) emissions by acquiring emissions offsets or other means acceptable to EPA. Overall, New England Wind will provide a net air quality benefit.
Water Quality (Section 5.2)	For both Phases of New England Wind, water quality impacts related to suspended sediments from cable installation, dredging, and other construction activities, such as horizontal directional drilling (HDD) or placement of scour protection, are expected to be short term and localized. Depending on site-specific conditions at each WTG and electrical service platform (ESP) position, seabed preparation may be required prior to scour protection or foundation installation. This could include the removal of large obstructions and/or leveling of the seabed. Such an activity may yield a temporary increase in suspended sediments; however, such impacts are anticipated to be a short-term and temporary due to the predominately sandy composition of the upper sediments in the SWDA.	The Proponent will require all vessels to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental spills. The Proponent has also developed a draft Oil Spill Response Plan for New England Wind, which is included in Appendix I-F. It is expected that nearly all vehicle fueling, and all major equipment maintenance, will be performed offsite at commercial service stations or a contractor's yard. Field refueling will not be performed within 30 meters (m) (100 feet [ft]) of wetlands or waterways, within 30 m (100 ft) of known private or community potable wells, or within any Town of Barnstable water supply Zone I area. Proper spill containment gear and absorption materials

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Water Quality (Section 5.2) (Continued)	The potential impacts to water quality via sediment resuspension from pile driving would be local to the pile outer diameter. Installation of suction bucket jackets or suction bucket bottom-frame foundations may similarly cause a temporary increase in suspended sediments, but such impacts are anticipated to be temporary. Modeling of cable installation activities, including dredging, indicates that suspended sediments will settle out within a matter of hours. Above-ambient total suspended solids (TSS) concentrations stemming from cable installation for the various model scenarios remain relatively close to the cable alignment, are constrained to the bottom of the water column, and are short-lived. For each Phase of New England Wind, some routine releases of liquid wastes are allowed to be discharged from vessels to marine waters in both the SWDA and OECC. These discharges include domestic water, uncontaminated bilge water, treated deck drainage and sumps, uncontaminated ballast water, and uncontaminated fresh or seawater from vessel air conditioning. As defined, these discharges will not pose a water quality impact. Other waste generation such as sewage, solid waste or chemicals, solvents, oils and, greases from equipment, vessels or facilities will be stored and properly disposed of on land or incinerated offshore and will not generate an impact.	will be maintained for immediate use in the event of any inadvertent spills or leaks. Any Phase 1 and Phase 2 onshore substation equipment will be equipped with full containment for any components containing dielectric fluid. See best management practices (BMPs) #1, #12, #37, #39, and #50 in Table 4.2-2.
Terrestrial Fauna, Including Inland Birds (Section 6.1)	For both Phases, due to the nature and location of the onshore facilities, impacts to terrestrial wildlife will largely be short-term and localized. Permanent loss of terrestrial habitat will be minimal, affecting approximately up to 0.012 square kilometers (km^2) (3.0 acres) of forested habitat at the Phase 1 onshore substation site, up to 0.004 km^2 (1 acre) for a potential access road to the Phase 1 onshore substation site, and up to 0.011 km^2 (2.8 acres) at Parcel #214-001. For Phase 2 the total area to be disturbed for the Clay Hill onshore substation site, including the substation development itself as well as site grading, and stormwater features along with associated access roads, will be approximately 0.06 km^2 (13.6 acres), which includes removal of the existing single-family residential structure. The total area of tree clearing associated with these activities will be approximately 0.05 km^2 (13.3 acres).. Taking into	The Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are sited primarily within public roadway layouts or existing utility rights-of-way (ROWs), thereby avoiding undisturbed forest interiors and other significant wildlife habitat. Specialty trenchless crossing methods are expected to be used where the Onshore Export Cable Routes and Grid Interconnection Routes traverse unique features such as busy roadways, wetlands, and waterbodies in order to avoid impacts to those features. For both Phases, at certain locations, expanded work zones and construction staging areas may be required to accommodate special construction equipment and materials. Wherever possible, these spaces will be located

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Terrestrial Fauna, Including Inland Birds (Section 6.1) Continued)	account the avoidance, minimization, and mitigation measures implemented to reduce impacts to terrestrial wildlife, population level impacts to terrestrial wildlife (including inland birds) near the onshore facilities are unlikely. For Phases 1 and 2, operations and maintenance (O&M) of onshore facilities under normal circumstances will not result in further habitat alteration or involve activities expected to have a negative impact on wildlife. Consequently, onshore O&M activities associated with Phases 1 and 2 are not anticipated to have population level impacts on terrestrial species.	Within previously developed areas, such as nearby parking lots, in order to avoid or minimize disturbance to naturally vegetated areas. Any previously undisturbed areas of wildlife habitat affected by expanded work zones or elsewhere along the Onshore Export Cable Routes and Grid Interconnection Routes will be restored in consultation with local officials. For construction within utility ROWs, any disturbed vegetated areas will be loamed and seeded to match pre-existing vegetation. For Phases 1 and 2, the Onshore Export Cable Routes and Grid Interconnection Routes are designed to provide points of access at the splice vaults. Maintenance and/or repairs are expected to take place primarily within these vaults, without disturbance to adjacent wildlife habitat. These measures will avoid or reduce any further impacts to terrestrial habitats and wildlife. See BMPs #24, 26, and #39 in Table 4.2-2.
Coastal and Marine Birds (Section 6.2)	The primary potential direct impact of each Phase to birds is mortality or injury due to collision with offshore WTGs. During construction, operations, and decommissioning of either Phase, coastal birds are expected to be ephemerally exposed during migration and marine birds are expected to be exposed during all seasons. Overall, coastal birds are expected to have **insignificant** to **potential** behavioral vulnerability. Of the coastal birds, shorebirds, peregrine falcons, and songbirds are the only species groups that may have **unlikely** exposure to the SWDA, and this will be limited to fall migration. Depending on the species, marine birds are expected to have a range of behavioral vulnerability and range of exposure to the SWDA. Of the marine birds, shearwaters and petrels, gulls, and auks were the species groups with **potential** exposure to the SWDA. During construction, operations, and decommissioning of either Phase, federally-listed species exposure is expected to be **insignificant** to **unlikely** and would largely be restricted to migration. Roseate terns are expected to	The SWDA is located within the Massachusetts Wind Energy Area (MA WEA), which was established by the Bureau of Ocean Energy Management (BOEM) through a multi-step process that involved significant agency and public input over a period of approximately six years. As described in Section 2.1 of COP Volume I, areas identified as important fishing areas and having high value sea duck habitat were excluded from the northeastern portion of the MA WEA (BOEM 2014). Effectively, the location of the SWDA minimizes and avoids exposure of birds to New England Wind's offshore wind energy generation facilities. During construction and O&M, the Proponent will reduce lighting as much as practicable. The Proponent will follow BOEM and Federal Aviation Administration (FAA) recommendations to use red aviation obstruction lights on WTGs (unless current guidance is modified by the FAA and BOEM by the time Phase 2 proceeds). In addition, when practicable, the Proponent will down-shield lighting or use down-lighting to limit bird attraction and

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Coastal and Marine Birds (Section 6.2) (Continued)	have **unlikely** exposure to the SWDA, **unlikely** vulnerability to collision, and **potential** to **likely** vulnerability to displacement. Piping plovers are expected to have **insignificant** to **unlikely** exposure and **insignificant** to **unlikely** vulnerability. Like roseate terns, piping plovers may be exposed during migration periods, though flight heights during migration are thought to be generally well above rotor swept zones (RSZs). Red knots are expected to have **insignificant** to **unlikely** exposure and **insignificant** to **unlikely** behavioral vulnerability.	Disorientation. For Phase 1, the Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent would expect to use the same or similar approaches to reduce lighting used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS. Use of ADLS would lessen the potential impacts of nighttime light on birds. Anti-perching is incorporated into the design of the WTGs using tubular support towers. In accordance with safety and engineering requirements, the Proponent will consider installing anti-perching devices on WTGs and ESP(s), where and if appropriate, to reduce potential bird perching locations. Using a standardized protocol for New England Wind, the Proponent will document any dead or injured birds found on vessels and structures during construction, O&M, and decommissioning. The Proponent is developing a draft Piping Plover Protection Plan for construction activities at either Phase 1 landfall site (see Appendix III-R). The Proponent expects to develop a similar plan for the Phase 2 landfall sites, if needed. Based on consultations with Natural Heritage and Endangered Species Program (NHESP) for Vineyard Wind 1 activities at the Covell's Beach landfall site, the Proponent expects that activities at the landfall sites will begin in advance of April 1, or will not begin until after August 31, to avoid and minimize noise impacts to piping plover during the breeding season. The Proponent is developing a framework for a post-construction monitoring program for birds and bats. The Proponent expects to model the framework based on the one developed for Vineyard Wind 1, allowing for the flexibility to include new technology and lessons learned. During decommissioning of both Phases of New England Wind, the Proponent will consider best practices available at the time to reduce any potential impacts to birds. See BMPs #24-27 in Table 4.2-2.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Bats (Section 6.3)	Potential impacts to bats during onshore construction and installation include habitat alteration and land disturbance. The onshore substation sites may serve as roosting or foraging habitat for bats, including northern long-eared bats. However, no known northern long-eared bat maternity roost trees or hibernaculum are located in the Town of Barnstable or surrounding towns (MA NHESP 2020). Agency consultation is ongoing for northern long-eared bat. This consultation will identify any necessary avoidance, minimization, and mitigation measures to protect bat species. During offshore construction, bats may be impacted by vessel lights, structure strikes hazard, and structure lights. Bats may be attracted to construction vessels (particularly if insects are drawn to the lights of the vessels) as well as WTGs and ESP(s) under construction (BOEM 2014). Overall, since there is little evidence to suggest that stationary objects pose significant risk to bats, behavioral vulnerability to collision is expected to be **insignificant**. As such, population level impacts are unlikely. During offshore O&M, bats may be impacted by vessel lights, structure strikes hazard, and structure lights. The exposure of cave-hibernating bats to the SWDA is expected to be **insignificant** to **unlikely** and would only occur rarely during migration when a small number of bats may occur in the MA WEA given its distance from shore (BOEM 2014). The exposure of cave-hibernating bats to the Offshore Development Area is expected to be **insignificant** to **unlikely** and would only occur on rare occasion during migration. Therefore, population level impacts to cave-hibernating bats are unlikely. Migratory tree bats have a higher potential to pass through the SWDA, but overall a small number of bats are expected in the SWDA given its distance from shore (BOEM 2014). Therefore, population level impacts are expected to be unlikely.	The Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are sited primarily within public roadway layouts or existing utility ROWs, thereby minimizing any potential impacts to bat habitat. The location of the New England Wind WTGs and ESP(s) far offshore avoids exposure of bats. During construction and O&M, the Proponent will reduce lighting to the extent practical to minimize attraction of bats. For Phase 1, the Proponent expects to use an ADLS that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent expects to use the same or similar approaches to reduce lighting used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS. Use of ADLS would lessen the potential impacts of nighttime light on bats. The Proponent is developing a framework for a post-construction monitoring program for birds and bats. The Proponent expects the framework to be modeled off of the framework developed for Vineyard Wind 1, but it will allow for the flexibility to include new technology and lessons learned. Best practices available at the time of decommissioning will be discussed with BOEM and the USFWS to avoid and minimize potential impacts to bats.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Coastal Habitats (Section 6.4)	At either Phase 1 landfall site, the ocean-to-land transition is expected to be completed by two HDD paths that are 300–365 m (1,000–1,200 ft) in length, though the final length will be refined through the ongoing engineering processes. This will avoid direct impacts to the beach, intertidal zone, and nearshore areas. At the Phase 2 Dowses Beach Landfall Site, HDD is also expected to be used for the ocean-to-land transition to avoid or minimize direct impacts to the beach, intertidal zone, and nearshore areas. The Phase 2 Wianno Avenue Landfall Site would use HDD or open trenching. However, New England Wind only expects to use the Wianno Avenue Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all of some of the Phase 2 offshore export cables. Regardless of the landfall site construction method used, no impacts to eelgrass beds are expected since only isolated rooted eelgrass plants were found at the Dowses Beach landfall site and none were considered part of an eelgrass bed.	For the Phase 1 and Phase 2 landfall sites, the Proponent has minimized or avoided impacts by selecting locations that are primarily situated in previously-disturbed areas and have sufficient workspace to allow construction and installation activities to be effectively segregated from any nearby sensitive coastal habitats (i.e. work at the landfall sites will primarily occur within paved area or otherwise disturbed areas). Similarly, use of HDD at the Phase 1 and Phase 2 landfall site will avoid or minimize impacts to the beach, intertidal area, and nearshore areas, though open trenching may also be used during Phase 2 if it is not feasible to use the Dowses Beach Landfall Site and open trenching is needed at the Wianno Avenue Landfall Site. Additionally, best management practices will be used in both Phases during refueling and lubrication of equipment to protect coastal habitats from accidental spills. The Proponent has also developed a draft Oil Spill Response Plan for New England Wind, which is included in Appendix I-F.
	The total seafloor impacts from offshore export cable installation are quantified for Phases 1 and 2 in Appendix III-T. These impacts are provided for the entire OECC within state and federal waters, but it is noted that only those portions of the OECC within state waters are considered to be within "coastal habitat." Areas requiring cable protection, if any, will be the only locations where post-installation conditions at the seafloor will permanently differ from existing conditions along the OECC. Normal O&M activities for either Phase will not result in further coastal habitat alteration. In the event of a cable fault along the OECC for either Phase, impacts from repair operations would be confined to the specific area of the repair(s) and, given the limited area(s) where repair(s) may occur, would be considerably less than the impacts during construction.	The Proponent has routed the proposed OECC to avoid and minimize impacts to sensitive habitats where feasible. The preliminary routing of the Phase 1 and Phase 2 cables has avoided sensitive habitats including eelgrass beds, hard bottom, and complex bottom (i.e. sand waves) where feasible, but avoidance of all sensitive habitats is not always possible. The identified eelgrass resources near Spindle Rock in proximity to the Phase 1 landfall sites will be avoided. Additionally, the eelgrass resources in proximity to the potential Phase 2 landfall sites, located outside the OECC boundary, will be avoided. It is also expected that isolated areas of hard bottom may be avoided, such as at Spindle Rock; however, in areas such as Muskeget Channel where hard bottom extends across the entire corridor, it will not be possible to avoid hard bottom. The Proponent will prioritize the least environmentally impactful cable installation alternative(s) that is/are practicable for each segment of cable installation. The Proponent intends to avoid or minimize the need for cable protection to the greatest extent feasible through careful site assessment

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Coastal Habitats (Section 6.4) (Continued)		and thoughtful selection of the most appropriate cable installation tool to achieve sufficient burial. Prior to the start of offshore export cable laying preparatory activities for either Phase, the Proponent will communicate with commercial fishermen following the protocols outlined in the Fisheries Communication Plan (FCP) provided in Appendix III-E to help avoid potential fishing gear interactions For each Phase, prior to the start of construction, contractors will be provided with a map of sensitive habitats to allow them to plan their mooring positions accordingly. Vessel anchors and legs will be required to avoid known eelgrass beds and will also be required to avoid other sensitive seafloor habitats (hard/complex bottom) as long as such avoidance does not compromise the vessel's safety or the cable's installation. Where it is considered impossible or impracticable to avoid a sensitive seafloor habitat when anchoring, use of mid-line anchor buoys will be considered, where feasible and considered safe, as a potential measure to reduce and minimize potential impacts from anchor line sweep. During O&M, the offshore export cables will be regularly monitored. See BMPs #6-9, #11, #12, #18, #20, and #37-39 in Table 4.2-2.
Benthic Resources (Section 6.5)	Impacts to benthic habitat due to installation of WTG/ESP foundations are expected to result in short-term loss of habitat within a localized area, such that population level impacts are unlikely. Potential impacts may be minimized or offset through the addition of structured habitat (WTG/ESP foundations, scour protection, and cable protection [if required]). Impacts to benthic resources due to introduction of structured habitat will be direct, long-term (over the operational lifetime of New England Wind), and localized. It is possible that the foundations will support more taxa than the surrounding primarily homogenous sand habitats. While mortality of benthic organisms is expected in the Offshore Development Area during construction where temporary disturbance of the seafloor would occur due to cable, scour protection, and foundation	New England Wind is located in the MA WEA, which has been sited to avoid the most sensitive areas for benthic and other resources. The WTGs and ESPs are widely-spaced so that their foundations (and associated scour protection), along with cable protection for inter-array and inter-link cables, only occupy a minimal portion of the SWDA, leaving a huge portion of the SWDA undisturbed. The portion of the SWDA that will be disturbed is only 1.1% of the maximum size of the SWDA. During construction, where feasible and considered safe, mid-line buoys on anchor lines will be used to minimize impacts from anchor line sweep. Additionally, at the Phase 1 and Phase 2 landfall sites, HDD is expected to be used, though open trenching may also be used during Phase 2 if it is not feasible to use the Dowses Beach Landfall Site and open trenching is needed at the Wianno Avenue Landfall Site. There will be no HDD during the O&M period.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Benthic Resources (Section 6.5) (Continued)	installation, the impacts are expected to be localized and population-level effects are unlikely. This is because the surrounding vicinity of the SWDA has an abundant area of similar habitat type, the portion of the SWDA that will be disturbed is relatively small, and the sandy bottom community typical to the Offshore Development Area has adapted to frequent natural sediment movement. Overall, impacts from the alteration of habitat in the SWDA and along the OECC are expected to be minimal and recovery of natural assemblages likely. Impacts to benthic resources from electromagnetic fields (EMFs) are expected to be unlikely and mitigated by cable burial.	The Proponent is also committed to developing an appropriate benthic monitoring framework for New England Wind, should it be necessary, in consultation with BOEM and other agencies as appropriate (see Appendix III-U for the draft framework). The framework for New England Wind will consider the draft Benthic Habitat Monitoring Plan for Vineyard Wind 1 in Lease Area OCS-A 0501. Due to the similarities in habitat across Lease Areas OCS-A 0501 and OCS-A 0534, the monitoring data collected during the Vineyard Wind 1 monitoring effort may also inform expected impacts to and recovery of benthic communities within the SWDA. See BMPs #6-9, #11, #12, #18, #20, and #40 in Table 4.2-2.
Finfish, Invertebrates, and Essential Fish Habitat (Section 6.6, Appendix III-F)	Overall, impacts to finfish and invertebrate species stemming from direct construction mortality, noise, sediment suspension and deposition, and water withdrawals during the construction of New England Wind are expected to be short-term and localized. The high species richness in the SWDA may enhance recovery following any construction and installation related disturbances (MacArthur 1955). Mobile species will be able to avoid construction areas and are not expected to be substantially impacted by construction and installation. Impacts to mobile pelagic fishes and invertebrate species include localized and short-term avoidance behavior. Direct mortality may occur to immobile benthic organisms that are in the direct path of construction processes. Mortality of drifting pelagic egg and larval life stages in the Offshore Development Area may occur from water withdrawals by construction vessels. Mortality of pelagic eggs due to increased suspended sediments is expected to be limited because sediment plumes are predicted to have low-concentrations and resettlement will occur quickly (less than six hours in the water column). Burial and mortality of some demersal eggs and sessile organisms are also expected during cable installation in the Offshore Development Area. However, lethal deposition levels are only expected in small, localized areas	The SWDA is in the MA WEA, which was identified as suitable for wind energy development after a multi-year, multi-agency public process partially because of its relatively low amount of important fish and invertebrate habitat, therefore reducing potential for impacts. The WTGs and ESPs will be widely spaced, leaving a large portion of the SWDA undisturbed by WTG and ESP installation. To mitigate the potential impacts of injury to fish from pile driving, New England Wind will apply a soft-start procedure to the pile driving process, which delivers initial pile drives at a lower intensity, allowing fish to move out of the activity area before the full-power pile driving begins. The Proponent expects to implement noise attenuation mitigation to reduce sound levels by a target of approximately 12 decibels (dB) or greater. Offshore export cable installation will avoid important habitats such as eelgrass beds and hard bottom sediments where feasible. Impacts may be minimized using mid-line buoys that are designed to minimize seabed impacts from cable sweep, if feasible and safe, and installation equipment that further minimizes installation impacts on the seabed. In nearshore areas where sensitive resources are located near the potential landfall sites, HDD may be used to minimize disturbance of coastal habitats by drilling underneath them instead of through them. Working with University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST), the Proponent is already collecting pre-construction fisheries data (via trawl and drop camera surveys) within New

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Finfish, Invertebrates, and Essential Fish Habitat (Section 6.6, Appendix III-F) (Continued)	adjacent to the cable routes and sediment discharge areas. Overall, demersal sessile (i.e. less mobile) benthic organisms will incur the brunt of construction impacts, but since the impacted area is only a small portion of the available habitat in the region, significant population-scale impacts are highly unlikely. Some alteration from unconsolidated fine substrate habitat to structured habitat in the SWDA may change species assemblages in the SWDA and attract more structure-oriented species. Cable protection may also be used along the OECC and create hard-bottom habitat. The addition of EMFs from submarine cables will likely not have an impact on elasmobranchs or other electro-sensitive fish species because cables will be buried in the substrate or covered with cable protection. Overall, current literature indicates noise generated from the operation of wind farms is minimal and only localized avoidance behaviors are expected; acclimation to the noise over time may occur.	England Wind. The Proponent plans to develop a framework for during and post-construction fisheries studies within New England Wind. The Proponent expects that such studies during and post-construction will involve coordination with other offshore wind energy developers in the MA WEA and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA). The Proponent also expects the development of the fisheries studies will be undertaken in coordination with BOEM, agencies, fisheries stakeholders, academic institutions, and other stakeholders. The Proponent is already engaging in collaboration with other developers, fishing industry representatives, and state and federal agencies through its participation in the Responsible Offshore Science Alliance (ROSA) and the Regional Wildlife Science Entity (RWSE). The21ssociate21onn and mitigation measures for O&M and decommissioning would be broadly the same as for construction, with the exception of pile driving mitigation measures. See BMPs #11, #12, #18, #19, #20, and #40 in Table 4.2-2.
Marine Mammals (Section 6.7)	Potential impacts to marine mammals will primarily be associated with underwater sound and vessel traffic during construction and installation. Species' vulnerability to these potential impacts vary, but it is unlikely that population level impacts will occur for Endangered Species Act (ESA)- and non-ESA- listed- species. Potential impacts from marine debris, reductions in prey availability, habitat disturbance and modification, entanglement, EMFs, and sediment mobilization are expected to pose little to no risk to populations of marine mammals. The expected type of impact for marine mammal species commonly found in the SWDA is disturbance of individuals, mainly from pile driving sound. Exposure probability is low for uncommon species but probable for individuals of common and regular species in months when they are present. The duration of the impact is expected to be short-term, and spread out over a minimum of two construction seasons with breaks in between activities, likely leading to recovery and behavioral restoration, and potentially some habituation and adaptation to sound sources associated with New England	Working collaboratively with BOEM and National Oceanic and Atmospheric Administration (NOAA), the Proponent will develop mitigation measures that are expected to effectively minimize and avoid the risk of impacts to marine mammals from underwater sound and vessel collision during construction, operations, and decommissioning. Modeling, as part of permitting and regulatory processes, will be used to evaluate potential risks and specific mitigation and BMP options. Potential monitoring and mitigation measures include, but are not limited to, the use of seasonal restrictions, sound attenuation technology, sound field verification, protected species observers (PSOs), pile driving sort-start procedures, passive acoustic monitoring (PAM), protective zones, shutdowns, vessel strike avoidance measures, and NARW-specific monitoring and mitigation. The Proponent expects to establish a restriction on pile driving between January 1 and April 30. Subject to discussions with regulatory agencies, the Proponent expects to implement noise attenuation mitigation to reduce sound levels by a target of approximately 12 dB or greater. As safe and

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Marine Mammals (Section 6.7) (Continued)	Wind. For all species, impacts resulting from sound exposure may affect individuals but have only very low to low risk of impact on marine mammal stocks or populations. The two most vulnerable species are North Atlantic right whale (NARW) and harbor porpoises. Density models suggest that both species are seasonal in the SWDA and predicted to occur in higher densities outside of the SWDA, indicating suitable habitat is available for any displaced individuals. Any potential displacement of NARW individuals is unlikely to significantly affect important activities like foraging, migrating, and mating. Masking may result from pile driving noise, but the duration and intensity would be short-term and localized, and habituation will likely reduce behavioral response over time. For harbor porpoises, given the use of this habitat for foraging, the installation of in-water structures may cause a decline in foraging activity in the area. However, feeding can occur in nearby areas if harbor porpoises are temporarily displaced.	Practicable, the Proponent will adhere to NOAA guidelines for vessel strike avoidance that are applicable at the time of construction and operations. In addition to monitoring and mitigation specific to New England Wind, the Proponent is establishing the Offshore Wind Protected Marine Species Mitigation Fund as part of Phase 1 of New England Wind. The Proponent has committed to provide up to $2.5 million to the Mystic Aquarium in Connecticut to continue evolving the understanding of underwater noise generated by offshore wind farms and the potential impacts on cetacean and pinniped behavior, hearing, and physiology. In addition, this fund will further the investigation of best practices and advance technologies to reduce potential sound impacts and collision threats from offshore wind project development. See BMPs #13, #14, #15, #16, #17, and #28-#30 in Table 4.2-2.
Sea Turtles (Section 6.8)	There are three species of sea turtles that may be exposed to impacts associated with New England Wind activities: Kemp's Ridley, leatherback, and loggerhead sea turtles. Green sea turtles are rare in the SWDA and thus have very low exposure risk. Both leatherback and loggerhead sea turtles have a higher risk of exposure to potential impacts than other sea turtle species because of their common use of the SWDA and surrounding areas. Key impact risks for sea turtles are associated with underwater sound exposure and vessel collision, with habitat modification and EMFs considered lower risk. Underwater sound exposure is short-term and localized, particularly sound from piling operations, which is limited to construction and installation. Vessel noise and vessel collision may occur through construction, operation and decommissioning of New England Wind; however, both risks are22ssociateed with moving sound sources, limiting both the temporal and spatial impact. Potential impacts from marine debris, reductions in prey availability, entanglement, and sediment mobilization are expected to pose little to no risk to populations of sea turtles.	Working collaboratively with BOEM and NOAA, the Proponent will develop mitigation that may effectively minimize and avoid risks to sea turtles from construction and installation, O&M, and decommissioning, which will incorporate knowledge and lessons learned from Vineyard Wind 1 as well as other offshore wind farm development in the MA WEA and RI/MA WEA. Proposed avoidance, minimization, and mitigation measures for threatened and endangered sea turtle species would be the same as those employed for marine mammals. In many cases, measures put in place to minimize potential impacts for marine mammals are more stringent than those required for sea turtles (e.g. pile driving soft-start procedures and use of noise attenuation systems). In addition to monitoring and mitigation specific to New England Wind, the Proponent is establishing the Offshore Wind Protected Marine Species Mitigation Fund as part of Phase 1 of New England Wind. The Proponent has committed to provide up to $2.5 million to the Mystic Aquarium in Connecticut to continue evolving the understanding of underwater noise

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Sea Turtles (Section 6.8) (Continued)	Species' vulnerability to stressors varies, but risk to individuals of these species generally remains low due to their seasonal use of the SWDA and planned implementation of monitoring and mitigation measures to avoid impact. Behavioral vulnerability for turtles is likely limited to short-term disturbance. Given the low estimated number of acoustic exposures modeled and the monitoring, mitigation, and BMPs that will be implemented to reduce the potentially negative impacts to sea turtles, no population level impacts are anticipated.	Generated by offshore wind farms. Although the fund will be prioritized around the protection of marine mammals, benefits of the fund will likely also be shared with sea turtles and other marine fauna. See BMPs #21-23, #28-30, and #40 in Table 4.2-2.
Demographics, Employment, and Economics (Section 7.1)	During the construction of Phases 1 and 2, the Proponent anticipates directly hiring a workforce spanning a diverse range of professions for fabrication, construction, and/or assembly of components. Construction activities are also anticipated to diversify and generate jobs and revenues in the Development Region's "ocean economy" sectors, particularly for tug and other vessel charters, dockage, fueling, inspection/repairs, provisioning, and crew work in the port communities identified in Section 3.2.2.5 and 4.2.2.5 of COP Volume I. Most New England Wind activities are anticipated to have location-specific effects, largely dependent on the magnitude of changes relative to existing local conditions. In addition, New England Wind will create opportunities for new market growth in sectors servicing the offshore wind industry along the US East Coast. Overall, economic impacts from New England Wind are expected to yield benefits in the Onshore Development Region and Offshore Development Region for the duration of each Phase's operational period. The Proponent anticipates opportunities for area marine trades industries including tug and other vessel charters, dockage, fueling, inspection/repairs, provisioning, and other port and harbor services.	During Phase 1 (Park City Wind), the Proponent has committed $26.5 million (nominal) to support the economic and community initiatives such as supply chain integration, workforce development, offshore wind-related marine and fisheries research and support the local communities in Connecticut. Additionally, Phase 2 (Commonwealth Wind) includes an investment of up to $35 million in local partnerships and programs. These programs include a robust Diversity, Equity, and Inclusion (DEI) Plan aimed at building a diverse, equitable, and inclusive offshore wind sector as well as a range of community benefits, environmental benefits, and innovation initiatives (see Appendix III-O). The Proponent is committed to working cooperatively with Connecticut educational institutions, including the University of Bridgeport and Connecticut State Colleges and Universities. The Proponent will also continue to work cooperatively with southeastern Massachusetts educational institutions, such as the Massachusetts Maritime Academy, University of Massachusetts Dartmouth, Bristol Community College, Cape Cod Community College, and others to maintain and further evolve training and educational opportunities for their students and faculty throughout each Phase of New England Wind.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Demographics, Employment, and Economics (Section 7.1) (Continued)	The new economic activity generated by offshore wind development in the SWDA can reasonably be expected to result in a substantial positive impact on state and local tax receipts. Impacts include increased personal income tax, payroll tax, sales tax, property tax, corporate tax, and other fee and tax revenues paid by the Proponent, its employees, and contractors (direct impacts) and taxes generated through the economic activities created in other areas of the economy through indirect and induced impacts.	Temporary impacts from construction and installation will be mitigated through BMPs, where practicable. Monitoring, outreach, and communication plans are expected to be implemented, as necessary, to assess and address impacts resulting from the construction of New England Wind. Such plans are anticipated to include the implementation of the Fisheries Communication Plan, the use of a Marine Coordinator, distribution of Offshore Wind Mariner Update Bulletins, and other navigational safety measures. Additional coordination with federal, state, local authorities, and other stakeholders will be pursued in advance of the construction and installation process.
Environmental Justice/ Minority and Low Income Communities (Section 7.2)	A number of areas around Phase 1 and Phase 2 activities in the Onshore Development Areas contain communities that meet federal criteria (or the more rigorous state criteria in Massachusetts) for Environmental Justice (EJ) concerns, especially around the possible port facilities which tend to be located in highly urban areas. Phases 1 and 2 construction (and similar decommissioning) activities may create potential short-term impacts to proximal EJ communities. Potential impacts would be typical of construction activities, such as increased noise, traffic and associated air emissions, and are anticipated to be minor. Onshore construction of Phases 1 and 2 are not anticipated to cause disproportionately high and adverse health or environmental effects on minority or low-income populations. No disproportionately high and adverse effects are anticipated to EJ populations from any O&M activities. Rather, New England Wind is expected to provide economic improvements and overall health benefits to EJ populations. The long- term impacts of Phases 1 and 2 are expected to include increased jobs, direct and indirect economic opportunities, and in the case of selected ports, upgraded port conditions, all of which are expected to benefit area EJ communities.	No disproportionately high and adverse health or environmental effects are anticipated to EJ communities from any Phases 1 and 2 activities. Thus, in accordance with the provisions of Executive Order No. 12898 (1994), no specific mitigation measures are necessary for EJ communities. Nevertheless, short-term impacts from onshore construction will be minimized by adherence to construction BMPs. The Proponent will assemble a Construction Management Plan (CMP) that will be used by the Proponent and its contractors during construction. The CMP will be an integral part of the Proponent's effort to ensure that environmental protection and sound construction practices are implemented. During O&M, impacts are expected to be negligible and therefore no specific measures are necessary to avoid, minimize, or mitigate effects. However, if needed, additional outreach to EJ populations will be coordinated by the Proponent and/or its contractors. Under Section 106 of the National Historic Preservation Act, if BOEM determines, in consultation with the federally recognized Wampanoag Tribe of Gay Head (Aquinnah), that visual impacts due to New England Wind will

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Environmental Justice/ Minority and Low Income Communities (Section 7.2) (Continued)		be adverse to the EJ population mapped in Aquinnah on Martha's Vineyard, BOEM will consult with the involved parties to develop mitigation measures that will be formalized in a Memorandum of Agreement, if necessary. The Proponent will execute a Diversity, Equity, and Inclusion (DEI) Plan for Commonwealth Wind that includes $15 million to fund DEI, workforce, and supply chain initiatives to support local content, increase diversity in the industry, and provide Environmental Justice (EJ) Population residents and other underrepresented populations real opportunities to join the offshore workforce and supply chain. To execute the DEI Plan, the Proponent has partnered with a diverse group of nonprofit partners located throughout Massachusetts. The Proponent has conducted, and will continue to conduct, an extensive community outreach effort to provide opportunities across many media for all affected parties to learn about New England Wind, express concerns and participate in the environmental review process.
Cultural, Historical, and Archaeological Resources (Section 7.3)	Installation of the Phase 1 and Phase 2 onshore export cables (including activities at the landfall sites), onshore substations, and grid interconnection cables involves ground-disturbing activities. An archaeological sensitivity assessment was prepared in May 2020 for the Phase 1 Onshore Development Area and zones of low, moderate, and high archaeological sensitivity were identified. In October 2021, an intensive archaeological survey was conducted at four archaeologically sensitive locations and no significant cultural resources were found. Therefore, no additional archaeological investigations of these components of the onshore export cable route are recommended. Archaeological monitoring of other Phase 1 ground-disturbing activities within areas of moderate or high archaeological sensitivity will be conducted during construction. For Phase 2, a due diligence review was completed in June 2020 and an archaeological reconnaissance survey was conducted in November 2021 for the Phase 2 Onshore Development Area. Zones of low, moderate, and high	Avoidance and minimization of adverse effects to terrestrial archaeological resources has been considered through the design of New England Wind by siting the Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes primarily along existing roadway layouts and utility ROWs. Reconnaissance surveys have been conducted for both Phases and intensive surveys have been conducted where recommended for the Phase 1 Onshore Development Area. Archaeological monitoring of ground-disturbing activities within areas of moderate or high archaeological sensitivity will be conducted during construction. If needed, additional avoidance, minimization, and mitigation measures for terrestrial archaeological resources in the APE will be determined through ongoing consultation with BOEM, MHC/SHPO, federally-recognized tribes, and other relevant consulting parties through the Section 106 and NEPA processes. If any archaeological sites are identified during archaeological monitoring of construction activities, construction will stop, and an evaluation of their National Register eligibility will be made before construction resumes. If a site is

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Cultural, Historical, and Archaeological Resources (Section 7.3) (Continued)	archaeological sensitivity were identified. In April 2022 an additional due diligence study was conducted at the Clay Hill substation site and in May 2023 an intensive archaeological survey was conducted at the Clay Hill site. No sites are recommended for eligibility for listing in the State and/or National Registers of Historic Places and the proposed onshore substation will not impact any potentially significant archaeological resources. Archaeological monitoring of Phase 2 ground-disturbing activities within areas of moderate or high archaeological sensitivity will be conducted during construction. A marine archaeological resources assessment (MARA) was conducted for both Phases of New England Wind. Three potential shipwrecks/shipwreck sites were identified within the SWDA, one potential shipwreck was identified in the OECC, and two potential shipwrecks were identified in the Western Muskeget Variant. Submerged ancient landforms that may have the potential to contain archaeological materials were also identified within the SWDA and OECC (including the Western Muskeget Variant). Avoidance is recommended for each of these features located within the PAPE during bottom-disturbing activities for New England Wind to the extent feasible.	Determined to be eligible, an assessment of the effect of New England Wind activities on the site will be made. If avoidance or minimization of an adverse physical effect on the archaeological site is not possible, a site-specific data recovery program may be implemented, in consultation with BOEM, MHC/State Historic Preservation Office (SHPO), and Tribal Historic Preservation Offices, to resolve the adverse effect. For marine archaeology, it is likely that shipwrecks or potential shipwrecks will be avoided. Submerged ancient landforms are more widespread and avoidance may not be feasible. If avoidance of these features is not possible, further geotechnical investigations may be warranted to better characterize their full archaeological sensitivity. Other mitigation measures, agreed to by BOEM and consulting parties during the Section 106 process, may also be appropriate. Potential mitigation measures for unavoidable impacts are provided in the MARA in Volume II-D.
Visual Resources (Section 7.4)	Potential visual impacts during construction of New England Wind would be limited to partially built WTGs, ESP(s), and vessels working offshore and traveling to and from ports. Visual impacts associated with construction would be minor as construction equipment would only be in use temporarily during construction. Visual impacts during decommissioning are expected to be similarly minor, but may be shorter in duration. The nearest New England Wind WTG will be 34 km (21.2 mi) off the coast of Martha's Vineyard (Squibnocket Point) and 40 km (25.1 mi) off the coast of Nantucket (Madaket). Visual daytime impacts during O&M would result from the introduction of the numerous vertical lines of the WTGs into a strongly horizontal landscape defined by the horizon line at sea. However, from all coastal vantage points, WTGs appear low on the distant horizon and are difficult to perceive. Given the distance of the WTGs and ESP(s) from shore, earth's curvature, and atmospheric conditions, visual impacts to onshore viewers of WTGs and ESP(s) in daylight would be expected to be minor.	New England Wind is located in the area identified by BOEM as suitable for offshore wind power development, sited far from shore to minimize visual impacts. The distance of the WTGs and ESP(s) from the nearest coastal vantage point eliminates all foreground, mid-ground, and even near background views from visually sensitive public resources and population centers. Due to the curvature of the earth, the foundations will fall partially or completely below the horizon from many land-based vantage points and there are no land-based vantage points from which a WTG or ESP can be viewed in its entirety. Atmospheric conditions reduce visibility, sometimes significantly, and the presence of waves obscures objects very low on the horizon. Furthermore, limits to human visual acuity reduce the ability to discern objects at great distances.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Visual Resources (Section 7.4) (Continued)	When turned on, aviation obstruction lights on the WTGs and ESP(s) would likely be discernible on clear nights from the shoreline. Weather conditions such as fog, haze, and clouds would greatly limit the visibility of the WTGs and ESP(s) and lighting from the shore. Therefore, the presence of flashing light(s) on WTGs and ESP(s) at night would result in minor impacts (BOEM 2007). Exclusive of the effects of earth curvature and meteorological visibility, a broadside view of a WTG at a distance of 34 km (21.2 mi) would measure only 0.016 degrees horizontally on the horizon and 0.33 degrees vertically to nacelle height. This is roughly equivalent to viewing a pencil at a distance of about 34 m (113 ft). Similarly, with a maximum width of 8 m (26 ft), the blade would measure only 0.013 degrees horizontally. This is roughly equivalent to the width of a drinking straw viewed at 28 m (91 ft). Overall, New England Wind will result in minimal change to landscape conditions for viewers along the Martha's Vineyard and Nantucket coastlines. Viewers on the islands will have limited visibility of the WTGs when weather conditions allow. However, at distances greater than 34 km (21.2 mi) for the WTGs and ESP(s) and viewed within the context of the ocean that includes the vast expanse of water, extended beach views and dunes, as well as the sights and sounds of breaking surf and wind, New England Wind would likely be considered visually subordinate to the wider landscape. All of Cape Cod's south coast (excluding a small area of shoreline at Woods Hole, which is screened from the SWDA by the landform of Martha's Vineyard in the foreground) and all of mainland Massachusetts, Rhode Island (including Block Island), Connecticut, and New York's Long Island fall beyond the maximum theoretical area of nacelle visibility and will not be affected by views of New England Wind. All offshore cables will be submerged and will not be visible. The Phase 1 onshore export cables and grid interconnection cables will be installed entirely underground and will not be visible, except for possibly at the Phase 1 Centerville River crossing. The Phase 2 onshore cables are also expected to be installed underground.	When viewed from ground level vantage points, the off-white/light grey color of the WTGs generally blends well with the sky at the horizon. The upper portion of the ESP(s) will also be a grey color which would appear muted and indistinct. The yellow color of the foundations largely falls below the visible horizon when viewed from shore and will be nearly undetectable from onshore viewpoints. No commercial/advertising messages will be placed on WTGs. Although aviation obstruction lights may be visible at night from beaches and coastal bluffs during clear weather conditions, it should be noted that recreational beaches are primarily visited during daytime hours, minimizing the number of affected viewers. To substantially reduce the amount of time the lights are visible, the Proponent expects to use an ADLS that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs/ESP(s), subject to BOEM approval. For Phase 2, the Proponent expects to use the same or similar approaches to reduce lighting used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS. An assessment of the activation frequency of an ADLS indicates that it would be activated less than one hour per year (see Appendix III-K). Marine navigation lights are expected to have a designed visual range of 5 nautical miles (NM) or less and are therefore not likely to be discernible from coastal vantage points. Potential visual impacts are avoided by siting the onshore cables largely underground in existing roadway layouts and utility ROWs. The Phase 1 onshore substation will include vegetative screening. Views of the Phase 2 Clay Hill onshore substation site are limited and represent a de minimis alteration to the existing visual character of the local landscape. Lower height electrical equipment and buildings associated with the substation will not be directly visible from any off-site vantage point. In areas where lightning masts are predicted to be visible; the lightning masts will be low within the intervening tree line. Land and tree clearing will be minimized to the extent practicable and an existing forested buffer around the substation will be maintained for visual screening.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Visual Resources (Section 7.4) (Continued)		Proposed measures to mitigate adverse visual effects on Gay Head Lighthouse and the Vineyard Sound and Moshup's Bridge TCP are provided in Attachment B of Appendix III-H.b. These measures will be refined in consultation with BOEM, MHC/SHPO, federally-recognized tribes, and other relevant consulting parties through the Section 106 and National Environmental Policy Act processes. In accordance with the Proponent's Good Neighbor Agreement with the Town and County of Nantucket and leading Island nonprofits, Phase 1 and Phase 2 of New England Wind will each contribute $3 million to the Nantucket Offshore Wind Community Fund at financial close. See BMPs #45-49 in Table 4.2-2.
Recreation and Tourism, Including Recreational Fishing (Section 7.5)	New England Wind, when viewed in isolation, may have an adverse visual effect on the Gay Head Lighthouse on Martha's Vineyard (listed on the National Register) and the Vineyard Sound and Moshup's Bridge Traditional Cultural Property (TCP) due to the introduction of new elements to the maritime settings of these resources. However, it should be noted that the potential adverse effect to these resources is inconsistent and weather dependent, as the vast majority of the time the SWDA will not be visible. Onshore construction period impacts will be limited to the Town of Barnstable for Phases 1 and 2. The new Phase 1 duct bank and the associated splice vaults will be located entirely underground (except for possibly at the Centerville River crossing), primarily within public roadway layouts or existing utility ROWs. The Phase 2 onshore cables will similarly include installation of new duct bank and splice vaults. The Phase 2 cables are expected to be installed underground within public roadway layouts and utility ROWs along one or two Onshore Export Cable Routes. Installation of the duct bank and splice vaults along the Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes may temporarily restrict access to parks/conservation areas along the routes. Similarly, construction at the Phase 1 and Phase 2 landfall sites may temporarily limits pedestrian access to limited areas of the landfall sites.	The Proponent's onshore construction schedule for Phases 1 and 2 will minimize impacts to recreational uses and tourism-related activities during peak summer months and other times when demands on these resources are elevated. For the installation of the Phase 1 and Phase 2 onshore duct bank and cables, construction is anticipated to occur during typical work hours (7:00 AM to 6:00 PM) on Monday through Friday, though in specific instances at some locations, or at the request of the Barnstable Department of Public Works (DPW), the Proponent may seek municipal approval to work at night or on weekends. Nighttime work will be minimized and performed only on an as-needed basis, such as when crossing a busy road, and will be coordinated with the Town of Barnstable. The Proponent will adhere to the general summer limitations on construction activities on Cape Cod for Phases 1 and 2. Activities at the landfall site where transmission will transition from offshore to onshore are not expected to be performed during the months of June through September unless authorized by the Town of Barnstable. Activities along the Onshore Export Cable Route(s) and Grid Interconnection Route(s) (particularly where the route follows public roadway layouts) will also likely be subject to significant construction limitations from Memorial Day through Labor Day unless authorized by Barnstable, but could extend through June 15 subject to consent from the DPW. The Proponent will also consult with the Town of Barnstable regarding the construction schedules for both Phases.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Recreation and Tourism, Including Recreational Fishing (Section 7.5) (Continued)	Impacts from decommissioning activities will be similar to those associated with construction. Short-lived construction period impacts will also occur at the onshore substation sites for each Phase. Construction noise and dust may temporarily disturb nearby recreational users and residents in the area surrounding the onshore facilities for Phases 1 and 2 of New England Wind. The construction and installation vessels operating in the SWDA and along the OECC may temporarily preclude recreational boating and fishing activities in the immediate vicinity of construction vessels or cause boaters and recreational fishermen to slightly alter their navigation routes. Construction activities may affect recreational fishing activities by impacting recreationally-important species. For example, noise from construction and installation activities, including pile driving and low-intensity noise from dredging or increased vessel traffic, may cause recreationally targeted species to temporarily avoid the immediate vicinity of the construction and installation activities (Kirkpatrick et al. 2017). The SWDA may provide additional recreational opportunities by creating sightseeing interest. The modest visual impacts of New England Wind may, at certain beaches, attract more visitors than those who are dissuaded from visiting, thereby creating a net positive effect for visitation. During O&M, recreational boating and fisheries may be impacted by potential navigation hazards due to the presence of structures in the Offshore Development Area and fish aggregation. O&M for Phases 1 and 2 could result in modest, positive impacts to recreational fisheries. The addition of foundations and scour protection, as well as cable protection in some areas, may act as an artificial reef and provide rocky habitat previously absent from the area. Increases in biodiversity and abundance of fish have been observed around WTG foundations due to attraction of fish species to new structured habitat (Riefolo et al. 2016; Raoux et al. 2017).	The Proponent will assemble a Construction Management Plan (CMP) that will be used by the Proponent and its contractors during construction. The CMP will be developed to guide contractors during construction, and the document will be an integral part of the Proponent's effort to ensure that environmental protection and sound construction practices are implemented throughout construction. For each Phase, upon completion of construction at the landfall sites and along the Onshore Export Cable Routes and Grid Interconnection Routes, all areas will be restored to pre-existing conditions. Accordingly, no restrictions on recreational activities or use are anticipated at the landfall sites or along the Onshore Export Cable Routes and Grid Interconnection Routes. Temporary safety buffer zones may be established around work areas during construction and installation. Temporary safety buffer zones are expected to improve safety in the vicinity of active work areas and would not affect the entire SWDA or OECC at any given time. To minimize hazards to navigation, all New England Wind-related vessels and equipment will display the required marine navigation lighting and day shapes. The Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the United Stated Coast Guard (USCG) to provide Notices to Mariners (NTMs) to notify recreational and commercial vessels of their intended operations within the Offshore Development Area. The Proponent has developed and is implementing a Fisheries Communication Plan (FCP) to facilitate regular and productive communication with fishermen, including recreational fishermen. The FCP is a living document and will be updated, as needed, as development proceeds for each Phase of New England Wind. The current FCP is included as Appendix III-E. The WTGs and ESPs in the SWDA will be oriented in an east-west, north-south grid pattern with one nautical mile (1.85 km) spacing between WTG/ESP positions, which will facilitate vessel navigation through the SWDA.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Recreation and Tourism, Including Recreational Fishing (Section 7.5) (Continued)		To aid mariners navigating the SWDA, each WTG and ESP will be maintained as a Private Aid to Navigation (PATON) in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The Proponent will implement a uniform system of marine navigation lighting and marking for the offshore facilities, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. Mariner Radio Activated Sound Signals (MRASS) and Automatic Identification System (AIS) transponders are included in the offshore facilities' design to enhance marine navigation safety. See BMPs #31-35 in Table 4.2-2.
Commercial Fisheries and For Hire Recreational Fishing (Section 7.6)	Impacts to finfish and invertebrates within the SWDA and along the OECC from construction of each Phase of New England Wind, including those species targeted by commercial fishermen, are expected to be short-term and localized. Only a small portion of available habitat in the area will be impacted by construction activities within the SWDA and along the OECC and recovery is expected. While there may be temporary impacts to some commercially important species, availability of these species in nearby waters outside the SWDA suggest that increased fishing effort outside the SWDA could offset any such impacts inside the SWDA. The placement of foundations, scour protection, and cable protection (if required) may displace sea scallop and surf clam habitat, if it is present where placement occurs; however, such habitat alteration would be very limited. The foundations, scour protection, and potential cable protection (if required) may serve as fish aggregating structures and may also alter local food web dynamics and species distribution. During construction of Phases 1 and 2, vessels operating in the SWDA and along the OECC may temporarily preclude commercial fishing activities in the immediate vicinity of construction vessels or cause commercial fishing	The MA WEA was selected by BOEM to exclude most sensitive fishes and invertebrate habitat after a multi-year process. BOEM also excluded areas of high fisheries value to reduce potential conflict with commercial and recreational fishing activities. The 1 x 1 NM WTG/ESP layout of New England Wind, which is consistent with recommendations from the USCG, will facilitate ongoing transit and fishing activities by commercial fishermen and is expected to accommodate traditional fishing patterns. Temporary safety buffer zones may be established around work areas during construction and installation. Temporary safety buffer zones are expected to improve safety in the vicinity of active work areas and would not affect the entire SWDA or OECC at any given time. No vessel restrictions are proposed other than those temporary safety buffer zones in the immediate vicinity of the construction and installation vessels. To minimize hazards to navigation, all New England Wind vessels and equipment will display the required navigation lighting and day shapes. To aid mariners navigating the SWDA, each WTG and ESP will be maintained as a

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Commercial Fisheries and For Hire Recreational Fishing (Section 7.6) (Continued)	vessels to slightly alter their navigation routes to avoid the construction area. The majority of the SWDA and OECC will remain accessible to commercial fishing vessels throughout the construction and installation process. During O&M for either Phase, the SWDA will be open to marine traffic, and no permanent vessel restrictions are proposed within the SWDA or along the OECC. A number of factors suggest that any economic impact from New England Wind will be only a small percentage of the estimated economic exposure (i.e. a measure of fishing that occurs within the SWDA). Commercial fishing vessels will continue to have access to the SWDA and OECC as currently permitted by regulation and the proposed grid layout provides 1 NM (1.85 km) wide corridors in the east-west and north-south directions as well as 0.7 NM (1.3 km) wide corridors in the northwest-southeast and northeast-southwest directions. The proposed layout is expected to accommodate traditional fishing patterns, including the "gentlemen's agreement" regarding the placement of mobile and fixed gear within the WEA. In addition, alternative fishing grounds with a demonstrated higher fishery revenue density are available nearby and may be fished at little to no additional cost. Appendix III-N provides a detailed description of potential economic exposure, potential fishing congestion impacts, and shoreside impacts. Vessels towing mobile gear in the SWDA may choose to exit the SWDA before retrieving gear or reversing course for a subsequent tow through the SWDA, thereby extending the amount of time fishing gear is deployed and/or more frequent retrieval and deployment of gear. This may incur additional costs or downtime associated with additional gear handling and increased steaming distances. In certain situations, longer periods of gear deployment may result in increased landings. Should vessels elect to fish outside the SWDA, they may spend additional time steaming to alternate fishing grounds. As noted in Appendix III-N, fishing grounds with similar harvest potential in proximity to the SWDA, however, suggests these choices would have only modest impacts on cost and revenue.	PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The Proponent will implement a uniform system of marine navigation lighting and marking for the offshore facilities, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. MRASS and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety. Each WTG and ESP will also be clearly identified on NOAA charts. The Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the USCG to provide NTMs to notify recreational and commercial vessels of their intended operations within the Offshore Development Area. The Proponent has developed a Fisheries Communication Plan (FCP) (included as Appendix III-E). Fisheries communication is conducted through several roles, including Fisheries Liaisons (FLs) and Fisheries Representatives. The Proponent also employs a Marine Operations Liaison Officer, who is responsible for safe marine operations by the Proponent. In an effort to provide fishermen with the most accurate and precise information on work within the SWDA and along the OECC, the Proponent is currently providing and will continue to provide portable digital media with electronic charts depicting locations of New England Wind-related activities. The Proponent is developing and implementing procedures for handling compensation to fishermen for potential gear loss. Additional information is provided in Appendix III-E. The Proponent has also made substantial commitments to fisheries research. As part of Phase 1, the Proponent has committed to provide up to $2.5 million to support fisheries research and education as part of a new initiative launched by the University of Connecticut to improve the understanding of potential environmental impacts from offshore wind. Additionally, as part of Phase 1, the Proponent will allocate up to $7.5 million in funds to support

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Commercial Fisheries and For Hire Recreational Fishing (Section 7.6) (Continued)	Anglers' interest in visiting the SWDA may also lead to an increased number of fishing trips out of nearby ports which could support an increase in angler expenditures at local bait shops, gas stations, and other shoreside dependents (Kirkpatrick et al. 2017). Impacts from the decommissioning activities would be similar to those associated with construction. Removal of the scour protection and any cable protection from the SWDA may result in a shift in the local finfish and invertebrate species assemblages to pre-construction, non-structure communities. Additionally, once offshore components are removed, there will be no more WTGs, ESPs, foundations, or scour protection within the SWDA and commercial fishing may occur in any orientation, though the WTGs and ESPs will no longer serve as aids to navigation.	environmental initiatives, assist Connecticut fishermen, and further bolster local communities in Connecticut where offshore wind development activities are taking place. The Proponent anticipates working with federal and Connecticut state agencies as well as environmental, fisheries, and local community stakeholders in Connecticut to identify key priorities and programs these funds could support. Working with SMAST, the Proponent is already collecting pre-construction fisheries data (via trawl and drop camera surveys) within New England Wind. The Proponent plans to develop a framework for during and post-construction fisheries studies within New England Wind. The Proponent expects that such studies during and post-construction will involve coordination with other offshore wind energy developers in the MA WEA and RI/MA WEA. The Proponent also expects the development of the fisheries studies will be undertaken in coordination with BOEM, agencies, fisheries stakeholders, academic institutions, and other stakeholders. The Proponent is already engaging in collaboration with other developers, fishing industry representatives, and state and federal agencies through its participation in the ROSA and the RWSE. The survey and monitoring work the Proponent will conduct will generate a substantial body of environmental, fisheries, and other data, all of which will be publicly available. Through the ROSA and the RWSE, the Proponent will work with fishermen, regulators, stakeholders and neighboring developers to find ways to streamline and standardize available data across all offshore efforts. During decommissioning, the avoidance, minimization, and mitigation measures employed will be similar to those described for New England Wind's construction activities. See BMPs # 31-35 in Table 4.2-2.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Land Use and Coastal Infrastructure (Section 7.7)	Construction and installation at the Phase 1 and Phase 2 landfall sites may require construction staging areas, which may temporarily affect parking and access to facilities in the immediate vicinity of the operation. Impacts are expected to be short-term, as activities at the landfall sites may be completed within a matter of months. Cable installation activities along the Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes may temporarily disturb neighboring land uses through construction noise, vibration, and dust. Onshore cable installation activities may also impact traffic on roads within the vicinity of the onshore routes. Impacts are expected to be short-term and limited to discrete areas, as onshore cable installation at any one location along a public road may be completed within a matter of days. Construction activities will be sequenced to avoid the highest traffic periods. Overall, installation of the onshore export cables and grid interconnection cables is expected to be completed without significant permanent alteration to any land use or existing infrastructure upon completion of construction and installation. The Phase 1 onshore substation site for New England Wind was selected, in part, because existing land uses are compatible with the proposed onshore substation and there will be no impacts to coastal infrastructure. The construction and installation process will make use of existing or planned port facilities. The Proponent will not implement any port improvements that may be made. During construction, vessel operations may increase in the areas surrounding the potential ports, navigational channels, inshore traffic zones, and any traffic separation scheme along the selected route to the SWDA. Impacts associated with O&M of New England Wind are not anticipated to have adverse effects on the surrounding communities and will not disrupt the communities' routine functions. Periodic maintenance or repair of O&M facilities, onshore export and grid interconnection cables, and other onshore	The Proponent's onshore construction schedule minimizes impacts to land uses to the greatest extent practicable by limiting onshore construction activities during peak summer months and other times when demands on these resources are elevated. Prior to construction, the Proponent will work closely with the Town of Barnstable to develop a Traffic Management Plan (TMP) for the onshore construction of each Phase. The TMP will be a living document such that any unanticipated change in construction location, timing, or method previously identified will result in revision of the TMP and approval by the appropriate authorities before any construction changes are implemented. The Proponent will utilize various methods of public outreach prior to and during construction to keep residents, business owners, and officials updated on the construction schedules, vehicular access, lane closures, detours, and other traffic management information, local parking availability, emergency vehicle access, construction crew movement and parking, laydown areas, staging, equipment delivery, nighttime or weekend construction, and road repaving. All disturbed areas during installation of the onshore export cables and grid interconnection cables will be restored upon completion of construction. The Proponent is designing its proposed onshore substations in a manner that will avoid and minimize impacts to adjacent land uses. For the Phase 1 onshore substation, the Proponent plans to plant a vegetated screening on the western and northern boundaries of the onshore substation site; the vegetated screening along the western edge would provide visual screening for existing residences. The entire site will have a perimeter access fence, and the westerly side may have a sound attenuation wall, if necessary. Phase 1 onshore substation construction may require initial clearing of the entire site, but revegetation along the onshore substation site boundaries would occur outside of the substation boundary/screening wall. Views of the Phase 2 Clay Hill onshore substation site are limited and represent a de minimis alteration to the existing visual character of the local landscape. Lower height electrical equipment and buildings associated with the substation will not be directly visible from any off-site vantage point. In areas where lightning

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Land Use and Coastal Infrastructure (Section 7.7) (Continued)	facilities may be necessary over the anticipated life of New England Wind. Repairs typically involve work on the onshore export cables and grid interconnection cables, which are accessed through manholes at installed splice vaults. As a result, repairs can be completed within the installed transmission infrastructure without impacting surrounding land uses or coastal infrastructure. During O&M, vessel operations are not anticipated to impact the areas surrounding the potential ports, navigational channels, inshore traffic zones, and any traffic separation scheme along the selected route to the SWDA. Impacts to land use and coastal infrastructure from decommissioning are expected to be generally similar to the impacts experienced during construction.	masts are predicted to be visible; the lightning masts will be low within the intervening tree line. Land and tree clearing will be minimized to the extent practicable and an existing forested buffer around the substation will be maintained for visual screening.. The Phase 2 onshore substation site will have a perimeter access fence and may include sound attenuation walls, if necessary. By identifying a wide range of ports, the Proponent expects to avoid or minimize any potential conflicts over port usage with other northeast offshore wind developers. The splice vaults, duct bank, and onshore substations may remain as valuable infrastructure that could be available for future offshore wind or other projects. The O&M facilities can be easily repurposed for continued use by the Proponent or another site operator. See BMPs #1, 3, and 41 in Table 4.2-2.
Navigation and Vessel Traffic (Section 7.8)	possible, or adjust their departure/arrival times to avoid navigational conflicts. However, navigational conflicts are not anticipated to be a common occurrence. New England Wind is expected to have little to no impact on a mariner's ability to see and use aids to navigation, including lighthouses and channel marker buoys. Increased risks to safe navigation may result from the presence of WTGs and ESPs in the SWDA where only open ocean previously existed. Some vessel operators may select routes that avoid the SWDA or may travel at reduced speeds through the SWDA, which could result in extended travel time. The presence of the WTGs and ESPs can increase the risk of incident with search and rescue (SAR) vessels and may affect the USCG's airborne SAR assets, although New England Wind may facilitate SAR operations as the WTGs and ESPs will be marked and lighted and New England Wind vessels will operate frequently within the SWDA. The submarine cables within the SWDA and along the OECC are not anticipated to preclude vessel activities.	New England Wind's 1 x 1 NM WTG/ESP layout is consistent with USCG's recommendations that WTG layouts within the WEAs should be developed along a standard and uniform grid pattern with at least three lines of orientation and standard spacing. As stated in USCG's (2020) Massachusetts and Rhode Island Port Access Route Study (MARIPARS), "A standard and uniform grid pattern for offshore structures with multiple straight orientations throughout the MA/RI WEA would maximize safe navigation within the MA/RI WEA." The WTGs and ESPs will become PATONs once they are installed. The Proponent will implement a uniform system of marine navigation lighting and marking for the offshore facilities, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. The Proponent also expects to indicate the WTG's air draft restriction on the foundation and/or tower. MRASS and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety. To minimize hazards to navigation, all

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Navigation and Vessel Traffic (Section 7.8) (Continued)	Increased vessel traffic due to New England Wind construction activities is expected to have little to no effect on the operation of marine radar systems. The New England Wind WTGs may affect some shipborne radar systems, potentially creating false targets and clutter on the radar display.	New England Wind-related vessels and equipment will display the required navigation lighting and day shapes. The Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue NTMs advising other vessel operators of construction and installation activities. The Proponent employs a Marine Operations Liaison Officer and will employ a Marine Coordinator during construction of each Phase to coordinate with maritime partners and stakeholders (e.g. USCG, US Navy, port authorities, state and local law enforcement, marine patrol, commercial operators, etc.). Local port communities and local media will also be notified and kept informed as the construction progresses. The Proponent's website will be updated regularly to provide information on the construction activities and specific New England Wind information. The WTGs and ESPs will also be clearly identified on NOAA nautical charts. To mitigate potential impacts to SAR aircraft operating in the SWDA, the Proponent will work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations. Temporary safety buffer zones are expected to improve safety in the vicinity of active work areas during construction. The temporary safety buffer zones would be adjusted as construction work areas change within the SWDA or along the OECC, allowing fishermen and other stakeholders to use portions of the Offshore Development Area not under construction. See BMPs #33, #41, and #43 in Table 4.2-2.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Other Uses (National Security, Aviation, Offshore Energy, Marine Minerals, Cables and Pipelines, Radar, and Scientific Research) (Section 7.9)	The Proponent does not anticipate that use of vessels during construction or O&M will result in significant interference with either US Navy or USCG operations. The New England Wind layout is consistent with the USCG's recommendations and is therefore not expected to cause significant interference with US Navy or USCG operations. Overall, construction of New England Wind may cause some aircraft (particularly those conducting training exercises, surveys, and SAR operations) to alter their flight paths to avoid WTGs in the SWDA; however, based on the volume of other airspace available and the low percentage of aircraft using the airspace above the Offshore Development Area, impacts to aviation are not expected. While at the construction staging area, the WTGs and onshore cranes may exceed 61 m (200 ft) above ground level (AGL) or may otherwise require notice to the FAA. Airports and heliports located along the shore in the vicinity of the vessel routes could be affected by vessels carrying WTG towers or other components. Due to the low altitude associated with Warning Area W-105A overlying portions of the SWDA, offshore wind development could have an impact on its training operations. At a maximum height of 357 m (1,171 ft), the WTGs may necessitate changes to minimum vectoring altitudes (MVAs) for several sectors in Boston Consolidated (A90) Terminal Radar Approach Control (TRACON) and Providence (PVD) TRACON. However, because most existing air traffic over the SWDA occurred at altitudes that would not be impacted by the presence of WTGs (i.e. between 457 and 1,524 m [1,500 and 5,000 ft] above mean sea level [AMSL]), it is unlikely that any potential impacts would affect a significant volume of flight operations. Based on the fact that there are multiple air traffic control, air defense, and homeland security radar sites within approximately 185 km (100 NM) of New England Wind, overlapping coverage in addition to existing efforts by the operator(s) to optimize radar systems are expected to mitigate any potential effects of New England Wind.	The SWDA is located in the MA WEA, which was selected by BOEM, in part, because it avoids and/or minimizes conflicts with the other uses of the OCS. The Proponent will coordinate closely with the Department of Defense (DoD), US Navy, and USCG to minimize potential conflicts in the Offshore Development Area during construction activities, O&M, and decommissioning. The Proponent will issue Offshore Wind Mariner Update Bulletins and work with the USCG to provide NTMs. In accordance with the stipulations in Lease OCS-A 0534, the Proponent will temporarily suspend operations and evacuate the SWDA if required for national security or defense purposes. All temporary and permanent structures, including vessels and their appurtenances, located within territorial airspace that exceed an overall height of 61 m (200 ft) AGL/AMSL or any obstruction standard contained in 14 CFR Part 77 will be marked and/or lighted in accordance with FAA Advisory Circular (AC)70/7460-1M (unless current guidance is modified by the FAA by the time Phase 2 proceeds). The WTGs and ESPs will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements in effect at the time each Phase proceeds. For Phase 1, the Proponent expects to use an ADLS that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent would expect to use the same or similar approaches to reduce lighting used for Phase 1, including the use of an ADLS. Use of an ADLS or similar system would reduce the potential impacts of nighttime light on migratory birds and minimize potential visual impacts. The Proponent will continue to collaborate with other offshore wind developers to minimize potential impacts to other offshore wind energy projects. The Proponent has also defined a range of ports that may be used for New England Wind construction activities to provide flexibility. Since there are no federal OCS sand and mineral lease areas or identified significant sand resource blocks within the Offshore Development Region, New England Wind avoids impacts to sand and mineral extraction activities.

Table 4.2-1 Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures (Continued)

Resource	Potential Impacts	Avoidance, Minimization, and Mitigation Measures
Other Uses (National Security, Aviation, Offshore Energy, Marine Minerals, Cables and Pipelines, Radar, and Scientific Research) (Section 7.9 (Continued)	The New England Wind offshore export cable routes and interconnection points for New England Wind may impact the siting of other offshore wind projects. New England Wind's construction activities could also affect other offshore wind projects' access to port facilities, vessels, construction equipment, and personnel. The Proponent does not anticipate that O&M activities will interfere with any of the offshore wind energy projects proposed within the MA WEA and RI/MA WEA. New England Wind is not anticipated to impact any proposed future sand and mineral extraction. While the OECC for Phases 1 and 2 does not cross any existing offshore cables or pipelines and will not cross Vineyard Wind 1's offshore export cables, the installation and alignment of the offshore export cables may impact the siting of future submarine cables. However, it is expected that any future-installed cables would be able to cross New England Wind's offshore export cables using standard cable crossing techniques. Because the closest NEXRAD facility to the SWDA (KBOX) is located approximately 110 km (68 mi) away, there are no anticipated impacts associated with the WTGs that would require the implementation of mitigation measures. During construction of Phases 1 and 2, research and survey vessels in the SWDA and along the OECC may need to temporarily alter transit routes to avoid construction activities. Low altitude aerial surveys may also need to alter routes to avoid WTGs. Potential offshore wind energy development in any of the lease areas within the RI/MA WEA and MA WEA may impact Northeast Fisheries Science Center (NEFSC) surveys.	The OECC for Phases 1 and 2 does not cross any existing offshore cables or pipelines. If a future crossing of the Proponent's offshore export cables is proposed by another offshore wind developed and cannot be avoided, the Proponent will work with the developer to ensure that the planned cable crossing maintains the integrity of the cables will minimizes impacts to other stakeholders (e.g. commercial fishermen). As a result of consultations with DoD and the North American Aerospace Defense Command (NORAD), for the Proponent expects to enter into an agreement with DoD to mitigate any potential conflicts or impacts to NORAD radar systems. There are no anticipated NEXRAD impacts associated with the WTGs that would require the implementation of mitigation measures. The Proponent will support the continuation of research in the Offshore Development Region and is participating in regional science efforts with a specific focus on fish, avian, and marine mammal species. The Proponent is already engaging in collaboration with other developers, fishing industry representatives, and state and federal agencies through its participation in ROSA and the RWSE. Furthermore, the Proponent has already conducted numerous surveys to characterize the Offshore Development Area including, but not limited to, boat-based offshore avian surveys, fisheries surveys, and benthic habitat surveys. Environmental and fisheries data collected by the Proponent will be available in the public domain in a manner consistent with other academic research. Additionally, BOEM and NOAA Fisheries have indicated they are working collaboratively to design appropriate surveys, or changes in survey methodologies, that can generate comparable information to the historic dataset. BOEM has contributed $650,000 to NOAA Fisheries to begin the process of adapting NOAA Fisheries sampling techniques for the bottom trawl survey to offshore wind facilities. BOEM and NOAA Fisheries have committed to implement NOAA Fisheries' Federal Survey Mitigation Program, which will be implemented within two years of the Vineyard Wind 1 COP approval and will address impacts from offshore wind development on NOAA Fisheries' surveys. See BMPs #42 and #44 in Table 4.2-2.

In addition to or in agreement with the avoidance, minimization, and mitigation measures described in Table 4.2-1 above, New England Wind will comply with BOEM's best management practices (BMPs) outlined in Appendix A of *Information Guidelines for a Renewable Energy Construction and Operations Plan (COP), Version 4.0 (2020)*. Table 4.2-2 identifies how New England Wind will address or adhere to BOEM's BMPs. However, it is important to recognize that New England Wind will implement additional BMPs beyond those prescribed by BOEM, as described in Table 4.2-1 above.

Table 4.2-2 BOEM's Best Management Practices

#	Best Management Practice	New England Wind Activities
Preconstruction Planning		
1	Minimize the area disturbed by preconstruction site monitoring and testing activities and installations.	The Proponent's preconstruction geophysical and geotechnical work is designed to minimize impacts in accordance with approved survey plans and lease requirements. Wildlife studies have employed minimally invasive techniques for observing species and habitat presence.
2	Contact and consult with the appropriate affected federal, state, and local agencies early in the planning process.	During the development of the COP (and other permit filings), the Proponent has engaged with federal, state, and local agencies to identify and address any issues of potential concern. This engagement has informed the design of New England Wind and the activities presented in the COP. See Section 5.2 of COP Volume I for a description of agency consultations.
3	Consolidate necessary infrastructure requirements whenever practicable.	The Proponent has made every effort to consolidate infrastructure requirements. This is perhaps most evident with respect to the installation of five offshore export cables—two cables for Phase 1 and three cables for Phase 2—within a shared OECC, which will also be used for Vineyard Wind 1's offshore export cables.
4	Develop a program to monitor environmental conditions during construction, operation, and decommissioning phases. The monitoring program, including adaptive management strategies, should be established at the project level to mitigate potential adverse impacts.	Environmental conditions will be carefully monitored during construction, operation, and decommissioning of New England Wind. New England Wind's Health, Safety, and Environmental (HSE) Management System is discussed in Sections 3.3.4 and 4.3.4 of COP Volume I. The draft HSE Management System is provided in Appendix I-B. Resource specific monitoring plans are discussed throughout COP Volume III. Adaptive management strategies, based on ongoing monitoring results, are expected to be established. A general discussion of proposed adaptive management strategies pertinent to each resource are located in the individual sections throughout COP Volume III.
5	Conduct seafloor surveys in the early phases of a project to ensure that the alternative energy project is sited appropriately to avoid or minimize potential impacts associated with seafloor instability or other hazards.	The SWDA is located within the MA WEA, which was identified by BOEM as suitable for wind energy development after a multi-year, multi-agency public process. In addition, the Proponent has conducted several years of geophysical and geotechnical surveys to confirm that site conditions are suitable for New England Wind. See COP Volume II for detailed discussions of site conditions.

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
Seafloor Habitats		
6	Conduct appropriate pre-siting surveys to identify and characterize potentially sensitive seafloor habitats and topographic features.	Pre-siting surveys have been conducted to identify and characterize potentially sensitive seafloor habitats and topographic features. See COP Volume II and Sections 6.5 and 6.6 of COP Volume III for detailed findings.
7	Avoid locating facilities near known sensitive seafloor habitats, such as coral reefs, hard-bottom areas, and chemosynthetic communities.	The SWDA is located in the MA WEA, which has been sited to avoid the most sensitive areas for benthic and other resources. The Proponent has routed the OECC to avoid and minimize impacts to sensitive habitats where feasible. The preliminary routing of the Phase 1 and Phase 2 offshore export cables has avoided sensitive habitats including eelgrass beds, hard bottom, and complex bottom (i.e. sand waves) where feasible, but avoidance of all sensitive habitats is not always possible. The identified eelgrass resources near Spindle Rock in proximity to the landfall sites will be avoided. Additionally, the eelgrass resources in proximity to the potential Phase 2 landfall sites, located outside the OECC boundary, will be avoided. It is also expected that isolated areas of hard bottom may be avoided, such as at Spindle Rock; however, in areas such as Muskeget Channel where hard bottom extends across the entire corridor, it will not be possible to avoid hard bottom. No state-managed artificial reefs have been documented within the SWDA. Other types of potentially sensitive or unique benthic habitat types, such as live bottom, are also not present based on the Shallow Hazards Assessment discussed in Section 3 of COP Volume II. Similarly, no observations of living bottom have been made within the SWDA based on data available on the National Oceanic and Atmospheric Administration (NOAA) Deep-Sea Coral Data Portal (NOAA 2019).
8	Avoid anchoring on sensitive seafloor habitats.	For each Phase, prior to the start of construction, contractors will be provided with a map of sensitive habitats to allow them to plan their mooring positions accordingly. Vessel anchors and legs will be required to avoid known eelgrass beds and will also be required to avoid other sensitive seafloor habitats (hard/complex bottom) as long as such avoidance does not compromise the vessel's safety or the cable's installation. Where it is considered impossible or impracticable to avoid a sensitive seafloor habitat when anchoring, use of mid-line anchor buoys will be considered, where feasible and considered safe, as a potential measure to reduce and minimize potential impacts from anchor line sweep.

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
	Seafloor Habitats (Continued)	
9	Employ appropriate shielding for underwater cables to control the intensity of electromagnetic fields.	Offshore cables will be configured as described in Sections 3.2.1.5, 3.2.1.6, 4.2.1.5, 4.2.1.6 of COP Volume I. In addition, cable casing and burial will serve to greatly mitigate potential EMF impacts.
10	Reduce scouring action by ocean currents around foundations and to seafloor topography by taking all reasonable measures and employing periodic routine inspections to ensure structural integrity.	Scour protection consisting of rock may be placed around each WTG and ESP foundation. An evaluation of the potential for scour at the SWDA is included as Appendix III-Q. Scour protection will be routinely inspected as described in Sections 3.3.2.3 and 4.3.2.3 of COP Volume I.
11	Avoid the use of explosives when feasible to minimize impacts to fish and other benthic organisms.	Explosives are not intended to be used during the construction, operation, or decommissioning of New England Wind.
12	Take all reasonable actions to minimize seabed disturbance and sediment dispersion during cable installation.	A number of cable installation techniques are being considered that will both minimize seabed disturbance and sediment dispersion and prioritize cable burial. See Section 5.2.2 of COP Volume III for detailed discussions of disturbance and sediment dispersion minimization.
	Marine Mammals	
13	Evaluate marine mammal use of the proposed project area and design the project to minimize and mitigate the potential for mortality or disturbance. The amount and extent of ecological baseline data required will be determined on a project basis.	Section 6.7.1 of COP Volume III contains an extensive discussion of marine mammal abundance, status, distribution, and occurrence within the Offshore Development Area and Offshore Development Region based on multi-year studies of marine mammal use of the site. New England Wind has been designed with an understanding of marine mammal presence in the Offshore Development Area. Measures to avoid, minimize, and mitigate impacts to marine mammals are described in Section 6.7.4 of COP Volume III.
14	Vessels related to project planning, construction, and operation shall travel at reduced speeds when assemblages of cetaceans are observed. Vessels will also maintain a reasonable distance from whales, small cetaceans, and sea turtles, and these will be determined during site-specific consultations.	The Proponent will adhere to legally mandated vessel speeds, approach limits, and other vessel strike avoidance measures to reduce the risk of impact to North Atlantic right whales (NARWs) as a result of New England Wind activities in the SWDA. As safe and practicable, New England Wind's vessels will also follow NOAA guidelines for vessel strike avoidance, including vessel speed restrictions and separation distances, that are applicable at the time of construction and operations.
15	Minimize potential vessel impacts to marine mammals and turtles by having project-related vessels follow the NMFS Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	The Proponent will adhere to legally mandated vessel speeds, approach limits, and other vessel strike avoidance measures to reduce the risk of impact to NARWs as a result of New England Wind activities in the SWDA. As safe and practicable, New England Wind's vessels will also

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
Marine Mammals (Continued)		
15		follow NOAA guidelines for vessel strike avoidance, including vessel speed restrictions and separation distances, that are applicable at the time of construction and operations. All New England Wind personnel working offshore will receive environmental training, which will stress individual responsibility for marine mammal awareness and reporting. See Sections 6.7.4 and 6.8.4 of COP Volume III for additional details.
16	Take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	As described in Section 6.7.4 of COP Volume III, the Proponent will employ measures that will effectively avoid, minimize, and mitigate potential impacts to marine mammals from pile driving noise. Potential monitoring and mitigation measures include, but are not limited to, the use of seasonal restrictions, sound attenuation technology, sound field verification, PSOs, pile driving sort-start procedures, PAM, protective zones, shutdowns, and NARW-specific monitoring and mitigation.
17	Avoid and minimize impacts to marine species and habitats in the project area by posting a qualified observer on site during construction activities. This observer will be approved by BOEM and NMFS.	Monitoring of clearance, exclusion, and/or monitoring zones during pile driving will be conducted by National Marine Fisheries Service (NMFS) and BOEM-approved PSOs.
Fish Resources and Essential Fish Habitats		
18	Conduct pre-siting surveys (may use existing data) to identify important, sensitive, and unique marine habitats in the vicinity of the projects; then design the project to avoid, minimize, or otherwise mitigate adverse impacts to these habitats.	Pre-siting surveys have been conducted in the SWDA and OECC. Volume II describes site specific surveys. Section 6.5 of COP Volume III contains a discussion of benthic habitats in the Offshore Development Area and Offshore Development Region and describes measures to avoid, minimize, and mitigate impacts to those habitats. Appendix III-F contains a discussion of essential fish habitat (EFH) and measures to avoid, minimize, and mitigate impacts to EFH.
19	Minimize construction activities in areas containing anadromous fish during migration periods.	Avoidance, minimization, and mitigation measures for all fish species are discussed in Section 6.6.2 of COP Volume III.
20	Minimize seafloor disturbance during construction and installation of the facility and associated infrastructure.	Measures to avoid and minimize seafloor disturbance are described in Section 6.5 of COP Volume III.
Sea Turtles		
21	Minimize potential vessel impacts to marine mammals and sea turtles by having project-related vessels follow the NMFS Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	The Proponent will adhere to legally mandated vessel speeds, approach limits, and other vessel strike avoidance measures to reduce the risk of impact to NARWs as a result of New England Wind activities in the SWDA. As safe and practicable, New England Wind's vessels will also follow NOAA guidelines for vessel strike avoidance, including vessel speed restrictions and separation distances, that are applicable at the time of construction and operations. All New England Wind personnel working offshore will receive environmental training, which will stress individual responsibility for marine mammal awareness and reporting. See Sections 6.7.4 and 6.8.4 of COP Volume III for additional details.

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
Sea Turtles (Continued)		
22	Take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	As described in Section 6.8.4 of COP Volume III, the Proponent will employ measures that will effectively avoid, minimize, and mitigate impacts to sea turtles from pile driving noise. Potential monitoring and mitigation measures include, but are not limited to, the use of seasonal restrictions, sound attenuation technology, sound field verification, PSOs, pile driving sort-start procedures, PAM, protective zones, and shutdowns.
23	Locate cable landfalls and onshore facilities so as to avoid impacts to known nesting beaches.	The landfall sites and onshore facilities are not located near known sea turtle nesting beaches.
Avian Resources		
24	Evaluate avian use in the project area and design the project to minimize or mitigate the potential for bird strikes and habitat loss. The amount and extent of ecological baseline data required will be determined on a project-to-project basis.	The SWDA is located in the MA WEA, which was selected by BOEM, in part, to minimize and mitigate impacts to avian species. Section 6.1 of COP Volume III contains a discussion of inland birds and Section 6.2 of COP Volume III contains a discussion of coastal and marine birds. The offshore location of the WTGs avoids impacts to many bird species. Additional avoidance, minimization, and mitigation measures for bird species are presented in Sections 6.1 and 6.2 of COP Volume III. Appendix III-C contains extensive data on avian use of the Offshore Development Area.
25	Take measures to reduce perching opportunities.	Anti-perching is incorporated in the design of the WTGs using tubular WTG support towers. In accordance with safety and engineering requirements, the Proponent will consider installing anti-perching devices on the WTGs and ESP(s), where and if appropriate, to reduce potential bird perching locations.
26	Locate cable landfalls and onshore facilities so as to avoid impacts to known nesting beaches of sensitive species during the breeding season.	With the exception of the Phase 2 Wianno Avenue Landfall Site, disturbance of the beach at the Phase 1 and Phase 2 landfall sites will be largely avoided as the cables will pass under the beach, intertidal zone, and nearshore areas via HDD and come ashore in an existing paved parking area or other previously disturbed area. Thus, the use of HDD will avoid disturbing beach or dune habitat that might be used by piping plovers, other migratory shorebirds, or seabirds. The Wianno Avenue Landfall Site is more suited for open trenching than HDD due to the parking lot's elevated topography and the steep slope of the shoreline. The shoreline at the Wianno Avenue Landfall Site has already been altered by the installation of a riprap seawall and lacks dune habitat. Due to the proximity of the coastal dune to the Phase 1 landfall sites, the Proponent is developing a draft Piping Plover Protection Plan for construction activities at either Phase 1 landfall site that will mirror a similar plan assembled for Vineyard Wind 1 that was approved by NHESP (see Appendix III-R). The Proponent expects to develop a similar plan for the Phase 2 landfall sites, if needed. The Proponent expects that activities at the landfall sites will begin in advance of April 1, or will not begin until after August 31, to avoid and minimize noise impacts to piping plover during the breeding season.

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
	Avian Resources (Continued)	
27	Comply with Federal Aviation Administration (FAA) and USCG requirements for lighting in accordance with BOEM's "Draft Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development," dated October 2019, and use lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian species.	New England Wind structures located beyond 22 km (12 NM) are expected to be marked and/or lighted in accordance with BOEM's 2021 *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* or subsequent updates to that guidance, which is generally consistent with FAA AC 70/7460-1M. New England Wind will follow BOEM and FAA recommendations to use re flashing aviation obstruction lights on WTGs (unless current guidance is modified by the FAA and BOEM by the time Phase 2 proceeds). Lighting has been designed to minimize impacts on avian species (see Section 6.2.2 of COP Volume III). Each WTG and ESP will be maintained as a PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters (see Section 7.8 of COP Volume III and Appendix III-I).
	Acoustic Environment	
28	Plan site characterization surveys by using the lowest sound levels necessary to obtain the information needed.	Site characterization studies conducted to-date have used the lowest sound levels necessary to obtain the information needed. Future surveys will likewise do the same. Field verification results have shown minimal noise generated from geophysical equipment.
29	Take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	As described in Sections 6.6.2, 6.7.4, and 6.8.4 of COP Volume III, the Proponent will employ measures that will effectively avoid, minimize, and mitigate impacts to marine life from pile driving noise. Potential monitoring and mitigation measures include, but are not limited to, the use of seasonal restrictions, sound attenuation technology, sound field verification, PSOs, pile driving sort-start procedures, PAM, protective zones, shutdowns, and NARW-specific monitoring and mitigation.
30	Employ, to the extent practicable, state-of-the-art, low-noise turbines or other technologies to minimize operational sound effects.	Each Phase's WTGs will be among the most efficient renewable energy generators commercially available for offshore use at the time of construction. Impacts from operational sound are expected to be minor (see Section 6.7.2.3 of COP Volume III).
	Fisheries	
31	Work cooperatively with commercial/recreational fishing entities and interests to minimize potential conflicts with commercial and recreational fishing interests during construction and operation of a project.	The 1 x 1 NM WTG/ESP layout of New England Wind, which is consistent with recommendations from the USCG, will facilitate ongoing transit and fishing activities by commercial fishermen and is expected to accommodate traditional fishing patterns (see Section 7.6 of COP Volume III). The Proponent has developed a Fisheries Communication Plan (FCP) (included as Appendix III-E). Fisheries communication is conducted through several roles, including Fisheries Liaisons (FLs) and Fisheries Representatives. The Proponent also employs a Marine Operations Liaison Officer, who is responsible for safe marine operations by the Proponent. In an effort to provide fishermen with the most accurate and precise information on work within the SWDA and along the OECC, the

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
Fisheries (Continued)		
31		Proponent is currently providing and will continue to provide portable digital media with electric charts depicting locations of New England Wind-related activities. The Proponent is developing and implementing procedures for handling compensation to fishermen for potential gear loss. Additional information is provided in Appendix III-E.
32	Review planned activities with potentially affected fishing organizations and port authorities to prevent unreasonable fishing gear conflicts. Minimize conflict with commercial fishing activity and gear by notifying registered fishermen of the location and time frame of the project construction activities well in advance of mobilization; provide updates throughout the construction period.	The FCP is found in Appendix III-E. The Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue NTMs advising other vessel operators of construction and installation activities. The Proponent employs a Marine Operations Liaison Officer and will employ a Marine Coordinator during construction of each Phase to coordinate with maritime partners and stakeholders (e.g. USCG, US Navy, port authorities, state and local law enforcement, marine patrol, commercial operators, etc.). Local port communities and local media will also be notified and kept informed as the construction progresses. The Proponent's website will be updated regularly to provide information on the construction activities and specific New England Wind information. The WTGs and ESPs will also be clearly identified on NOAA nautical charts (see Section 7.6 of COP Volume III).
33	Use practices and operating procedures that reduce the likelihood of vessel accidents and fuel spills.	The Proponent is firmly committed to full compliance with applicable environmental protection regulations and codes. Environmental protection measures that reduce the likelihood of vessel accidents and fuel spills are discussed in Sections 5.2.2 and 8 of COP Volume III. The Proponent has also developed a draft Oil Spill Response Plan for New England Wind, which is included in Appendix I-F.
34	Avoid or minimize impacts to the commercial fishing industry by marking applicable structures (e.g., wind turbines, wave generation structures) with USCG-approved measures (e.g., lighting) to ensure safe vessel operation.	Each WTG and ESP will be maintained as a PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The Proponent will implement a uniform system of marine navigation lighting and marking for the offshore facilities, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. MRASS and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety. See Section 7.8 of COP Volume III and Appendix III-I for additional details.
35	Avoid or minimize impacts to the commercial fishing industry by burying cables, where practicable, to avoid conflict with fishing vessels and gear operation. If cables are buried, inspect cable burial depth periodically during project operation to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity.	The target burial depth for all inter-array, inter-link, and offshore export cables is 1.5 to 2.5 m (5 to 8 ft) below the seafloor, which is more than twice the burial depth that is required to protect the cables from fishing activities (e.g. the use of bottom trawl gear) and also provides a maximum of 1 in 100,000 year probability of anchor strike, which is considered a negligible risk (see Appendix III-P). During O&M, the offshore export cables will be regularly monitored.

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
	Coastal Habitats	
36	Avoid hard-bottom habitats, including seagrass communities and kelp beds, where practicable, and restore any damage to these communities.	The Proponent has routed the proposed OECC to avoid and minimize impacts to sensitive habitats where feasible. The preliminary routing of the Phase 1 and Phase 2 cables has avoided sensitive habitats including eelgrass beds, hard bottom, and complex bottom (i.e. sand waves) where feasible, but avoidance of all sensitive habitats is not always possible. The identified eelgrass resources near Spindle Rock in proximity to the landfall sites will be avoided. Additionally, the eelgrass resources in proximity to the potential Phase 2 landfall sites, located outside the OECC boundary, will be avoided. It is also expected that isolated areas of hard bottom may be avoided, such as at Spindle Rock; however, in areas such as Muskeget Channel where hard bottom extends across the entire corridor, it will not be possible to avoid hard bottom. Prior to the start of construction for each Phase, contractors will be provided with a map of sensitive habitats to allow them to plan their mooring positions accordingly. Vessel anchors and legs will be required to avoid known eelgrass beds and will also be required to avoid other sensitive seafloor habitats (hard/complex bottom) as long as such avoidance does not compromise the vessel's safety or the cable's installation. Where it is considered impossible or impracticable to avoid a sensitive seafloor habitat when anchoring, use of mid-line anchor buoys will be considered, where feasible and considered safe, as a potential measure to reduce and minimize potential impacts from anchor line sweep (see Section 6.4 of COP Volume III).
37	Implement turbidity reduction measures to minimize effects to hard-bottom habitats, including seagrass communities and kelp beds, from construction activities.	Any turbidity related to cable installation activities, HDD, and foundation installation is expected to be temporary and limited in spatial scope. See Section 5.2 of COP Volume III and Appendix III-A.
38	Minimize effects to seagrass and kelp beds by restricting vessel traffic to established traffic routes.	The identified eelgrass resources near Spindle Rock in proximity to the landfall sites will be avoided. Additionally, the eelgrass resources in proximity to the potential Phase 2 landfall sites, located outside the OECC boundary, will be avoided. Prior to the start of construction for each Phase, contractors will be provided with a map of sensitive habitats to allow them to plan their mooring positions accordingly. Vessel anchors and legs will be required to avoid known eelgrass beds.
39	Minimize impacts to wetlands by maintaining buffers around wetlands, implementing BMPs from erosion and sediment control, and maintaining natural surface drainage patterns.	Through careful route selection and proper use of construction techniques such as HDD and other trenchless crossings, New England Wind is designed to avoid potential wetlands impacts to the maximum extent practicable. See Section 6.1 of COP Volume III.

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
Electromagnetic Fields		
40	Use submarine cables that have proper electrical shielding and bury the cables in the seafloor, when practicable.	Offshore cables will be configured as described in Sections 3.2.1.5, 3.2.1.6, 4.2.1.5, 4.2.1.6 of COP Volume I. In addition, cable casing and burial will serve to greatly mitigate potential EMF impacts.
Transportation and Vessel Traffic		
41	Site alternative energy facilities to avoid unreasonable interference with major ports and USCG-designated Traffic Separation Schemes.	The SWDA is within the MA WEA, which, after public comment, was developed to avoid shipping lanes and USCG-designated Traffic Separation Schemes.
42	Meet FAA guidelines for sighting and lighting of facilities.	The WTGs and ESPs will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements in effect at the time each Phase proceeds (see Sections 3.2.1 and 4.2.1 of COP Volume I).
43	Place proper lighting and signage on applicable alternative energy structures to aid navigation per USCG circular NVIC 07-02 (USCG 2007) and comply with any other applicable USCG requirements.	Each WTG and ESP will be maintained as a PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The Proponent will implement a uniform system of marine navigation lighting and marking for the offshore facilities, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. MRASS and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety. See Section 7.8 of Volume III and Appendix III-I for additional details.
44	Conduct all necessary studies of potential interference of proposed wind turbine generators with commercial air traffic control radar systems, national defense radar systems, and weather radar systems; also identify possible solutions.	The Proponent undertook an Air Traffic Flow Analysis and an Obstruction Evaluation and Airspace Analysis, which are provided in Appendix III-J. Mitigation measures are discussed in Section 7.9 of COP Volume III.
Visual Resources		
45	Address key design elements, including visual uniformity, use of tubular towers, and proportion and color of turbines.	The WTGs are uniformly tubular towers that will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color; the Proponent anticipates that the WTGs will be painted off-white/light grey to reduce their visibility against the horizon. The upper portion of the ESP(s) will also be a grey color, which would appear muted and indistinct. Sections 3.2.1 and 4.2.1 of COP Volume I provide the dimensions and coloring of the WTGs and ESPs.
46	Use appropriate viewshed mapping, photographic and virtual simulations, computer simulation, and field inventory techniques to determine, with reasonable accuracy, the visibility of the proposed project. Simulations should illustrate sensitive and scenic viewpoints.	Geographic Information System (GIS) viewshed calculation, photo simulations, and field observations have been used to determine the visibility of New England Wind's offshore facilities. The photo simulations illustrate the offshore facilities from key observation points. See Section 7.4 of COP Volume III and Appendices II-H.a and H.b.

Table 4.2-2 BOEM's Best Management Practices (Continued)

#	Best Management Practice	New England Wind Activities
Visual Resources (Continued)		
47	Comply with FAA and USCG requirements for lighting in accordance with BOEM's "Draft Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development," dated October 2019, and minimize visual impacts through appropriate application.	The WTGs and ESPs will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements in effect at the time each Phase proceeds (see Sections 3.2.1 and 4.2.1 of COP Volume I). Each WTG and ESP will be maintained as a PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The Proponent will implement a uniform system of marine navigation lighting and marking for the offshore facilities, which is currently expected to include yellow flashing lights on every WTG foundation and ESP (see Section 7.8 of Volume III and Appendix III-I).
48	Seek public input in evaluating the visual site design elements of proposed wind energy facilities.	Outreach on visual impacts and visual simulations was conducted on both Martha's Vineyard and Nantucket in August and September of 2017, respectively, for Vineyard Wind 1, which is adjacent to New England Wind. Notices advertising the meetings were placed in the local newspapers. Such discussions have informed the development of New England Wind.
49	Within FAA guidelines, directional aviation lights that minimize visibility from shore should be used.	To substantially reduce the amount of time the aviation obstruction lights are visible, the Proponent expects to use an ADLS that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent expects to use the same or similar approaches to reduce lighting used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS.
Operations		
50	Prepare waste management plans, hazardous material plans, and oil spill prevention plans, as appropriate, for the facility.	The Proponent has developed a draft Oil Spill Response Plan for New England Wind, which is included in Appendix I-F. New England Wind's draft HSE Management System is provided in Appendix I-B. As planning and design proceeds, a detailed chemical and waste management plan will be developed and provided to BOEM. See Sections 3.3.4 and 4.3.4 of COP Volume I.

5.0 PHYSICAL RESOURCES

5.1 Air Quality

This section describes the benefits and impacts from New England Wind on regional air quality.

The Bureau of Ocean Energy Management (BOEM) only regulates air quality for facilities located on the Outer Continental Shelf (OCS) in the Gulf of Mexico west of 87°30'W longitude and areas offshore the North Slope of Alaska. The Environmental Protection Agency (EPA) regulates air quality in all other portions of the OCS. Emissions from New England Wind on the OCS are therefore regulated through EPA's OCS Air Permit process under the OCS Air Regulations (40 CFR Part 55). Per 30 CFR § 585.659 and BOEM's Construction and Operations Plan (COP) guidelines, the Proponent will provide a copy of New England Wind's OCS Air Permit application(s) to BOEM when submitted to EPA. The application(s) will quantify potential emissions from New England Wind's OCS sources.

This section provides an analysis of all potential air emissions from both Phases of New England Wind[15] (both emissions regulated and not regulated by the OCS Air Regulations) in order for BOEM to assess New England Wind's impacts to air quality under the National Environmental Policy Act (NEPA). Appendix III-B contains a preliminary inventory of New England Wind's anticipated emission sources and describes the methodology used to estimate New England Wind emissions.

5.1.1 Description of the Affected Environment

While New England Wind's wind turbine generators (WTGs) will not generate air emissions, air emissions from construction, operations and maintenance (O&M), and decommissioning activities may affect air quality in and around the Offshore Development Region and Onshore Development Region.

With respect to air quality, the Offshore Development Region is the broader offshore geographic region surrounding the Southern Wind Development Area (SWDA), which includes all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501, the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]), and ports that could be affected by New England Wind-related activities. This includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), and waters surrounding potential vessel routes to the ports identified for use by New England Wind.

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15 The air emission analysis for NEPA purposes includes New England Wind emissions onshore, in state waters, and in federal waters within the US Exclusive Economic Zone, which extends approximately 370 kilometers (km) 200 nautical miles (NM) offshore.

The Onshore Development Region, with respect to air quality, is the broader onshore geographic region comprising of the cities, towns, and communities surrounding New England Wind's onshore facilities, O&M facilities, port facilities, and construction staging areas that could be affected by New England Wind-related activities. The Onshore Development Region encompasses the Onshore Development Areas for Phases 1 and 2. For each Phase, the Onshore Development Area consists of the areas where the onshore facilities could be physically located, which includes the landfall sites, the Onshore Export Cable Routes, the onshore substation sites, the Grid Interconnection Routes, and the grid interconnection point.[16]

Within Massachusetts, the geographic areas where New England Wind-related air emissions may occur include Barnstable County, Bristol County, Dukes County, Essex County, and Nantucket County (offshore). New England Wind air emissions in Barnstable County will primarily result from the construction and installation of offshore export cables, onshore cables, and onshore substations. Air emissions in Bristol County may result from port usage and construction staging activities at the New Bedford Marine Commerce Terminal, other areas in New Bedford Harbor, Brayton Point, and/or Fall River. Post usage and construction staging activities in Salem Harbor (if used), would result in emissions in Essex County. Air emissions in Dukes County will be associated with offshore export cable installation and the use of port facilities in Vineyard Haven. In Nantucket County, emissions will only occur offshore Nantucket during vessel transits and offshore export cable installation.

As described in Sections 3.2.2.5, 3.2.2.6, 4.2.2.5, and 4.2.2.6 of COP Volume I, both Phases of New England Wind may also use port facilities in Rhode Island, Connecticut, New York, and New Jersey.[17] Use of ports in Rhode Island as well as vessel transits to/from those ports may result in emissions occurring within all counties in Rhode Island. Use of ports in Connecticut and on Long Island (including vessel transits to/from the ports) may cause emissions in New London, Middlesex, New Haven, and Fairfield Counties in Connecticut as well as Suffolk County, New York and Washington County, Rhode Island. Use of ports in the New York City Metropolitan Area and New York Capital Region may cause emissions within New York and New Jersey counties along the East River and Hudson River from the Atlantic Ocean to Albany. Use of port facilities in Paulsboro, New Jersey may cause emissions within counties in New Jersey, Delaware, and Pennsylvania along the Delaware River between the ocean and Paulsboro. It is also possible that one or more Canadian and European ports could be used; however, the New England Wind air emissions analysis focuses on impacts within United States (US) waters.

16 As described in Sections 4.1.3 and 4.1.4 of COP Volume I, one or more Phase 2 offshore export cables may deliver power to a second grid interconnection point via the South Coast Variant if technical, logistical, grid interconnection, or other unforeseen issues arise.

17 It is not expected that all the ports identified would be used; it is more likely that only some ports would be used.

Air quality within a region is measured against National Ambient Air Quality Standards (NAAQS), which EPA has established to protect public health and welfare. EPA has set NAAQS for six criteria air pollutants that are considered harmful to public health and the environment: sulfur dioxide (SO_2), two types of particulate matter (smaller than 10 microns as PM_{10} and smaller than 2.5 microns as $PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), lead (Pb), and ozone (O_3). Typically, ozone is not emitted directly into the air; instead, ground-level ozone primarily forms from the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NOx) in sunlight. VOCs and NOx, which are often emitted directly into the air, are commonly referred to as ozone precursors. Therefore, emissions of the precursors to ozone are quantified instead of ozone.

NAAQS have been developed for various durations of exposure and consist of primary and secondary standards. Primary standards are intended to protect human health. Secondary standards are intended to protect public welfare from known or anticipated adverse effects associated with the presence of air pollutants, such as damage to property or vegetation. The NAAQS are summarized in Table 5.1-1 below.

Table 5.1-1 National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	NAAQS[7] (µg/m³)	
		Primary	Secondary
NO_2	Annual[1]	100	Same
	1-hour[2]	188	None
SO_2	3-hour[3]	None	1300
	1-hour[4]	196	None
$PM_{2.5}$	Annual[1]	12	15
	24-hour[5]	35	Same
PM_{10}	24-hour[3]	150	Same
CO	8-hour[3]	10,000	Same
	1-hour[3]	40,000	Same
Ozone	8-hour[6]	147	Same
Pb	3-month[1]	0.15	Same

Notes:
1. Not to be exceeded.
2. 98th percentile of one-hour daily maximum concentrations, averaged over three years.
3. Not to be exceeded more than once per year.
4. 99th percentile of one-hour daily maximum concentrations, averaged over three years.
5. 98th percentile, averaged over three years.
6. Annual fourth-highest daily maximum eight-hour concentration, averaged over three years.
7. Source: https://www.epa.gov/criteria-air-pollutants/naaqs-table.

To assess compliance with the NAQQS, ambient air quality concentrations of criteria pollutants are determined using data collected by a network of monitoring stations that are mainly operated by US states. These monitoring sites provide long-term assessment of pollutant levels by measuring the quantity and types of certain pollutants in the surrounding, outdoor air.

EPA uses this air quality data to classify all areas of the country as in *attainment*, *nonattainment*, or *unclassified* with the NAAQS. When the monitored pollutant levels in an area exceed the NAAQS for any pollutant, the area is classified as in "nonattainment" for that pollutant. An attainment area is defined as an area that meets or is cleaner than the NAAQS. An unclassified area is defined as an area that cannot be classified as meeting or not meeting the NAAQS based on available information and is treated as an attainment area. Note that an area can be in attainment/unclassified for some pollutants and nonattainment for others. Additionally, if an area was in nonattainment within the last 20 years, but is currently in attainment or unclassified, the area is called a maintenance area. For coastal areas, the nonattainment or maintenance area boundary extends to the state's seaward boundary, which is three nautical miles (NM) for most states (EPA 2010). An area's attainment status can be found in Designation of Areas for Air Quality Planning Purposes (40 CFR Part 81). Revisions to 40 CFR Part 81 are periodically published by the EPA in the Federal Register and made available in the EPA's Green book (EPA 2019).

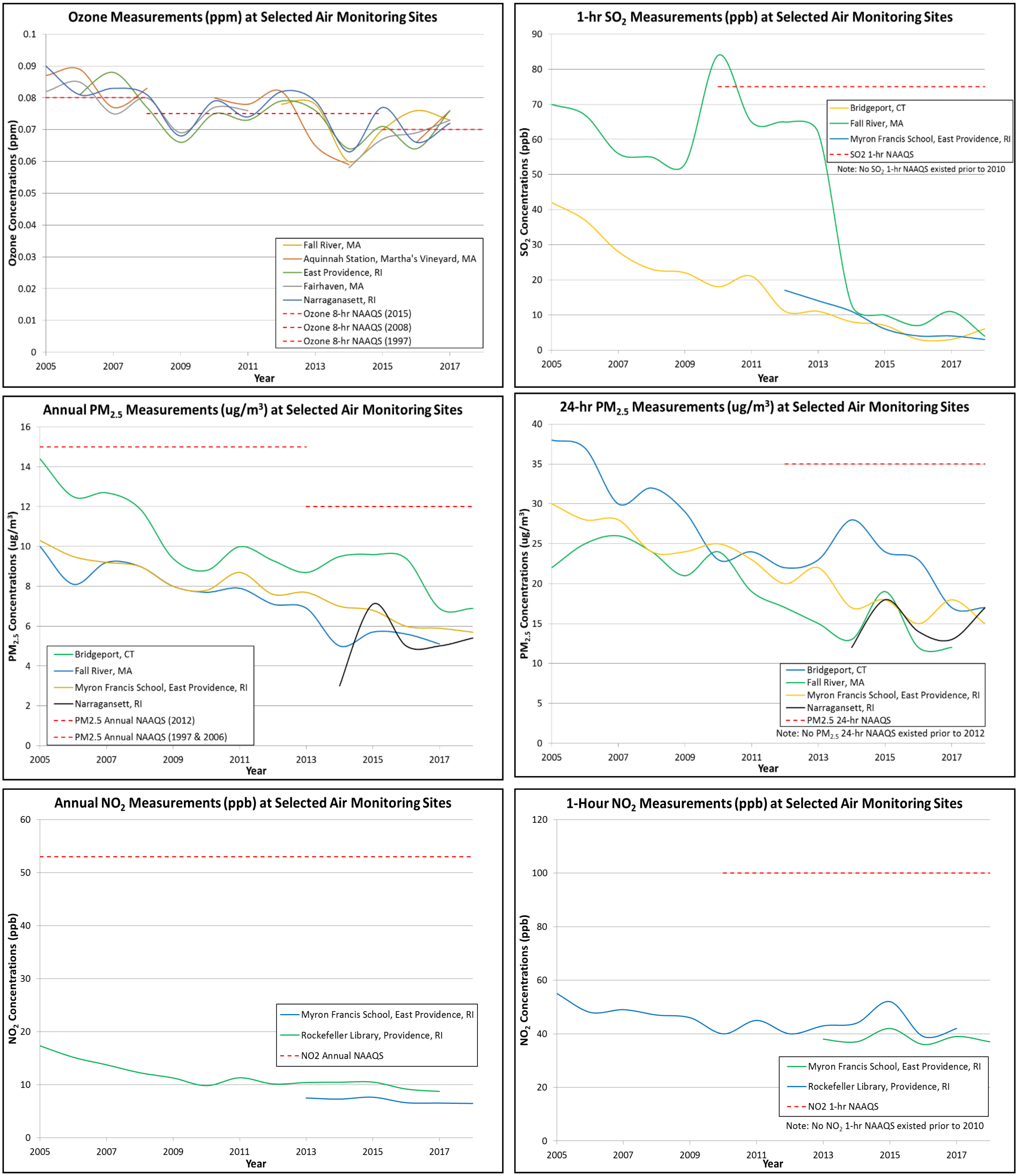
In addition to the criteria air pollutants discussed above, the assessment of potential emissions from New England Wind also includes hazardous air pollutants (HAPs) and greenhouse gases (GHGs). Although there are no national ambient air quality standards for HAPs and GHGs, emissions of these pollutants are regulated through state and federal emission standards (e.g. National Emission Standards for Hazardous Air Pollutants [NESHAPS]) and permit requirements. EPA has developed a list of 187 HAPs, also known as toxic air pollutants or air toxics, that are known or suspected to cause cancer or other serious health effects (e.g. reproductive health effects, birth defects, adverse environmental effects, etc.). HAPs are a subset of VOCs and PM.

GHGs, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and sulfur hexafluoride (SF_6), trap heat in the atmosphere. CO_2, which is a product of complete and incomplete combustion, accounts for the majority of GHGs (EPA 2016). SF_6 is often used to insulate electrical equipment. Because GHGs have different radiative properties and lifetimes in the atmosphere, GHGs differ in their ability to trap heat in the atmosphere. GHG emissions are calculated as carbon dioxide equivalents (CO_2e) to express their warming influences in a common metric.

The status of ambient air quality in areas where New England Wind emissions may occur are discussed below. In general, measured ambient air concentrations of key pollutants at several monitoring stations closest to the Offshore Development Area (i.e. the offshore area where New England Wind's offshore facilities are physically located, which includes the SWDA and OECC) show an overall trend of improvement in regional air quality over the last decade (see Figure 5.1-1).

Massachusetts

In Massachusetts, New England Wind emissions may occur in Barnstable, Bristol, Dukes, Essex, and Nantucket counties.



Sources: MassDEP Annual Air Quality Reports and US EPA Annual Air Monitor Summary Data

Figure 5.1-1

Ambient Air Quality in the Onshore Development Region

The Massachusetts Department of Environmental Protection (MassDEP) operates a network of 21 ambient air quality monitoring stations across Massachusetts to measure the concentration of numerous pollutants (criteria pollutants and their precursors, toxic air pollutants, and others) and assess compliance with the NAAQS. The Wampanoag Tribe of Gay Head (Aquinnah) also operates an ozone monitoring station on Martha's Vineyard (MassDEP 2019). Based on data from these air quality monitoring stations, Dukes County, Barnstable County, Bristol County, Essex County, and Nantucket County are presently designated in attainment or unclassified (which is treated as attainment) for five of the six criteria pollutants: SO_2, CO, PM (PM_{10} and $PM_{2.5}$), NO_2, and Pb (EPA 2019). The entire Commonwealth is in attainment/unclassifiable with the 2015 eight-hour ozone standard of 0.07 parts per million (ppm); however, Dukes County is still classified as in marginal nonattainment with the previous, less stringent 2008 eight-hour ozone standard of 0.075 ppm until that standard is revoked.[18] Attainment designations for each county are summarized in Table 5.1-2.

Between 1990 and 2016, GHG emissions in Massachusetts decreased by 21% from 95.4 million metric tons (MMT) of CO_2e in 1994 to 74.2 MMT CO_2e in 2016. However, in recent years (2012-2016), annual GHG emissions have plateaued at around 75 MMT CO_2e (Mass.gov 2019).

Rhode Island

New England Wind emissions may occur in all Rhode Island counties (Bristol, Kent, Newport, Providence, and Washington counties).

The Rhode Island Department of Environmental Management (RI DEM) and Rhode Island Department of Health monitor ambient air quality at six locations in Rhode Island to determine if Rhode Island is in compliance with the NAAQS (RI DEM 2018). The entire State of Rhode Island is currently in attainment for all six criteria pollutants and does not include any maintenance areas (EPA 2019). In Rhode Island, GHG emissions have generally declined since 1990. From 1990 to 2015, GHG emissions decreased from 12.48 to 11.33 MMT CO_2e (EC4 2016).

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18 Dukes County was designated as a marginal nonattainment area for the 2008 eight-hour ozone standard of 0.075 ppm and the rest of the Commonwealth was classified as being in attainment/unclassifiable with the 2008 standard. Effective December 28, 2015, the eight-hour ozone standard was further reduced to 0.07 ppm. Initial attainment designations for the 2015 standard were published by EPA on November 16, 2017 and became effective January 16, 2018; additional attainment designations were published by EPA on April 30, 2018 and became effective August 3, 2018. Because air quality in Massachusetts has improved, under the new designations, the entire Commonwealth, including Dukes County, is in attainment/unclassifiable with the stricter 2015 ozone standard. Although Dukes County attained the 2008 ozone standard by the 2015 attainment deadline and is in attainment with the stricter 2015 ozone standard, Dukes County is still considered a nonattainment area for the 2008 standard until that standard is revoked.

New York Metro Area

The New York-Northern New Jersey-Long Island, NY-NJ-CT Area, also known as the New York Metro Area, is comprised of the region surrounding New York City, Long Island, the southwestern portion of Connecticut, and the northern half of New Jersey. Within the New York Metro Area, emissions from New England Wind may occur in Fairfield, Middlesex, and New Haven counties in Connecticut; Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, and Westchester counties in New York; and Bergen, Hudson, Middlesex, and Monmouth counties in New Jersey.

The Connecticut Department of Energy and Environmental Protection (CT DEEP) monitors the concentrations of criteria pollutants, toxics, and metals via an air quality monitoring network of 14 stations (CT DEEP 2020). The New York State Department of Environmental Conservation (NYSDEC) monitors ambient air via 50 monitoring stations across the State, four of which are in Long Island (NYSDEC 2020). As of 2018, the New Jersey Department of Environmental Protection (NJDEP) operated 32 monitoring stations statewide, with 16 located in northern New Jersey.

Based on data collected from these stations, the New York Metro Area is classified as being in serious nonattainment with the 2008 eight-hour ozone standard (EPA 2019). The New York Metro Area was designated as a moderate nonattainment area for the revised 2015 ozone standard (EPA 2019). As summarized in Table 5.1-2 below, all counties in the New York Metro Area except New York County are in attainment for Pb, CO, NO_2, PM and SO_2, although some counties are still maintenance areas for certain pollutants. New York County is in moderate nonattainment with the 1987 PM_{10} standard and is a maintenance area for $PM_{2.5}$ and CO.

According to CT DEEP (2018), annual GHG emissions in Connecticut generally increased from 1990 to 2004, reaching a peak of approximately 54 MMT CO_2e in 2004. Between 2004 and 2016, annual GHG emissions decreased to approximately 41 MMT CO_2e in 2016, or 9% below 1990 levels. According to the New York State Energy Research and Development Authority (NYSERDA 2019), GHG emissions in New York followed a trend similar to Connecticut, generally increasing from 1990 to 2005 and decreasing from 2005 to 2016. GHG emissions in New York declined 13% between 1990 and 2016, from approximately 236 to 206 MMT CO_2e (NYSDERA 2019). According to NJDEP (2019), GHG emissions in New Jersey increased between 1990 and 2006, then decreased annually from 2006 to 2018. Since 2006, New Jersey has reduced GHG emissions from 126 to 97 MMT CO2e, or a reduction of approximately 23% (NJDEP 2019).

Greater Connecticut (Outside of New York Metro Area)

Outside of the New York Metro Area, New England Wind emissions may occur in New London County, which is part of the Greater Connecticut nonattainment area. The Greater Connecticut nonattainment area is designated as a serious nonattainment area for the 2008 ozone NAAQS, but is designated as in marginal nonattainment with the 2015 ozone standard (EPA

2019). New London County is currently in attainment for $PM_{2.5}$, PM_{10}, CO, Pb, and SO_2. As described above, GHG emissions in Connecticut have decreased in recent years (between 2004 and 2016).

Hudson River Valley (Outside of New York Metro Area)

In addition to the New York Metro Area, the use of ports on the Hudson River in the New York Capital Region may cause New England Wind emissions in Putnam, Orange, Dutchess, Ulster, Columbia, Greene, Rensselaer, and Albany counties in New York. These counties are all in attainment with NAAQS for Pb, CO, NO_2, PM, and SO_2, as well as both the 2008 and 2015 ozone standards. As described above, GHG emissions in New York have generally decreased in recent years (between 2005 and 2016).

Delaware River Valley (from Delaware Bay to Paulsboro, NJ)

Possible use of port facilities in Paulsboro, New Jersey may result in emissions along the Delaware River within Cape May, Cumberland, Gloucester, and Salem counties in New Jersey; Kent, New Castle, and Sussex counties in Delaware; and Delaware County in Pennsylvania. As determined by two air quality monitoring sites in New Jersey, one in Pennsylvania, and 11 in Delaware, these counties are all in attainment with NAAQS for Pb, CO, NO_2, PM, and SO_2.

Cape May, Cumberland, Gloucester, Salem, New Castle, and Delaware counties are within the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area, which is in marginal nonattainment for both the 2008 and 2015 ozone standards. Sussex County is in marginal nonattainment with the 2008 ozone standard, but is in attainment with the more stringent 2015 ozone standard. Kent County is in attainment for ozone.

No emission inventory specific to the Delaware River Valley area is readily available. In the state of Delaware itself, GHG emissions have decreased from 20 MMt CO_2e in 1990 to 15 MMt CO_2e in 2016, a reduction of 25% (DNREC 2019).

Attainment designations for all counties where New England Wind emissions may occur are summarized in Table 5.1-2. All counties potentially affected by New England Wind air emissions are in attainment with the NAAQS for 2012 $PM_{2.5}$, Pb, SO_2, and NO_2, which are not included in the following table.

Table 5.1-2 Air Quality Designations for Areas Where New England Wind Emissions May Occur

Area/County	2015 8-hour Ozone Standard	2008 8-Hour Ozone Standard	1997 & 2006 $PM_{2.5}$ Standard	1987 PM_{10} Standard	1971 CO Standard
Massachusetts					
Barnstable, Bristol, Essex, Nantucket, MA	Attainment[1]	Attainment	Attainment	Attainment	Attainment
Dukes, MA	Attainment	Dukes County Marginal Nonattainment Area	Attainment	Attainment	Attainment
Rhode Island					
All Rhode Island Counties (Bristol, Kent, Newport, Providence, Washington)	Attainment	Attainment	Attainment	Attainment	Attainment
New York Metro Area					
New Haven, CT	New York Metro Moderate Nonattainment Area	New York Metro Serious Nonattainment Area	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area	New Haven Maintenance Area	New Haven-Meriden-Waterbury, CT Maintenance Area
Middlesex, CT	New York Metro Moderate Nonattainment Area	New York Metro Serious Nonattainment Area	Attainment	Attainment	Hartford-New Britain-Middletown, CT Maintenance Area
Fairfield, CT	New York Metro Moderate Nonattainment Area	New York Metro Serious Nonattainment Area	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area	Attainment	New York-N. New Jersey-Long Island, NY-NJ-CT / New Haven-Meriden-Waterbury, CT Maintenance Area
Kings, Richmond, Bronx, Queens, Westchester, Nassau, NY	New York Metro Moderate Nonattainment Area	New York Metro Serious Nonattainment Area	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area	Attainment	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area
Rockland, NY	New York Metro Moderate Nonattainment Area	New York Metro Serious Nonattainment Area	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area	Moderate Nonattainment	Attainment

Table 5.1-2 Air Quality Designations for Areas Where New England Wind Emissions May Occur (Continued)

Area/County	2015 8-hour Ozone Standard	2008 8-Hour Ozone Standard	1997 & 2006 $PM_{2.5}$ Standard	1987 PM_{10} Standard	1971 CO Standard
New York, NY	New York Metro Moderate Nonattainment Area	New York Metro Serious Nonattainment Area	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area	Moderate Nonattainment	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area
Suffolk, NY, Bergen, NJ, Hudson, NJ, Middlesex, NJ, Monmouth, NJ	New York Metro Moderate Nonattainment Area	New York Metro Serious Nonattainment Area	New York-N. New Jersey-Long Island, NY-NJ-CT Maintenance Area	Attainment	Attainment
Greater Connecticut (Outside of New York Metro Area)					
New London, CT	Greater CT Marginal Nonattainment Area	Greater CT Serious Nonattainment Area	Attainment	Attainment	Attainment
Hudson River Valley (Outside of New York Metro Area)					
Albany, Rensselaer, Putnam, Orange, Dutchess, Columbia, Ulster, Greene, NY	Attainment	Attainment	Attainment	Attainment	Attainment
Delaware River Valley (from Delaware Bay to Paulsboro, NJ)					
Cape May, Cumberland, Salem, NJ	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Marginal Nonattainment Area	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Marginal Nonattainment Area	Attainment	Attainment	Attainment
Gloucester, NJ, New Castle, DE, Delaware, PA	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Marginal Nonattainment Area	Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Marginal Nonattainment Area	Philadelphia-Wilmington, PA-NJ-DE Maintenance Area	Attainment	Attainment
Kent, DE	Attainment	Attainment	Attainment	Attainment	Attainment
Sussex, DE	Attainment	Marginal Nonattainment	Attainment	Attainment	Attainment

Note:

1. Counties/areas depicted as in attainment may be in attainment or unclassified.

In addition, Connecticut, Delaware, Massachusetts, New Jersey, New York, Pennsylvania, and Rhode Island are part of the Ozone Transport Region (OTR). The OTR was established by Congress in 1990 in Section 184(a) of the Clean Air Act (CAA) to address ozone formation and pollution due to transport from upwind states to downwind states. Prevailing southwest to west winds carry air pollution in the form of NOx and VOCs from emission sources located outside of northeastern state boundaries into the northeast, contributing to high ozone concentrations in these areas. Other states included in the OTR are Maine, Maryland, New Hampshire, Vermont, parts of Virginia, and the District of Columbia. For states that are members of the OTR, counties or areas designated as unclassifiable/attainment for the 2008 and 2015 ozone standards are treated as moderate nonattainment areas for ozone (see CAA § 184(b)(2)).

Offshore in State and Federal Waters

Areas offshore are not assessed for NAAQS compliance; no air quality monitoring stations are located offshore to measure concentrations of air pollutants. Although there are no air quality monitoring stations offshore, the discussion of regional air quality above applies generally to the SWDA and OECC.

Vessels are the predominant emission sources in state and federal waters. Table 5.1-3 shows the tons of NOx, VOCs, CO, PM_{10}, $PM_{2.5}$, SO_2, and CO_2 emitted by commercial marine vessels (excluding recreational vessels) in US waters in 2017, according to supporting documentation developed for EPA's 2017 National Emissions Inventory (NEI).[19]

Table 5.1-3 Total Emissions from US Commercial Marine Traffic (2017)

Pollutant	NO_x	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2
Category 1 and 2 Marine Engines	213,637	8,348	31,290	5,807	5,628	738	14,628,561
Category 3 Marine Engines	633,966	35,093	66,492	29,324	26,978	182,324	31,181,884
Total Commercial Marine Emissions (tons)	847,603	43,441	97,782	35,131	32,607	183,062	45,810,445

Vessels with Category 1 and 2 engines (engines with a displacement of less than 30 liters per cylinder) tend to be smaller ships that operate closer to shore and along inland and intracoastal waterways, whereas vessels that use Category 3 engines for propulsion (with a displacement of

19 From *Table 9. Total NEI Emissions by Category 1 and 2 Marine Vessels* of Eastern Research Group's (ERG, 2019) *Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory* and total emissions from Category 3 commercial marine vessels from ERG's (2019) *Category 3 Commercial Marine Vessel 2017 Emissions Inventory*. Both documents were developed for the 2017 NEI and estimate emissions within 370 km (200 NM) of the official US coastline.

30 liters per cylinder or greater) tend to be ocean-going vessels (EPA 2018). Of the ~4,150 commercial marine vessels equipped with Category 1 and 2 propulsion engines included in EPA's 2014 National Emission Inventory, the large majority (76%) have engines manufactured before EPA's marine engine emission standards took effect in 2004 (i.e. have EPA Tier 0 engines). Only 1% of the vessels were reported to have engines meeting EPA's highest marine emission standards at that time (EPA Tier 3).

Few region or state-specific analyses of vessel emissions have been conducted in recent years for the Northeast region. MassDEP's *Massachusetts 2016 Diesel Particulate Matter Inventory* (2018) estimated PM emissions from recreational and commercial vessels (excluding Category 3 engine-powered vessels) in the state of Massachusetts. For 2016, MassDEP estimated that 5,797 diesel marine vessels operating in Massachusetts (including some vessels operating in inland waterways) emitted 75 US tons of $PM_{2.5}$. The vast majority of these vessels were fishing vessels (59%) and recreational vessels (38%), which contributed 54% and 25% of the total $PM_{2.5}$ emissions, respectively. Commercial marine vessels with an average power rating of 8,500 kilowatts (kW) constituted less than 1% of the vessel population, but contributed to 16% of $PM_{2.5}$ emissions due to their larger engine size (MassDEP 2018).

The Port Authority of New York and New Jersey (PANYNJ) annually compiles an inventory of emissions associated with the marine terminal activities linked to facilities maintained by PANYNJ. From 2006 to 2018, NOx, SO_2, and CO_2e emissions for ocean-going vessels calling at five PANYNJ marine terminals decreased by 41%, 98%, and 22%, respectively. In the same time span, NOx and SO_2 emissions from harbor craft decreased by 18% and more than 99%, respectively, while CO_2e emissions increased by 7% (PANYNJ 2020). In part, PANYNJ attributes these significant reductions in vessel emissions to the use of fuel with a sulfur content less than 1,000 ppm per the North American Emission Control Area requirements that took effect in 2015, which significantly reduces SO_2, NOx, and PM emissions from ocean-going vessels. The fuel sulfur limits for the North American Emission Control Area, which extends along the entire US East Coast, are expected to have similarly reduced emissions over the last few years at the ports planned for use by New England Wind. Practices such as the use of shore power while vessels hotel in port and financially incentivizing vessels to comply with Vessel Speed Reduction and exceed the current vessel emission standards have also contributed to the reduction in nearshore vessel emissions (PANYNJ 2020).

5.1.2 Potential Impacts of New England Wind

New England Wind's WTGs will not generate air emissions. Rather, electricity generated by the WTGs will displace electricity produced by fossil fuel power plants and significantly reduce emissions from the ISO New England (ISO-NE) electric grid over the lifespan of New England Wind. However, there will be air emissions from vessels, engines on construction equipment, aircraft (e.g. helicopters), generators, on-road vehicles, and some fugitive emissions during the construction, operation, and decommissioning of New England Wind.

The potential impacts and benefits of New England Wind on air quality during construction, O&M, and decommissioning are summarized in Table 5.1-4 and discussed in more detail in the following sections. As described in Section 3, the potential impacts and benefits to air quality are assessed in relation to New England Wind offshore and onshore development as a whole. The maximum design scenario considers a total buildout of the SWDA of 130 WTG/electrical service platform (ESP) positions, the installation of five offshore export cables for Phases 1 and 2, and onshore development within the Onshore Development Areas for Phases 1 and 2.

The following sections also include a preliminary estimate of air emissions from the construction and operation of New England Wind (Phases 1 and 2 combined), Phase 1, and Phase 2. The estimate of New England Wind's air emissions was first conducted for the maximum design scenario of both Phases of New England Wind (i.e. for all 130 WTG/ESP positions). Then, based on the maximum design scenario for each Phase individually, the total air emissions of New England Wind were apportioned to develop an estimate of emissions for each Phase separately.

5.1.2.1 Construction and Installation

5.1.2.1.1 Description of Potential Impacts (Phases 1 and 2)

Air emissions during the construction of New England Wind will primarily come from the main propulsion engines, auxiliary engines, and auxiliary equipment on marine vessels used during construction activities. Emissions from vessel engines will occur while vessels install offshore facilities within the SWDA, during installation of the offshore export cables, during vessel transits to and from port, and while vessels are in port. See Sections 3.2.2.5 and 4.2.2.5 of COP Volume I for a description of ports used during construction of Phases 1 and 2, respectively.

During offshore construction, vessels (e.g. heavy lift vessels, heavy transport vessels, tugboats, barges, and/or jack-up vessels) will be used to transport the WTGs, ESPs, and foundations to the SWDA. Installation of the WTGs, ESPs, and foundation components is expected to be performed using a combination of jack-up vessels, anchored vessels, and dynamic positioning vessels. Scour protection may be installed around the WTG and ESP foundations and cable protection may be placed over limited sections of the offshore cable system using specialized rock-dumping vessels or other vessels. Cable laying is expected to be performed by specialized cable laying vessels. Prior to cable laying, a pre-lay grapnel run and pre-lay survey would be made by the cable laying vessel, a support vessel, and/or a survey vessel along the planned offshore cable alignments. To achieve proper cable burial depth, a specialized dredging vessel may also be used in limited areas of the OECC prior to offshore export cable laying to remove the upper portions of sand waves. Crew transfer vessels and helicopters are expected to be used to transport personnel to and from the SWDA and may be used for environmental monitoring. Service operation vessels or other large support vessels (e.g. jack-up vessels) may provide offshore living accommodations for workers in the Offshore Development Area.

Table 5.1-4 Impact Producing Factors for Air Quality

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction Staging Areas/Ports	Construction and Installation	Operations and Maintenance	Decommissioning
Vessel Air Emissions	•	•		•	•	•	•
Offshore Generator and Construction Equipment Air Emissions	•	•			•	•	•
Aircraft Air Emissions	•				•	•	•
Onshore Air Emissions (i.e. non-road engine emissions, on-road vehicle emissions, and construction dust)			•	•	•	•	•
Fugitive Air Emissions	•		•		•	•	•
Avoided Air Emissions from Renewable Energy Production	•	•	•	•		•	

Additional offshore construction-related emissions will likely come from diesel generators used to temporarily supply power to the WTGs and ESPs. There may also be emissions from other construction equipment used aboard vessels such as pile driving hammer engines and noise mitigation devices (e.g. air compressors used to supply air to bubble curtains) should they be required during pile driving. A more complete list of vessels and equipment anticipated to be used during construction can be found in Appendix III-B.

Emission sources used during offshore construction are expected to include:

- Anchor handling tug supply (AHTS) vessels
- Barges
- Bunkering vessels
- Cable laying vessels
- Crew transfer vessels (CTVs)
- Dredging vessels
- Heavy lift vessels (HLVs)
- Heavy transport vessels (HTVs)
- Jack-up vessels
- Scour/cable protection installation vessels (e.g. fallpipe vessels)
- Service operation vessels (SOVs)
- Support vessels (e.g. work boats, supply boats, accommodation vessels)
- Survey vessels
- Tugboats
- Diesel generators
- Other construction equipment (e.g. air compressors, pile driving hammer engines, motion compensation system engines)
- Helicopters
- Fugitive emissions of solvents, paints, coatings, diesel fuel storage/transfer, and SF_6

Emission sources from onshore construction activities will include construction equipment and vehicles used during the unloading and loading of components at the port facilities, construction at the landfall sites (e.g. horizontal directional drilling), installation of the onshore cables, and construction of the onshore substations. Onshore emission sources include:

- Non-road construction and excavation equipment (e.g. backhoes, bore/drill rigs, compactors, concrete trucks, concrete saws, cranes, excavators, forklifts, graders, light plants, off-highway trucks, and pavers)
- Non-road commercial equipment, including generators, pumps, and welders
- Non-road industrial equipment, such as air conditioning units and aerial lifts
- Worker vehicles
- Delivery and heavy-duty vehicles
- Fugitive emissions from incidental solvent release and SF_6
- Particulate emissions from construction dust

More detailed descriptions of offshore and onshore construction activities can be found in Sections 3.3.1 and 4.3.1 of COP Volume I.

The following sections provide an estimate of construction emissions for both Phases of New England Wind combined, followed by an estimate of construction emissions for the maximum design scenario of each Phase separately. As explained in Section 3, due to the range of buildout scenarios for Phases 1 and 2, summing the maximum construction emissions for Phase 1 and Phase 2 would overestimate the total construction emissions of New England Wind.

Estimate of New England Wind Construction Emissions—Phases 1 and 2

The preliminary estimate of potential air emissions within the US[20] during construction of both Phases of New England Wind is provided in Table 5.1-5 for NOx, VOCs, CO, PM_{10}, $PM_{2.5}$, SO_2, CO_2e, and total HAPs (individual compounds are either VOCs or PM). The air emissions estimate for offshore construction of both Phases is based on the installation of 130 total WTGs and ESPs and

[20] Includes emissions onshore, in state waters, and in federal waters within the US Exclusive Economic Zone, which extends approximately 370 km (200 NM) offshore.

the maximum length of offshore cables,[21] which represents the maximum design scenario. To account for the envelope of possible ports used during construction, the emissions estimate uses the combination of ports with the longest transit distances to and from the Offshore Development Area within US waters.[22] The estimate of onshore emissions was based on the maximum design scenario for each Phase's onshore facilities (e.g. the maximum length of onshore export cables and grid interconnection cables). See Appendix III-B for additional description of the maximum design scenario employed.

Table 5.1-5 provides an estimate of total emissions for the entire construction period of both Phases, which would be distributed over several years.

Table 5.1-5 Maximum Air Emissions During Multi-Year New England Wind Construction (Phases 1 and 2)

Activity	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
New England Wind Construction Emissions (US tons)	12,834	272	3,052	549	533	89	40	862,756

A complete description of all anticipated emission sources associated with the construction of New England Wind, including engine sizes, hours of operation, load factors, emission factors, and fuel consumption rates, along with a description of the air emissions calculation methodology, is provided in Appendix III-B.

During construction, indirect impacts to air quality may result from the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses. These indirect impacts are no different than the air quality impacts that would result from any other project providing economic development by building infrastructure.

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21 The maximum length of the Phase 2 offshore export cables is based on the installation of three Phase 2 offshore export cables within the OECC that travels from the northwestern corner of the SWDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then heads northward along the eastern side of Muskeget Channel toward landfall sites in the Town of Barnstable. While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels through the eastern side of Muskeget Channel, the Proponent is reserving the fallback option to install one or two Phase 2 cables along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant (see Section 4.1.3.2 of COP Volume I). Should any Phase 2 cables be installed within the Western Muskeget Variant, the total length of the Phase 2 offshore export cables would be less.

22 The emissions estimate considers the farthest port that could be used for each individual vessel activity based on the best available information at the time of submission.

Estimate of Construction Emissions - Phase 1

The estimate of potential NOx, VOC, CO, PM_{10}, $PM_{2.5}$, SO_2, CO_2e, and HAP emissions within the US during construction of Phase 1 is provided in Table 5.1-6. The estimate of potential air emissions for Phase 1 is based on the installation of 62 WTGs and two ESPs, the maximum length of Phase 1 offshore cables, the maximum length of Phase 1 onshore cables, and the combination of ports with the longest transit distances to and from the Offshore Development Area, which represents the maximum design scenario for Phase 1 (see Appendix III-B for additional details). Table 5.1-6 provides an estimate of total emissions during the construction of Phase 1, which is expected to be distributed over more than one year.

Table 5.1-6 Maximum Air Emissions During Phase 1 Construction

Activity	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Phase 1 Construction Emissions (US tons)	5,917	124	1,406	238	230	41	18	393,627

Estimate of Construction Emissions—Phase 2

The estimate of potential NOx, VOC, CO, PM_{10}, $PM_{2.5}$, SO_2, CO_2e, and HAP emissions within the US during construction of Phase 2 is provided in Table 5.1-7. The estimate of potential air emissions for Phase 2 is based on the maximum number of Phase 2 WTG/ESP positions,[23] the maximum length of Phase 2 offshore cables, the maximum length of Phase 2 onshore cables, and the combination of ports with the longest transit distances to and from the Offshore Development Area, which represents the maximum design scenario for Phase 2 (see Appendix III-B for additional details). The total Phase 2 construction emissions presented in Table 5.1-7 are anticipated to be distributed over more than one year of construction.

Table 5.1-7 Maximum Air Emissions During Phase 2 Construction

Activity	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Phase 2 Construction Emissions (US tons)	7,732	164	1,841	339	329	54	24	520,958

23 The fraction of the total New England Wind air emissions apportioned to Phase 2 was calculated based on the installation of 79 total WTG/ESP positions. However, the Proponent believes that these conservative Phase 2 emission estimates also cover the scenario where more than 79 WTGs/ESPs are installed (i.e., even if up to the maximum of 88 positions are installed [of which, three may be ESPs]).

<u>*5.1.2.1.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)*</u>

New England Wind itself is an air quality impact avoidance measure; the electricity generated by the WTGs will displace electricity produced by fossil fuel power plants and avoid emissions resulting from those power plants. Air emissions from the construction, O&M, and decommissioning of New England Wind will be minimized wherever feasible. The air quality avoidance, minimization, and mitigation measures employed during both Phases of New England Wind are discussed in more detail below.

Avoidance Measures

Emissions of regulated pollutants during construction are temporary and will be quickly offset by reductions in emissions from the ISO-NE electric grid during the operational period. The avoided emissions are discussed below in Section 5.1.2.2.

Minimization Measures

During offshore construction, emissions will come primarily from internal combustion engines, including marine diesel engines, diesel engines on construction equipment, and diesel generators. Engine manufacturers use minimization techniques specific to their engine type to ensure compliance with air quality regulatory standards. Emissions are generally minimized by ensuring complete combustion to avoid formation of CO, PM, and VOCs, and by controlling the mixing of fuel and oxygen during combustion to avoid hot spots that generate NOx. Marine engine optimization, which will differ from engine to engine, can include changes to "fuel injection timing, pressure, and rate (i.e. rate shaping), fuel nozzle flow area, exhaust valve timing, and cylinder compression volume" (DieselNet 2016). Controls can also include the use of water injection and exhaust gas recirculation to cool the combustion temperature.

New England Wind will minimize SO_2 and PM emissions through the use of clean, low-sulfur fuels in compliance with the air pollution requirements detailed in this section. Annex VI of the International Maritime Organization's (IMO's) MARPOL treaty is the main international treaty that addresses air pollution from marine vessels. In the US, MARPOL Annex VI is implemented through the Act to Prevent Pollution from Ships (33 U.S.C. §§ 1901-1905) and Control of NOx, SOx, and PM Emissions from Marine Engines and Vessels Subject to the MARPOL Protocol (40 CFR Part 1043). Under MARPOL Annex VI and EPA's corresponding regulations, any foreign and domestic vessel used during New England Wind will comply with the fuel oil sulfur content limit of 1,000 ppm. Applicable non-road engines (e.g. generators used offshore) will comply with the non-road diesel fuel sulfur limit of 15 ppm under 40 CFR Part 80.

The engines and generators used for New England Wind will meet or emit less than the applicable on-road, non-road, and marine engine emission standards for NOx, CO, VOCs (as hydrocarbons [HC]), and PM. Key marine engine emission standards include:

- **MARPOL Annex VI:** Annex VI of the MARPOL treaty establishes global limits on the sulfur content of fuel oil used aboard any foreign or domestic vessel and NOx emissions limits from foreign vessels built after 2000 with engine sizes greater than 130 kW (~174 horsepower).

- 40 CFR Part 1042 – Control of Emissions from New and In-Use Marine Compression-Ignition Engines and Vessels: 40 CFR § 1042 sets emission standards and certification requirements for marine diesel engines.

EPA's emission standards for marine compression-ignition engines contained in 40 CFR Part 1042 are structured as a tiered progression, with each tier of emission standards becoming increasingly stringent. These standards are primarily a function of the size, engine displacement, and age of the marine diesel engine. Each tier phased in over several years (by categories of engine size).

In addition to the regulations above, some offshore emissions from New England Wind are regulated through EPA's OCS Air Permit process under the OCS Air Regulations (40 CFR Part 55). The OCS Air Regulations, which implement Section 328(a)(1) of the CAA, establish federal air pollution control requirements for OCS sources located beyond a state's seaward boundaries. Under 40 CFR Part 55, OCS sources located within 25 NM beyond a state's seaward boundary are also required to comply with the air quality requirements of the Corresponding Onshore Area (COA). The CAA defines an *OCS source* as "any equipment, activity, or facility" that "(i) emits or has the potential to emit any air pollutant, (ii) is regulated or authorized under the Outer Continental Shelf Lands Act, and (iii) is located on the Outer Continental Shelf or in or on waters above the Outer Continental Shelf" (42 U.S.C. § 7627(a)(4)(C)). The definition of OCS source only includes vessels while they are permanently or temporary attached to the seabed or an existing OCS source. However, emissions from all vessels servicing or associated with an OCS source or OCS facility (when within 25 NM) are considered potential emissions from the OCS source and are included when determining the applicability of other CAA programs, assessing the impact of an OCS source's emissions on ambient air quality, and calculating the number of emission offsets required (if any).

On January 28, 2022, the Proponent submitted a Notice of Intent (NOI) to initiate the OCS Air Permit process for both Phases to EPA Region 1, MassDEP, RI DEM Office of Air Resources, and the New Hampshire Department of Environmental Services Air Resources Division. In the NOI, the Proponent identified Massachusetts as the Nearest Onshore Area to the Offshore Development Area. Since EPA did not receive a request from any neighboring state air pollution control agencies to be designated as the COA within the 60-day period allotted in 40 CFR Part 55.5(b)(l), Massachusetts (the Nearest Onshore Area) became the designated COA without further Agency action after 90 days (see 40 CFR Part 55.5(c)(l)). Therefore, New England Wind's OCS sources will be required to comply with applicable Massachusetts air quality regulations including Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) under 310 CMR § 7.00.

Based on the OCS Air Permit issued for Vineyard Wind 1 on May 19, 2021, the Proponent expects the following requirements would also apply to New England Wind's OCS sources to meet BACT and LAER, which would minimize New England Wind's emissions:

- **For engines on the WTGs and ESPs:** Use of engines that are certified to meet or exceed the highest applicable emission limits at 40 CFR Part 1042 (i.e. EPA Tier 3 or 4 marine engine emission standards, depending on engine size) and use of ultra-low sulfur diesel (ULSD) with a maximum sulfur content of 15 ppm.

- **For engines on CTVs or supply vessels:** Use of vessels with the highest EPA Tier marine engines available (starting with Tier 4 or Tier 3, depending on engine size), and no lower than EPA Tier 2 marine engines. The primary CTV must have the highest applicable EPA Tier marine engines.

- **For all other domestic and foreign-flagged vessels:** Use of vessels with engines meeting EPA's or IMO's highest applicable marine emission standards, where available, and no lower than EPA or IMO Tier 1 marine engines.

The Proponent will require its contracted vessels to use good combustion practices and operate their engines in the most efficient configuration. Per EPA's GHG Guidance, the application of methods to increase energy efficiency is a key GHG-reducing opportunity that falls under the category of "lower-polluting processes/practices." The IMO adopted legally binding energy efficiency measures as amendments to MARPOL Annex VI, which went into effect in 2013. Under IMO's energy-efficiency regulations (Annex 19, Resolution MEPC.203(62)), existing ships must have an energy management plan that addresses measures such as "improved voyage planning, cleaning the underwater parts of the ship and the propeller more often, introducing technical measures such as waste heat recovery systems, or even fitting a new propeller" (IMO 2018). The regulations, which apply to ships over 400 gross tonnage engaged in international voyages make Energy Efficiency Design Index mandatory for new ships and the Ship Energy Efficiency Management Plan mandatory for all ships. Since 2013, the Energy Efficiency Design Index has required a minimum energy efficiency level per capacity mile for new ships based on their type and size (IMO 2018). The Ship Energy Efficiency Management Plan is an operational measure that establishes mechanisms to improve the energy efficiency of a ship and incorporates best practices for fuel-efficient ship operation (IMO 2018). Use of these two programs will ensure efficient engine operation and minimize GHG emissions from vessels used during New England Wind.

For onshore construction at the landfall sites, along the Onshore Export Cable Routes and Grid Interconnection Routes, and at the onshore substations, all diesel-powered non-road engines will be required to comply with the MassDEP Diesel Retrofit Program.[24] Consistent with the Program, all non-road engines used during onshore construction will comply with the non-road diesel fuel sulfur limit of 15 ppm under 40 CFR Part 80. Any onshore emergency generators will comply with the performance standards of New Source Performance Standards Subpart IIII (Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, 40 CFR Part 60) and would be subject to MassDEP's Environmental Results Program (ERP) Standards for emergency engines and turbines detailed in 310 C.M.R. § 7.26(42).

In accordance with Massachusetts' anti-idling law (M.G.L. c. 90, § 16A; M.G.L.c. 111, §§ 142A–142M; 310 C.M.R. § 7.11), emissions from on-road vehicles will be required to limit idling to five minutes except when engine power is necessary for the delivery of materials or to operate accessories to the vehicle, such as power lifts. PM emissions from construction activities will be minimized through best management practices such as removing waste in covered trailers, wetting exposed soils, and minimizing the storage of construction waste onsite.

Lastly, according to BOEM's (2014) Revised Environmental Assessment for the MA WEA, prevailing winds would predominately transport vessel emissions in the MA WEA away from shore, although wind directions may shift and transport vessel emissions toward shore. However, when winds transport emissions toward shore, given the distance between the SWDA and shore (~32 km [~20 mi] from Martha's Vineyard[25]), emissions within the SWDA are unlikely to affect any onshore areas. Furthermore, due to the large size of the SWDA, emissions from construction vessels will be dispersed over a large area, further minimizing ambient air quality impacts.

Mitigation Measures

Engine manufacturers can use mitigation techniques specific to their engine type to ensure compliance with air quality regulatory standards. Depending on the engine's age, type, and size, add-on pollution controls can be used to mitigate air emissions formed during the combustion process. For example, selective catalytic reduction reverses the NOx formation reaction, returning NOx to nitrogen and water in the presence of a catalyst. Oxidation catalysts can also be

[24] Compliance with the MassDEP Diesel Retrofit Program would require diesel-powered non-road engines (for those with horsepower ratings of 50 and above that are used for 30 or more days over the course of New England Wind construction) to either be EPA Tier 4–compliant or have EPA-verified (or equivalent) emissions control devices such as oxidation catalysts or other comparable technologies (to the extent that they are commercially available) installed on the exhaust system side of the diesel combustion engine.

[25] This measurement excludes the two separate aliquots of the SWDA that are located closer to shore along the northeast boundary of Lease Area OCS-A 0501.

used to eliminate products of incomplete combustion (e.g. CO, VOCs, and PM) using technology similar to the catalytic converter found in automobiles. A diesel particulate filter can remove PM from some engine exhausts.

The Proponent expects that its OCS Air Permit(s) for New England Wind will contain, at a minimum, emission limitations and monitoring, testing, and reporting requirements.

5.1.2.1.3 Summary (Phases 1 and 2)

As described in Section 5.1.2.1.1, air emissions from the construction of New England Wind will primarily come from engines on marine vessels and will occur within the SWDA, along the OECC, and along vessel routes to ports. The Proponent intends to employ a number of measures to minimize emissions, including using low sulfur fuels and internal combustion engines that comply with applicable air quality regulatory standards. Since the SWDA is located far offshore (approximately 32 km [20 mi] from Martha's Vineyard[26]), the SWDA is situated to the southeast of the mainland, and prevailing winds are from the west, emissions within the SWDA are unlikely to affect any onshore areas. Construction vessel activities within the ports are within the realm of normal harbor activities and will likely contribute only a small fraction of air pollution that is already caused by marine vessel traffic within the ports. Further, both onshore and offshore construction emissions will be temporary.

Finally, New England Wind's air quality impacts will be regulated through the OCS Air Permit process. Since Massachusetts is the COA per 40 CFR § 55.5, emissions from OCS sources during construction will need to meet applicable Massachusetts BACT and LAER limits.

5.1.2.2 Operations and Maintenance

5.1.2.2.1 Description of Potential Impacts (Phases 1 and 2)

Operation of New England Wind will provide a net air quality benefit; the clean, renewable power generated by the New England Wind WTGs will displace electricity generated by fossil fuel power plants, reducing overall regional emissions from the ISO-NE electric grid.

However, there will be emissions from vessel and engine usage during O&M of New England Wind. CTVs, helicopters, and/or SOV(s) will frequently transport crew to the Offshore Development Area for inspections, routine maintenance, and repairs. Jack-up vessels, support vessels, and various other offshore construction vessels may travel to the Offshore Development Area infrequently for more significant maintenance and repairs. During O&M, New England Wind may use port facilities in Massachusetts, Rhode Island, Connecticut, New York, and/or New Jersey (see Sections 3.2.2.6 and 4.2.2.6 of COP Volume I for further details).

[26] This measurement excludes the two separate aliquots of the SWDA that are located closer to shore along the northeast boundary of Lease Area OCS-A 0501.

Onshore O&M activities will include occasional inspections and repairs to the onshore substations and splice vaults, which would require minimal use of worker vehicles and construction equipment. See Sections 3.3.2 and 4.3.2 of COP Volume I for further description of O&M activities.

Emission sources during the operational period (onshore and offshore) may include:

- AHTS vessels
- Barges
- Bunkering vessels
- Cable laying vessels
- CTVs
- HLVs
- HTVs
- Jack-up vessels
- Scour/cable protection installation vessels (e.g. fallpipe vessel)
- SOVs
- Support vessels (e.g. work boats, supply boats, accommodation vessels)
- Survey Vessels
- Tugboats
- Diesel generators
- Other construction equipment
- Helicopters
- Worker and delivery vehicles
- Fugitive emissions of solvents, paints, coatings, diesel fuel storage/transfer, and SF_6

A detailed description of potential emission points associated with New England Wind O&M, including engine sizes, hours of operation, load factors, emission factors, and fuel consumption rates, along with a description the air emissions calculation methodology is provided in Appendix III-B.

The following sections provide an estimate of operational emissions for both Phases of New England Wind combined, followed by an estimate of O&M emissions for the maximum design scenario of each Phase separately. As explained in Section 3, due to the range of buildout scenarios for Phases 1 and 2, summing the maximum O&M emissions for Phase 1 and Phase 2 would overestimate the total O&M emissions of New England Wind.

Estimate of New England Wind O&M Emissions - Phases 1 and 2

Table 5.1-8 provides a preliminary estimate of air emissions from the operation of both Phases of New England Wind, including an estimate of air emissions for a typical year of operation (for planned, routine O&M activities) as well as an estimate of the maximum annual operational air emissions (assuming several repair activities occur all within the same year). The emissions estimate is based on the maximum design scenario for the O&M of 130 total WTGs and ESPs. To account for the envelope of ports used during O&M, the emission estimate uses the combination of ports with the longest transit distances to and from the Offshore Development Area within US waters.

Table 5.1-8 Annual Air Emissions During New England Wind O&M (Phases 1 and 2)

Activity	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
New England Wind O&M Emissions, Typical Year (US tons/year)	357	6.4	90	12	12	1.1	0.9	47,783
New England Wind O&M Emissions, Maximum Year (US tons/year)	472	8.5	117	16	15	1.5	1.2	55,346

Although O&M activities will generate some air emissions, operation of New England Wind will provide clean energy that will reduce emissions from the ISO-NE electric grid. The WTGs used for New England Wind are expected to be among the most efficient machines commercially available for offshore use at the time of construction, with an estimated annual capacity factor of approximately 50%.[27] Based on air emissions data for New England power generation facilities,[28] Table 5.1-9 quantifies the emissions associated with conventional power generation that would

[27] Capacity factor refers to the ratio of New England Wind's annual power production to its nameplate production potential.

[28] The avoided emissions analysis assumes a minimum total capacity of 2,004 megawatts (MW) for both Phases combined, with a 50% average capacity factor transmitted using high voltage alternating current (HVAC) export cables for Phases 1 and 2. The analysis is based on Northeast Power Coordinating Council (NPCC) New England subregion annual non-baseload output emission rates from EPA's Emissions & Generation Resource Integrated Database eGRID2018(v2) released March 2020 (EPA 2020).

be avoided by using electricity generated from New England Wind while both Phases are operational. The pollutants included in the analysis are NOx, SO_2, and CO_2e. See Appendix III-B for additional details.

Table 5.1-9 Avoided Air Emissions Resulting from New England Wind (Phases 1 and 2)

	CO_2e	NOx	SO_2
New England Wind - Emissions Avoided Annually (US tons/year)	3,931,069	2,103	1,117

Based on 2018 Northeast Power Coordinating Council (NPCC) New England air emissions data from EPA's Emissions & Generation Resource Integrated Database (eGRID2018), operation of both Phases of New England Wind would displace 14% of CO_2e emissions, 10% of NOx emissions, and 16% of SO_2 emissions produced by New England's electric grid annually. This reduction in CO_2e emissions is roughly equivalent to taking 775,000 cars off the road each year. Thus, New England Wind would result in significantly lower emissions in the New England region.

In addition, New England Wind would decrease reliance on fossil fuels and enhance the reliability and diversity of the energy supply in the Northeastern US. This is particularly important given that several thermal baseload and cycling plants have already retired, are slated for retirement, or are approaching the end of life. According to ISO-NE (2020), 1,829 MW of coal, 1,332 MW of residual oil, and 604 MW of nuclear-fired power generation facilities retired between 2011 and 2017.

Estimate of O&M Emissions - Phase 1

Table 5.1-10 provides a preliminary estimate of air emissions during a typical year of Phase 1 operation as well as an estimate of the maximum annual air emissions during Phase 1 O&M. The estimate of operational emissions for Phase 1 is based on the O&M of 62 WTGs and two ESPs and the combination of ports with the longest transit distances to and from the Offshore Development Area, which represents the maximum design scenario for Phase 1 (see Section 3).

Table 5.1-10 Annual Air Emissions During Phase 1 O&M

Activity	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Phase 1 O&M Emissions, Typical Year (US tons/year)	178	3.2	45	6.0	5.8	0.5	0.5	20,259
Phase 1 O&M Emissions, Maximum Year (US tons/year)	266	4.8	65	8.9	8.6	0.8	0.7	26,039

Although Phase 1 O&M activities will generate some air emissions, operation of Phase 1 will provide clean energy that will reduce emissions from the ISO-NE electric grid. The WTGs used for Phase 1 will be among the most efficient machines commercially available for offshore use at the time of construction, with an estimated annual capacity factor of approximately 50%. Based on 2018 air emissions data for New England power generation facilities,[29] Table 5.1-11 quantifies the emissions associated with conventional power generation that would be avoided by using electricity generated from New England Wind Phase 1. The pollutants included in the analysis are NOx, SO_2, and CO_2e.

Table 5.1-11 Avoided Air Emissions Resulting from Phase 1

	CO_2e	NOx	SO_2
Phase 1 - Emissions Avoided Annually (US tons/year)	1,585,878	848	450

Based on NPCC New England 2018 air emissions data from eGRID2018, operation of Phase 1 would displace 6% of CO_2e emissions, 4% of NOx emissions, and 6% of SO_2 emissions produced by New England's electric grid annually. Therefore, Phase 1 is expected to provide significant benefits to regional air quality.

Estimate of O&M Emissions - Phase 2

Table 5.1-12 quantifies typical and maximum annual air emissions that could occur within the US specific to the O&M of Phase 2. The estimate of operational emissions for Phase 2 is based on the maximum number of Phase 2 WTG/ESP positions[30] and the combination of ports with the longest transit distances to and from the Offshore Development Area, which represents the maximum design scenario for Phase 2 (see Section 3).

As noted above, due to the range of buildout scenarios for Phases 1 and 2, the maximum Phase 2 O&M emissions presented below should not be added to the Phase 1 O&M emissions in Table 5.1-10 to derive the total emissions from concurrent operation of Phases 1 and 2.

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29 The avoided emissions analysis assumes a Phase 1 capacity of 804 MW with a 50% average capacity factor transmitted using HVAC export cables. The analysis is based on NPCC New England subregion annual non-baseload output emission rates from EPA's Emissions & Generation Resource Integrated Database eGRID2018(v2) released March 2020 (EPA 2020).

30 The fraction of the total New England Wind air emissions apportioned to Phase 2 was calculated based on the installation of 79 total WTG/ESP positions. However, the Proponent believes that these conservative Phase 2 emission estimates also cover the scenario where more than 79 WTGs/ESPs are installed (i.e., even if up to the maximum of 88 positions are installed [of which, three may be ESPs]).

Table 5.1-12 Annual Air Emissions During Phase 2 O&M

Activity	NOx	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Phase 2 O&M Emissions, Typical Year (US tons/year)	179	3.2	45	6.0	5.8	0.5	0.5	27,594
Phase 2 O&M Emissions, Maximum Year (US tons/year)	270	4.9	67	9.0	8.7	0.9	0.7	33,606

Although Phase 2 O&M activities will generate some air emissions, operation of Phase 2 will provide clean energy that will likely reduce emissions from the ISO-NE electric grid. The magnitude of the emission reductions enabled by Phase 2 will depend on the final generating capacity of Phase 2, which will depend on the capacity and number of WTGs ultimately installed.

Using 2018 air emissions data for New England power generation facilities,[31] Table 5.1-13 estimates the NOx, SO_2, and CO_2e emissions associated with conventional power generation that could be avoided by using electricity generated from New England Wind Phase 2, assuming a minimum total capacity of 1,200 MW.

Table 5.1-13 Avoided Air Emissions Resulting from Phase 2

	CO_2e	NOx	SO_2
Phase 2 - Emissions Avoided Annually (US tons/year)	2,345,191	1,255	666

Based on NPCC New England 2018 air emissions data from eGRID2018, operation of Phase 2 could displace up to 8% of CO_2e emissions, 6% of NOx emissions, and 9% of SO_2 emissions produced by New England's electric grid annually. Therefore, Phase 2 has the potential to provide significant benefits to regional air quality.

5.1.2.2.2 Avoidance, Minimization, and Mitigation Measures

Avoidance, minimization, and mitigation techniques are described in Section 5.1.2.1.2 above. Electricity generated by the WTGs will avoid emissions resulting from fossil fuel power plants and significantly reduce emissions from the ISO-NE electric grid over the lifespan of New England

31 The avoided emissions analysis assumes a Phase 2 capacity of 1,200 MW with a 50% average capacity factor transmitted using HVAC export cables. The analysis is based on NPCC New England subregion annual non-baseload output emission rates from EPA's Emissions & Generation Resource Integrated Database eGRID2018(v2) released March 2020 (EPA 2020).

Wind. Additionally, it is expected that the OCS Air Permit(s) will require the Proponent to offset applicable NOx and VOC emissions by acquiring emissions offsets or other means acceptable to EPA.

Any equipment containing SF_6 at the onshore substations will meet the applicable requirements of 310 CMR 7.72. Per the regulation, "this type of switchgear is pre-charged with SF_6, sealed at the factory, and cannot be refilled by its user." Equipment will be certified by the manufacturer to have a 1.0% maximum annual leak rate, and the Proponent will follow manufacturer-recommended maintenance procedures and best industry practices to avoid leakage. Upon equipment removal, the Proponent will be responsible for the secure storage, reuse, recycling, or destruction of the SF_6. The Proponent expects little to no leakage of SF_6, based on the purchase and maintenance of equipment with leakage guarantees.

5.1.2.2.3 Summary (Phases 1 and 2)

Air emissions from O&M of New England Wind will be significantly less than emissions from construction. As with construction air emissions, emissions from O&M activities will be minimized through the use of low sulfur fuels and use of internal combustion engines that are in compliance with applicable air quality regulatory standards. The Proponent expects that its OCS Air Permit(s) will contain requirements for monitoring, testing, and reporting for OCS sources during O&M.

Furthermore, energy produced by each Phase of New England Wind will displace electricity generated by fossil fuel power plants, reducing emissions from the ISO-NE electric grid. Air emissions from O&M of New England Wind will be quickly offset by reductions in emissions from the electric grid. Consequently, it is not anticipated that O&M emissions from New England Wind will cause any violation of the NAAQS. Rather, by displacing emissions from conventional power generation facilities, New England Wind should aid in the continued improvement of ambient air quality within New England.

5.1.2.3 Decommissioning

5.1.2.3.1 Description of Impacts (Phases 1 and 2)

As described in Sections 3.3.3 and 4.3.3 of COP Volume I, the decommissioning process will be largely the reverse of the installation process. As a result, the impacts of decommissioning on air quality are expected to resemble the impacts from construction. During decommissioning, marine vessels would be used to remove the offshore cable system (if removal is required), WTGs, ESPs, foundations, scour protection, and cable protection (if used). It is anticipated that the suite of equipment and vessels used for decommissioning will be similar to those used during construction but will likely have lower-polluting engines (historically, emission standards for marine vessels have become increasingly stringent over time).

For onshore decommissioning activities, removal of onshore cables from the duct bank (if required) would be performed using truck mounted winches, cable reels, and cable reel transport trucks. The concrete-encased duct bank, splice vaults, and elements of the onshore substations and grid interconnections may be left in place for future reuse. Consequently, onshore decommissioning emissions are expected to be significantly less than onshore construction emissions.

Given the level of uncertainty regarding the types of vessels and equipment that will be available at the time of decommissioning, potential emissions from decommissioning are not quantified at this time. However, it is reasonable to expect that when each Phase is ready to be decommissioned, technological advances in methods and equipment servicing the offshore industry may result in increased efficiency as well as a reduced level of environmental impacts. Therefore, the Proponent anticipates that emissions during decommissioning will be significantly less than emissions during construction.

5.1.2.3.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Proponent expects that avoidance, minimization, and mitigation techniques during decommissioning would be similar to those used during the construction of New England Wind (see Section 5.1.2.1.2 above). However, vessel and equipment engines available for use at the time of decommissioning will likely be cleaner than those available today due to refinements in engines and emission control technologies over time. Current trends towards improvements in engine design, propulsion design, operational controls, vessel route optimization, and fuel quality are expected to continue, advances in onshore emissions control and energy efficiency technology will continue to transfer to the marine propulsion industry, and low- and no-emission marine engine technologies are expected to be developed over the next approximately 30 years.

5.2 Water Quality

This section discusses water quality in the Offshore Development Region and the Offshore Development Area. The Offshore Development Area is the offshore area where the Proponent's offshore facilities are physically located, which includes all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]) as well as the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]). Five offshore export cables—two cables for Phase 1 and three cables for Phase 2—will transmit electricity from the SWDA to shore. Unless technical, logistical, grid interconnection, or other unforeseen issues arise, all New England Wind offshore export cables will be installed within a shared OECC that will travel from the northwestern corner of the SWDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then head northward along the eastern side of Muskeget Channel toward the southern shore of Cape Cod. With respect to water quality, the Offshore Development Region is the broader offshore geographic region surrounding the SWDA and OECC that could be affected by New England Wind-related activities, which includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), and the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA).

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the option to install one or two Phase 2 cables along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[32] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

The section also includes a discussion of potential impacts of various aspects of New England Wind to water quality. New England Wind may also impact water quality through activities within the Onshore Development Areas, which are the onshore areas where New England Wind's onshore facilities are physically located. Each Phase has a separate Onshore Development Area. Onshore activities include construction of new onshore substations, construction along Onshore Export Cable Routes (which are the onshore routes within which the onshore export cables will be installed), construction along Grid Interconnection Routes (which are the onshore transmission routes that connect the onshore substations to the grid interconnection point), and grid interconnection at the West Barnstable Substation.

5.2.1 Description of the Affected Environment

Water quality generally refers to the physical, chemical, and biological attributes of water. For the purposes of this section, water quality specifically refers to the ability of waters in the southern New England coastal and shelf areas to maintain their ecosystems. Factors such as pollutant loading from both natural and anthropogenic sources can contribute to changes in water quality, which are usually detrimental. Natural pollutants can be delivered into water systems via atmospheric deposition, freshwater drainage, transport of offsite marine waters, and influx from sediments. Anthropogenic pollutant sources often include those from direct discharges, runoff, dumping, seabed activities, and spills.

For the offshore area south of Martha's Vineyard and Nantucket, known as the Outer Continental Shelf, oceanic circulation patterns play a role in transporting and dispersing anthropogenic contaminants and determining water quality. Water quality data available for coastal and offshore marine waters include temperature expressed in degrees Celsius (°C) (degrees

[32] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

Fahrenheit [°F]), salinity expressed in Practical Salinity Units (psu), chlorophyll *a* expressed as microgram per liter (µg/L), nutrients expressed micromolar (µm), dissolved oxygen expressed as milligram per liter (mg/L), and turbidity expressed as Nephelometric Turbidity Unit (NTU).

Water Quality Data Sources

One of the major water quality datasets available for Nantucket Sound, as well as Cape Cod Bay to the north, is that from the Center for Coastal Studies (CCS) (CCS 2019). Sampling is performed through a collaboration of CCS with volunteer citizen scientists and partnering organizations. The sampling stations for Nantucket Sound are shown in Figure 5.2-1. Of particular interest is the set of three offshore stations extending from south to north in the area of the OECC and shown circled and labeled as NTKS-1, NTKS-2, and NTKS-3. The data for these stations included over 60 sampling times between 2010 and 2016. The minimum, mean, and maximum parameter values are shown in Table 5.2-1. The individual parameters will be discussed below.

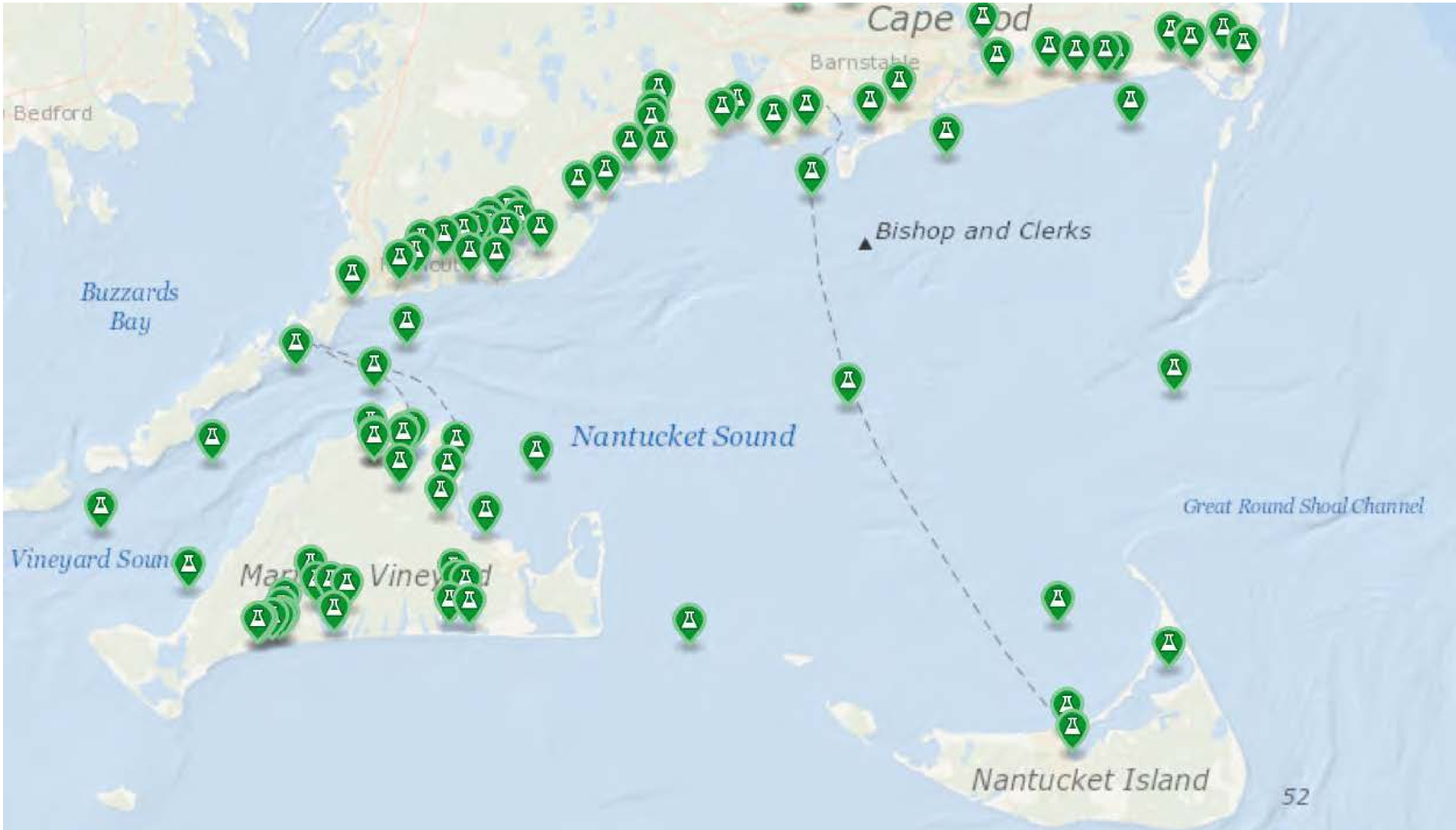


Figure 5.2-1

Locations of Water Quality Data Used from Center for Coastal Studies Stations (Circled)

Table 5.2-1 Minimum, Mean, and Maximum Values of Water Quality Parameters Reported in Nantucket Sound by the CCS for the period 2010–2016

Parameter	Value	Station NTKS-1 (South)	Station NTKS-6 (Central)	Station NTKS-13 (North)
Temperature (°C)	Min Mean Max	8.70 17.95 22.76	8.15 19.21 24.23	9.87 20.36 26.31
Salinity (psu)	Min Mean Max	30.72 31.75 32.71	30.71 31.76 32.51	30.56 31.60 32.49
Dissolved Oxygen (mg/L)	Min Mean Max	6.89 8.00 9.63	6.39 7.59 11.39	5.37 7.32 8.75
Chlorophyll *a* (mg/L)	Min Mean Max	0.45 1.79 4.73	0.23 1.93 4.80	0.59 1.81 4.33
Turbidity (NTU)	Min Mean Max	0.09 0.66 3.17	0.09 0.70 2.27	0.13 0.58 2.19
Total Nitrogen (µm)	Min Mean Max	4.438 10.645 18.057	3.285 11.143 20.420	3.120 12.984 75.799
Total Phosphorus (µm)	Min Mean Max	0.285 0.648 1.627	0.205 0.814 1.881	0.331 0.853 2.584

Another large dataset is held by the Northeast Fisheries Science Center Multispecies Bottom Trawl Survey (NEFSC) (NEFSC 2017). This survey has collected temperature and salinity data in addition to its primary biological data collection function. Three seasons have been monitored for many years: autumn since 1963, spring since 1968, and winter between 1992 and 2007; the summer season has not been monitored. Results are shown in Table 5.2-2. The data collected are mostly for the offshore areas south of Nantucket Sound, and include the SWDA, as shown in Figure 5.2-2. The individual parameters are discussed below.

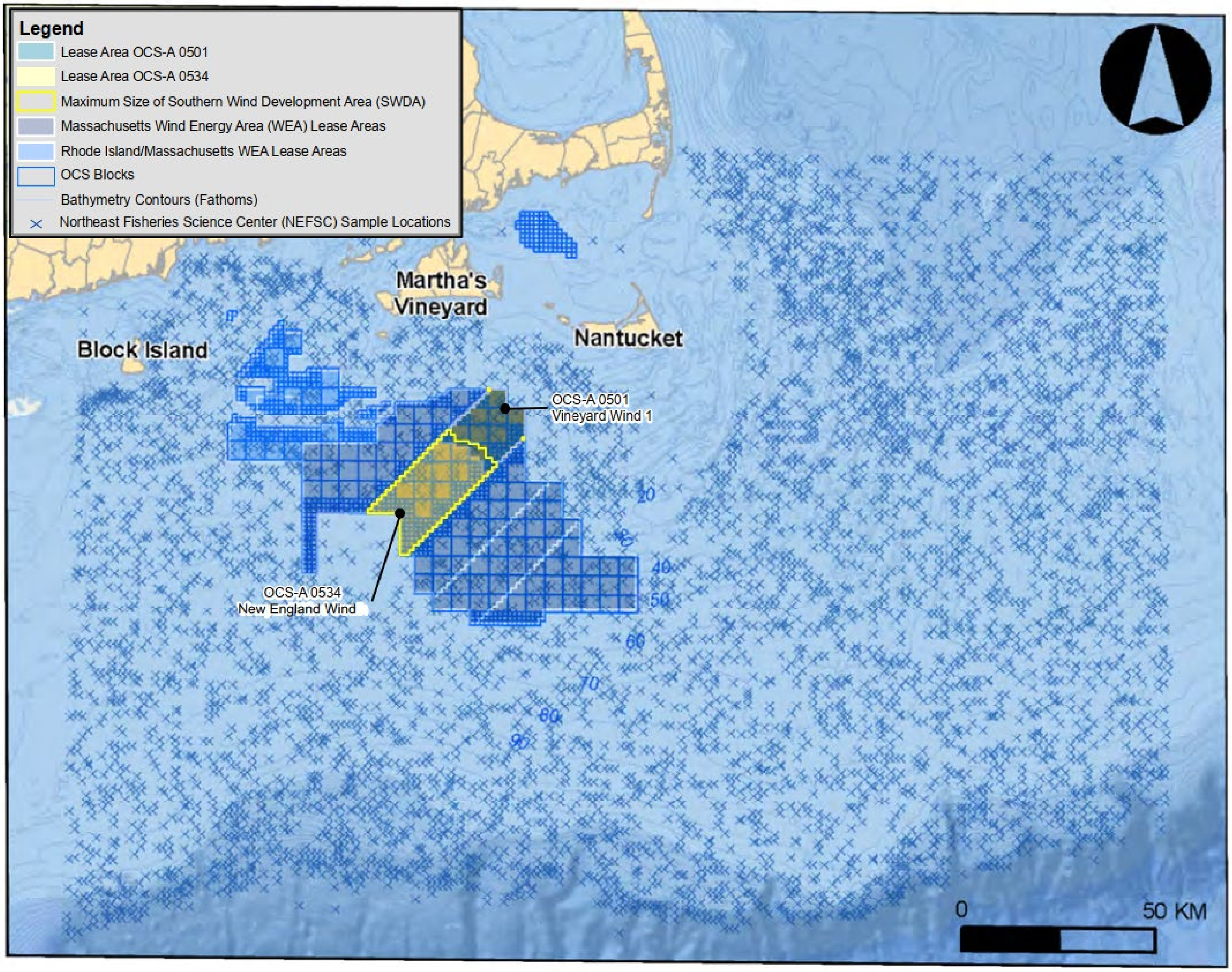


Figure 5.2-2

Locations of Water Quality Data Used from NEFSC Trawls (1948-2014)

Table 5.2-2 Mean and Standard Deviation for Seasonal (Spring, Fall, and Winter) Temperature and Salinity Data from the NEFSC Multispecies Bottom Trawl Survey

Season	Average Bottom Depth (meters)	Layer	Temperature (°C) (Mean ± 1 SD)	Salinity (psu) (Mean ± 1 SD)
Spring	94 (305 ft)	Surface Bottom	6.3 ± 2.0 7.2 ± 2.9	32.9 ± 0.7 33.5 ± 1.1
Fall	88 (290 ft)	Surface Bottom	17.5 ± 3.2 12.7 ± 3.1	32.9 ± 1.1 33.4 ± 1.2
Winter	104 (340 ft)	Surface Bottom	5.4 ± 1.6 7.5 ± 3.3	32.9 ± 0.5 33.8 ± 1.1

In addition, the National Oceanic Atmospheric Administration (NOAA) National Data Buoy Center (NDBC) has two data collection buoys, one (44020) that is located in the Nantucket Sound Main Channel in 11 meters (m) (36 feet [ft]) of water and the other (44097) in the offshore area to the west of the SWDA between Block Island and Martha's Vineyard in 48 m (157 ft) of water (see Figure 5.2-3). Data were downloaded from the NDBC website (NDBC 2020) for the period from 2016 through early 2020 with monthly values shown in Tables 5.2-3a and 5.2-3b. The individual parameters are discussed below.

Table 5.2-3a Mean Monthly Surface Temperature Data from the NOAA NDBC Buoy 44020 from January 2016 through December 2019

Station 44020 Mean Surface Temperature (°C)				
Month	**2016**	**2017**	**2018**	**2019**
January	5.3	5.2	1.3	2.6
February	3.7	4.0	2.8	1.0
March	5.4	3.7	3.9	2.8
April	7.8	7.3	6.1	7.9
May	11.4	11.1	13.0	11.8
June	17.29	15.9	17.1	17.3
July	22.0	20.9	22.5	23.0
August	23.8	21.6	24.4	23.9
September	21.0	18.9	22.1	20.8
October	15.6	17.0	16.6	15.2
November	10.0	11.3	9.9	10.5
December	5.1	5.6	4.8	6.2

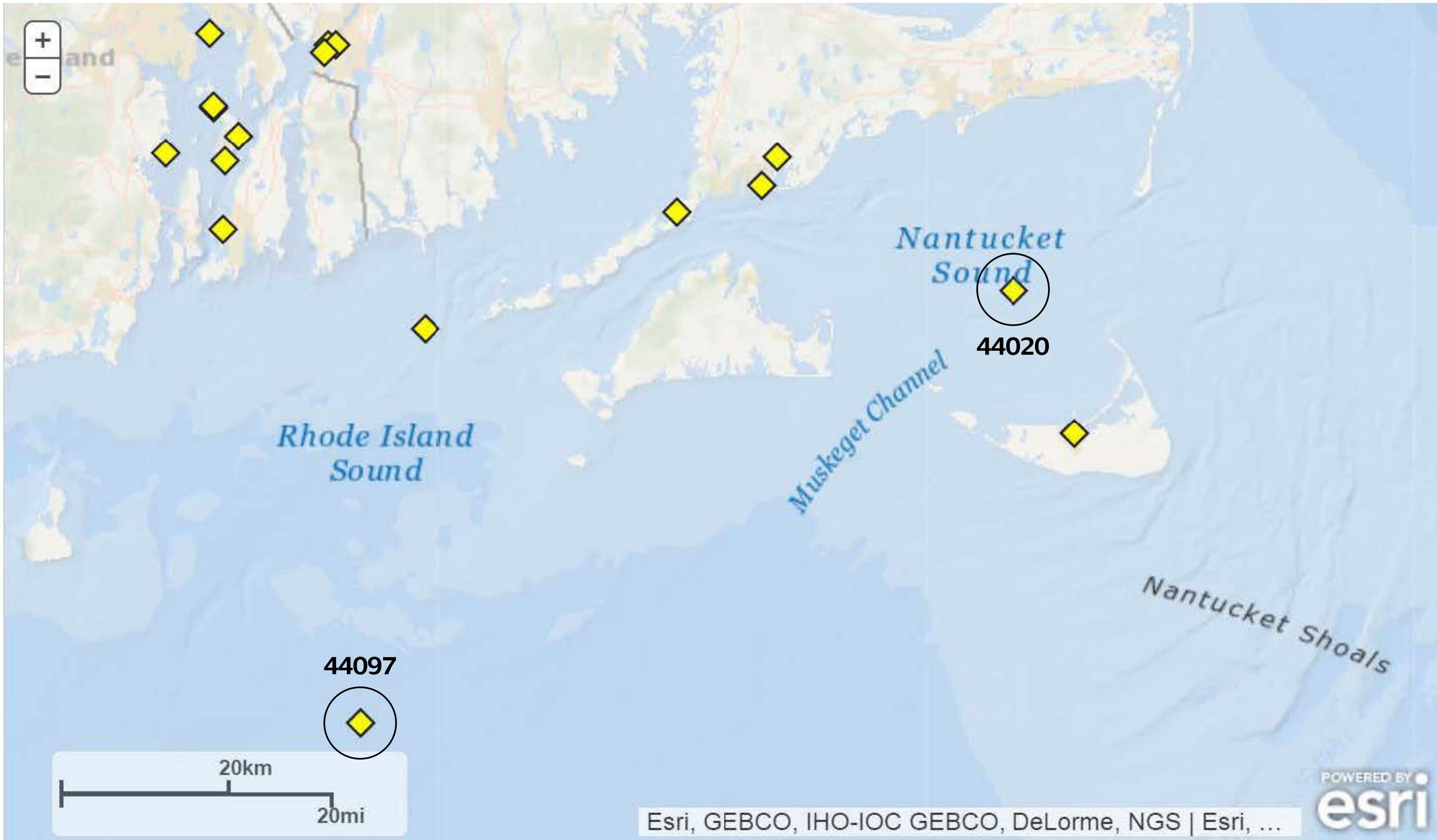


Figure 5.2-3

Locations of NOAA NDBC Buoys (Circled)

Table 5.2-3b Mean Monthly Surface Temperature Data from the NOAA NDBC Buoy 44097 from May 2016 through February 2020

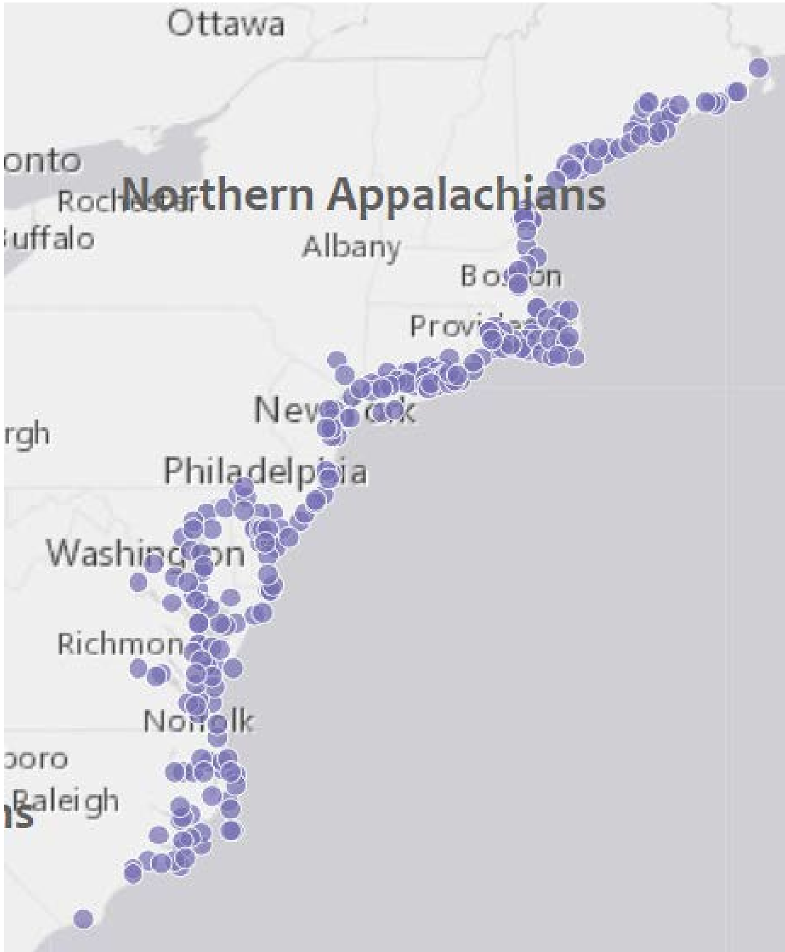
Station 44097 Mean Surface Temperature (°C)					
Month	**2016**	**2017**	**2018**	**2019**	**2020**
January		8.3	5.9	7.4	7.6
February		6.4	4.3	5.5	6.7
March		5.4	4.6	5.3	
April		6.5	5.6	8.1	
May	12.1	10.7	10.4	10.5	
June	16.3	15.0	14.9	15.7	
July	21.2	21.5	21.4	21.2	
August	23.1	21.1	23.2	23.2	
September	19.9	18.9	20.5	19.8	
October	17.7	17.0	17.3	16.5	
November	15	11.3	13.3	14	
December	11.3	11.2	9.8	10.2	

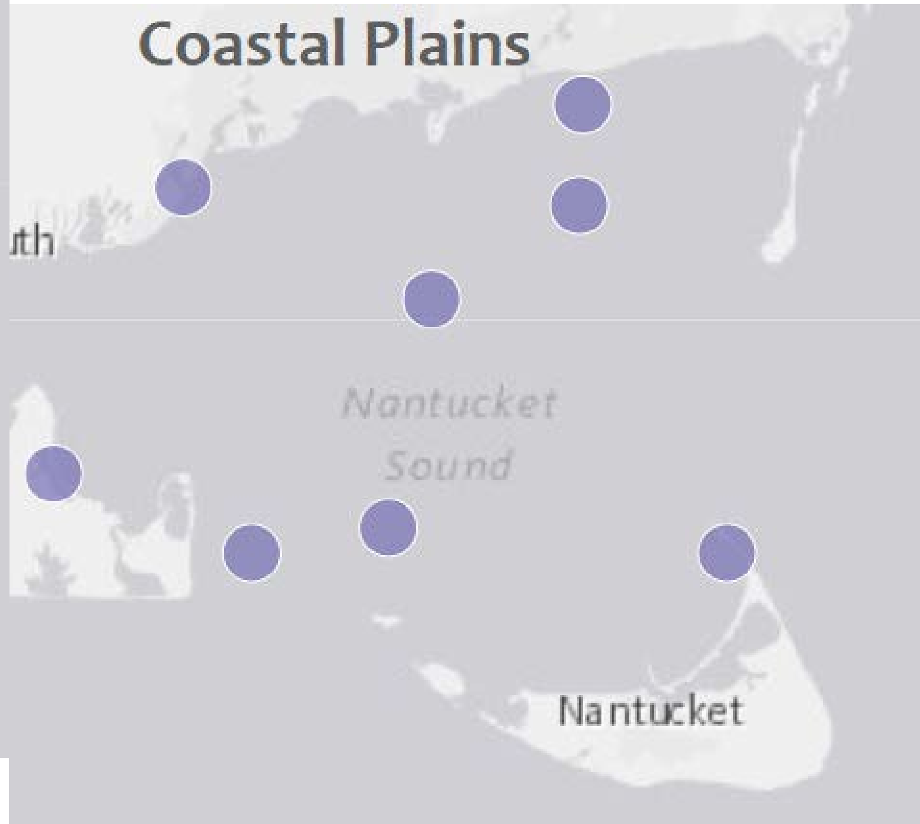
A large study conducted by the Environmental Protection Agency (EPA) evaluated over 1,100 coastal locations in 2010, as reported in their National Coastal Condition Assessment (EPA 2015). No results from this program after 2010 have been reported. The EPA used a Water Quality Index (WQI) to determine the quality of various coastal areas including the northeast coast from Virginia to Maine and assigned three condition levels for a number of constituents: good, fair, and poor. Figure 5.2-4 shows the larger northeast coastal area as well as the eight stations in Nantucket Sound. It should be noted, however, that this study was not designed to characterize conditions on as fine a scale as Nantucket Sound. With that caveat, both the regional and local constituent condition level results are reported in the following paragraphs.

Temperature

Three of the four data sources identified above reported temperature measurements. The recent seven year (2010–2016) CCS data showed an increase in temperature from south to north for the three stations in Nantucket Sound with means of 17.95, 19.21, and 20.36 °C (64.31, 66.58, and 68.65 °F) that was generally reflected in the minima and maxima as well. The seasonality of mean surface temperature differs between the NDBC stations. The lowest winter mean is 1 °C (33.8 °F)

Nantucket Sound





Northeastern US

Figure 5.2-4

Locations of EPA NCCA Stations for Northeastern US (Left) and Nantucket Sound (Right) and was recorded in February at Nantucket Station 44020, while the lowest spring mean is 2.8 °C (37.0 °F) and was recorded in March at Nantucket Station 44020. Both stations showed warmest mean surface temperatures of 24.4 °C (75.9 °F) (44020) and 23.2 °C (73.8 °F) (44097) during summer (August). The NEFSC data indicate that surface waters show a wider range of temperatures (12.1 °C [53.8 °F]) through the seasons, while bottom waters showed a much narrower range of temperatures (5.5 °C [41.9 °F]) through the seasons at water depths of approximately 90–100 m (300–330 ft).

Salinity

Unlike temperature, only small variations in the salinity of Nantucket Sound are reported in the CCS data. The mean salinities from south to north for the three stations are 31.75, 31.76, and 31.60 psu with similarly small variability of less than 2 psu between maximum and minimum at each station. This effect is also seen in the NEFSC data where the mean surface salinity is the same (32.9 psu) for the three seasons, while the mean bottom salinity varies only slightly (between 33.4 and 33.8 psu) over the seasons.

Chlorophyll a

Chlorophyll *a* concentrations, an indicator of primary productivity, vary substantially on a seasonal basis but are largely consistent spatially within Nantucket Sound. The recent seven year (2010–2016) CCS dataset shows small spatial differences from south to north for the three stations in Nantucket Sound with means of 1.79, 1.93, and 1.81 mg/L that is generally reflected in the minima (0.45, 0.23, and 0.50 mg/L) and maxima (4.73, 4.80, and 4.33 mg/L). The variability between minima and maxima is due to natural seasonal variations.

Chlorophyll *a* levels in northeastern coastal waters are generally rated as fair (45%) to good (51%) condition, as measured by the EPA WQI, based on measurements collected in 2010 (EPA 2015). Data specific to the eight stations in Nantucket Sound show that 88% were identified as good condition and 12% as fair.

Nutrients

Nutrients in the oceanic context consist of nitrogen, phosphorus, and silica (Kaplan 2011). Nitrogen in marine environments is mostly derived from dissolved nitrogen gas, with the rest formed by the dissolved inorganic nitrogen forms of nitrate, nitrite, and ammonium ion, as well as dissolved and particulate organic nitrogen. Inorganic phosphate is the primary form of phosphorus, known as orthophosphate, with lower levels of organic phosphate found in surface waters. Silicate makes up most of the silica in marine environments.

Sources of nutrients that enter New England marine waters include:

- Recycling or resuspension from sediments
- River and stream discharges

- ♦ Transport onto the shelf from offshore waters
- ♦ Atmospheric deposition
- ♦ Upwelling from deeper waters

Nutrient information is available from the data reported by CCS. For the three stations in Nantucket Sound, these data show increasing levels from south to north for mean total nitrogen (10.645, 11.143, and 12.984 µm) and maximum total nitrogen (18.057, 20.420, and 75.799 µm); minimum total nitrogen does not reflect this trend (4.438, 3.285, and 3.120 µm). The data reflect a similar pattern for total phosphorus levels, with increasing levels from south to north for means (0.648, 0.814, and 0.853 µm) and maximums (1.627, 1.881, and 2.584 µm); minimum total phosphorus shows no real trend (0.285, 0.205, and 0.331 µm). The general trend of increasing nutrient levels with increasing proximity to the Cape Cod mainland makes sense given the sources of nutrients in New England marine waters. The maxima of total nitrogen and total phosphorous for the northern station is particularly high compared to other measurements at that site.

Nitrogen levels in northeastern coastal waters are generally rated as fair (13%) to good (82%) condition while phosphorus levels are rated as fair (62%) to good (26%), as measured by the EPA WQI, for the northeastern coast based on 2010 data (EPA 2015). For the eight stations in Nantucket Sound, one measurement at each of the eight stations indicated a rating of 100% good for nitrogen and 100% fair for phosphorous.

Dissolved Oxygen

Dissolved oxygen mainly enters the ocean via exchange with the atmosphere. Concentrations are also controlled by physical factors (e.g. water temperature) and biological factors (e.g. respiration, photosynthesis, and bacterial decomposition), which may result in concentration changes through the water column.

The CCS data shows a decrease from south to north for the three stations in Nantucket Sound with means of 8.00, 7.59, and 7.32 mg/L that is reflected in the minima (6.89, 6.39, 5.37 mg/L) but not in the maxima (9.63, 11.39, 8.75 mg/L).

Dissolved oxygen levels in northeastern coastal waters are generally rated as fair (14%) to good (80%) condition, as measured by the EPA WQI, based on results of the 2010 NCCA (EPA, 2015). The eight stations in Nantucket Sound were sampled a total of 14 times in 2010, with 93% rated as good and 7% rated as fair.

Turbidity

Turbidity is a measure of the scattering of light by suspended particulate matter and is different from total suspended solids (TSS), which is a measure of the concentration of sediment particles in the water column. The only accurate way to convert from one to the other is to take simultaneous measurements of both and perform a regression analysis. Historically, turbidity has been measured directly in NTUs, while TSS concentrations were determined in the laboratory in units of mg/L, although newer instruments can now measure total suspended sediment directly. The discussion of benthic resources in Section 6.5 of COP Volume III includes information related to TSS and biological exposure.

The CCS data does not show a consistent variation from south to north for the three stations in Nantucket Sound with means of 0.66, 0.70, and 0.58 NTU, but these differences are small. The minima show a slight increase (0.09, 0.09, 0.13 NTU) while the maxima show a decrease (3.17, 2.27, and 2.19 NTU) from south to north.

Turbidity levels in northeastern coastal waters are generally rated as fair (10%) to good (78%) condition, as measured by the EPA WQI, based on results of the 2010 NCCA (EPA 2015). No turbidity data for the eight Nantucket Sound stations was acquired in 2010.

5.2.2 Potential Impacts of New England Wind

Potential impacts to water quality are most closely related to New England Wind development as a whole within the SWDA and along the OECC, as well as within the Phase 1 Onshore Development Area and Phase 2 Onshore Development Area. Impacts to water quality are also similar for each Phase. Accordingly, this assessment considers the full buildout of Phases 1 and 2 of New England Wind (e.g. full buildout of a maximum of 130 WTG and ESP positions and installation of five offshore export cables. The impact producing factors for water quality are listed in Table 5.2- 4.

Table 5.2-4 Impact Producing Factors for Water Quality

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Pile driving	•			•		
Cable installation/ maintenance	•	•	•	•	•	
Horizontal directional drilling		•		•		
Scour protection installation	•			•		
Discharges	•	•		•	•	•

5.2.2.1 Construction and Installation

5.2.2.1.1 Pile Driving and Foundation Installation (Phases 1 and 2)

As described in Section 3.2.1 of COP Volume I, the Phase 1 Envelope includes two foundation types for WTGs and ESPs: monopiles and piled jackets. As described in Section 4.2.1 of COP Volume I, the Phase 2 Envelope includes monopiles and/or jackets (with piles or suction buckets) for WTGs, ESPs, and bottom-frame foundations (with piles or suction buckets) for WTGs.

Depending on site-specific conditions at each WTG and ESP position, seabed preparation may be required prior to scour protection or foundation installation. This could include the removal of large obstructions and/or leveling of the seabed. Such an activity may yield a temporary increase in suspended sediments; however, such impacts are anticipated to be a short-term and temporary due to the predominately sandy composition of the upper sediments in the SWDA.

Pile driving within the SWDA is expected to be necessary for each Phase during monopile, piled jacket, or piled bottom-frame foundation installation. The potential impacts to water quality via sediment resuspension from repeated hammer blows to the pile would be local to the pile outer diameter. No studies of offshore pile driving were identified that concluded this activity would cause any significant sediment resuspension.

During installation of suction bucket jackets or suction bucket bottom-frame foundations for Phase 2, it is expected that a suction pump attached at the top of the bucket will reduce water pressure inside the bucket by pumping water out, which creates a driving force that pushes the bucket down into the seafloor. Installation may cause a temporary increase in suspended sediments, but, similar to installation of other foundation types, such impacts are anticipated to be temporary.

5.2.2.1.2 Offshore Cable Installation (Phases 1 and 2)

Each Phase of New England Wind includes cable installation activities in marine waters. Within the SWDA, inter-array cables will be installed for each Phase to connect the WTGs to the ESPs, and inter-link cables may be installed to connect ESPs from either Phase. In addition, short segments of offshore export cable will be installed from the SWDA boundary to the Phase 1 and Phase 2 ESPs. Within the OECC, Five offshore export cables—two cables for Phase 1 and three cables for Phase 2—will be installed within a shared OECC.

In order to assess the potential impacts of cable installation activities within the SWDA and along the OECC, a sediment dispersion modeling assessment was carried out through two interconnected modeling tasks:

1. Development of a three-dimensional hydrodynamic model application of a domain encompassing New England Wind activities using the HYDROMAP modeling system; and

2. Simulations of the suspended sediment fate and transport (including evaluation of seabed deposition and suspended sediment plumes) using the SSFATE (Suspended Sediment FATE) modeling system to simulate installation activities. Velocity fields developed using the HYDROMAP model are used as the primary forcing for SSFATE.

The modeling was performed to characterize the effects associated with the offshore cable installation activities. The effects were quantified in terms of the above-ambient TSS concentrations as well as seabed deposition of sediments suspended in the water column during cable installation activities.

Details of the models, their applications, and the results of the calculations are provided in Appendix III-A and summarized here. As described in Sections 3.3.1.3 and 4.3.1.3 of COP Volume I, several possible techniques may be used for cable installation for each Phase, though the majority of the offshore export cables are expected to be installed using jetting techniques (e.g. jet plow or jet trenching) or mechanical plow. Additionally, within the OECC, dredging may be required prior to cable installation to remove the upper portions of sand waves. No sand wave dredging will be required within the SWDA. Installation methodologies under consideration for each Phase that were modeled in the sediment dispersion study include:

- **Trailing Suction Hopper Dredge (TSHD):** Suction dredging through a drag arm near the seabed, overflow of sediment laden waters from a hopper and disposal of sediments from the hopper. Use of a TSHD was modeled for removal of all sand wave sizes where dredging is needed.

- **Limited TSHD:** This method is the same as THSD; the TSHD, however, is "Limited" in that it is only applied to larger (greater than 2 m [6.6 ft]) sand waves where dredging is needed.

- **Cable Installation:** Cable installation is accomplished by jetting techniques (e.g. jet plow, jet trenching, or similar) in areas where sand waves do not exist or have been cleared.

- **Cable Installation Aided by Jetting:** Cable installation is accomplished as described above; however, this method includes additional jetting by controlled flow excavation in areas of small sand waves.

- **Cable Installation using Vertical Injector:** Cable installation is accomplished in areas with or without sand waves through the use of the vertical injector tool, which is a high-volume low-pressure water jetting tool that uses directed water jets to fluidize the seabed and lower the cable via the integral depressor to the bottom of the fluidized trench.

The scenarios that were modeled include a representative offshore export cable route for the full length of the OECC and representative sections of cable routes within the OECC. Due to the use of a shared OECC for Phases 1 and 2, the model scenario results are applicable to both Phases. Model scenarios also include a representative inter-array cable route within the SWDA that, due to the similarities in installation methods and the selection of a model route with relatively finer sediment, is also representative of potential impacts of any Phase 1 or Phase 2 inter-array, inter-link, and offshore export cable installation within the SWDA. The model scenarios include:

- Inter-array cable installation with typical burial installation parameters
- Inter-array cable installation with maximum impact burial installation parameters
- OECC sand wave clearing by TSHD
- OECC sand wave clearing by Limited TSHD
- OECC cable installation with typical burial installation parameters
- OECC cable installation aided by jetting with typical burial installation parameters
- OECC cable installation in the lease area with typical burial installation parameters
- OECC section of cable installation with vertical injector with typical burial installation parameters
- OECC section of cable installation along the landfall approach with typical burial installation parameters

Simulations of sand wave dredging using a TSHD and associated disposal activities along the OECC show that above-ambient TSS originating from the source is intermittent along the route, matching the intermittent need for dredging. Above-ambient TSS concentrations may be present throughout the entire water column since sediments are released at or near the water surface.

Above-ambient TSS concentrations of 10 mg/L extend up to 16 km (8.6 nautical miles [NM]) and 8.5 km (4.6 NM) from the area of activity for the TSHD and limited TSHD model scenarios, respectively; however, these concentrations only persist for a matter of hours. Concentrations greater than 10 mg/L persist for less than six hours for TSHD activities and for less than four hours for limited TSHD activities. Figure 25 through Figure 30 in Appendix III-A provide the modeled TSS concentrations for simulations of sand wave dredging using a TSHD.

Simulations of several possible export or inter-array cable installation methods using either typical installation parameters (for export and inter-array cable installation) or maximum impact parameters (for inter-array cable installation only) predict a plume that is localized to the seabed. The plume may be located in the bottom approximate 6 m (20 ft) of the water column, which is typically a fraction of the water column; however, in shallow waters, the plume may occupy the entire water column. Simulations of cable installation found that above-ambient TSS greater than 10 mg/L and deposition over 1 millimeter (0.04 inches) stayed closer to the cable alignment as compared to the dredging footprints; this is due to the fact that sediments are introduced to the water column closer to the seabed. Above-ambient TSS concentrations greater than 10 mg/L typically stayed within 200 m of the alignment, though did extend up to a maximum distance of approximately 2.1 km for typical installation parameters and up to 2.2 km for maximum impact installation parameters (for inter-array cable installation only). The extent of above-ambient TSS concentrations decreases at higher concentration thresholds.

Above-ambient TSS concentrations stemming from cable installation for the various model scenarios remain relatively close to the cable alignment, are constrained to the bottom of the water column, and are short-lived. Above-ambient TSS concentrations substantially dissipate within one to two hours and fully dissipate in less than four hours for most of the model scenarios. For the vertical injector model scenario, above-ambient TSS concentrations similarly substantially dissipated within one to two hours but required up to six hours to fully dissipate, likely due to the relatively slower installation rate and deeper trench (greater volume disturbed per unit length). Figure 32 through Figure 46 in Appendix III-A provide the modeled TSS concentrations for simulations of cable installation within the SWDA and OECC. The results of the extent and persistence of the plume for export or inter-array cable installation scenarios are generally similar regardless of the route location (SWDA versus OECC). Ancillary cable installation activities such as boulder relocation and the pre-lay grapnel run could also generate some TSS, but impacts are expected to be less than typical cable installation.

5.2.2.1.3 Offshore Export Cable Installation (Phase 2 OECC Western Muskeget Variant)

As mentioned above, modeling of sediment transport potential was conducted for one representative cable installation within the OECC that is illustrative of expected impacts for each of the three cables that may be installed within the OECC. Given the similarities in substrate type, ocean conditions, and the shorter corridor distance within the Western Muskeget Variant, suspended sediment concentrations and durations are expected to be similar or less than the values presented for the OECC. For additional details of the models, their applications, and the results of the calculations for the Western Muskeget Variant, see Appendix III-A: Appendix B Western Muskeget Variant Sediment Transport Modeling.

5.2.2.1.4 Onshore Cable Installation (Phases 1 and 2)

For Phase 1 and 2, the Onshore Export Cable Routes, which are the onshore routes within which the onshore export cables will be installed, and Grid Interconnection Routes, which are the onshore transmission routes that connect the onshore substation to the grid interconnection point, may pass through mapped water resource areas. Mapped water resource areas include Massachusetts Department of Environmental Protection Zone I[33] and II[34] areas and wellhead

[33] As defined in 310 CMR 22.02, Zone I "means the protective radius required around a public water supply well or Wellfield…"

[34] As defined in 310 CMR 22.02, Zone II "means that area of an aquifer that contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation). The Zone II must include the entire Zone I area…"

protection areas determined by hydro-geologic modeling and approved under the Commonwealth's Drinking Water Program, Freshwater Recharge Areas identified by the Cape Cod Commission's Regional Policy Plan, Potential Public Water Supply Areas mapped by the Cape Cod Commission's Priority Land Acquisition Assessment Project, and the Barnstable Groundwater Protection Overlay District.

Portions of the Phase 1 Onshore Export Cable Routes and Grid Interconnection Routes pass through Zone II areas, Freshwater Recharge Areas, Potential Public Water Supply Areas, and the Barnstable Groundwater Protection Overlay District (see Figure 5.2-5). No Phase 1 Onshore Export Cable Routes or Grid Interconnection Route pass through any Zone I areas. Portions of the Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes pass through Zone I and Zone II areas, Freshwater Recharge Areas, Potential Public Water Supply Areas, and the Barnstable Groundwater Protection Overlay District and the Wellhead Protection Overlay District (see Figure 5.2-5). An Approval of Easement from MassDEP may be required as Phase 2 Onshore Export Cable and Grid Interconnection Routes pass through Zone I areas. Impacts to water quality will be minimized or avoided because both the Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are primarily located within existing public roadway layouts or utility rights-of-way, and construction involves standard inert materials such as concrete, polyvinyl chloride conduit, and solid dielectric cable. Proper erosion and sedimentation controls will be maintained for both Phases of New England Wind.

5.2.2.1.5 Landfall Site Construction and Horizontal Directional Drilling (Phase 1 and 2)

As described in Sections 3.3.1.8 and 4.3.1.8 of COP Volume I, horizontal directional drilling (HDD) is expected to be used at the Phase 1 and Phase 2 landfall site to avoid impacts of standard cable burial techniques in the nearshore region. These activities will only occur in the OECC. To facilitate cable pull-in and expose the conduit end, a shallow "pit" would be excavated at the HDD exit point. After the cables are pulled in through the conduit, the seaward end of the conduit would then be reburied beneath the seafloor. It is possible that potential, limited sediment releases could occur during the excavation or reburial at the HDD exit point, but impacts would be localized and short-term.

Although not anticipated, a small amount of bentonite clay could be released at the exit point of the HDD operation, and the contractor may install silt curtains at the exit point. Bentonite clay is an inert, naturally-occurring substance and is appropriate for use in sensitive environments because it poses minimal environmental risks; for this reason, bentonite is commonly used for the HDD process. Nevertheless, the contractor will minimize the amount of bentonite near the exit hole and will have controls near the exit hole to minimize and contain any bentonite. The temporary receiving pit will be filled back in with the same material once the offshore export cable has been brought to land, thereby restoring the ocean bottom to pre-installation conditions.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

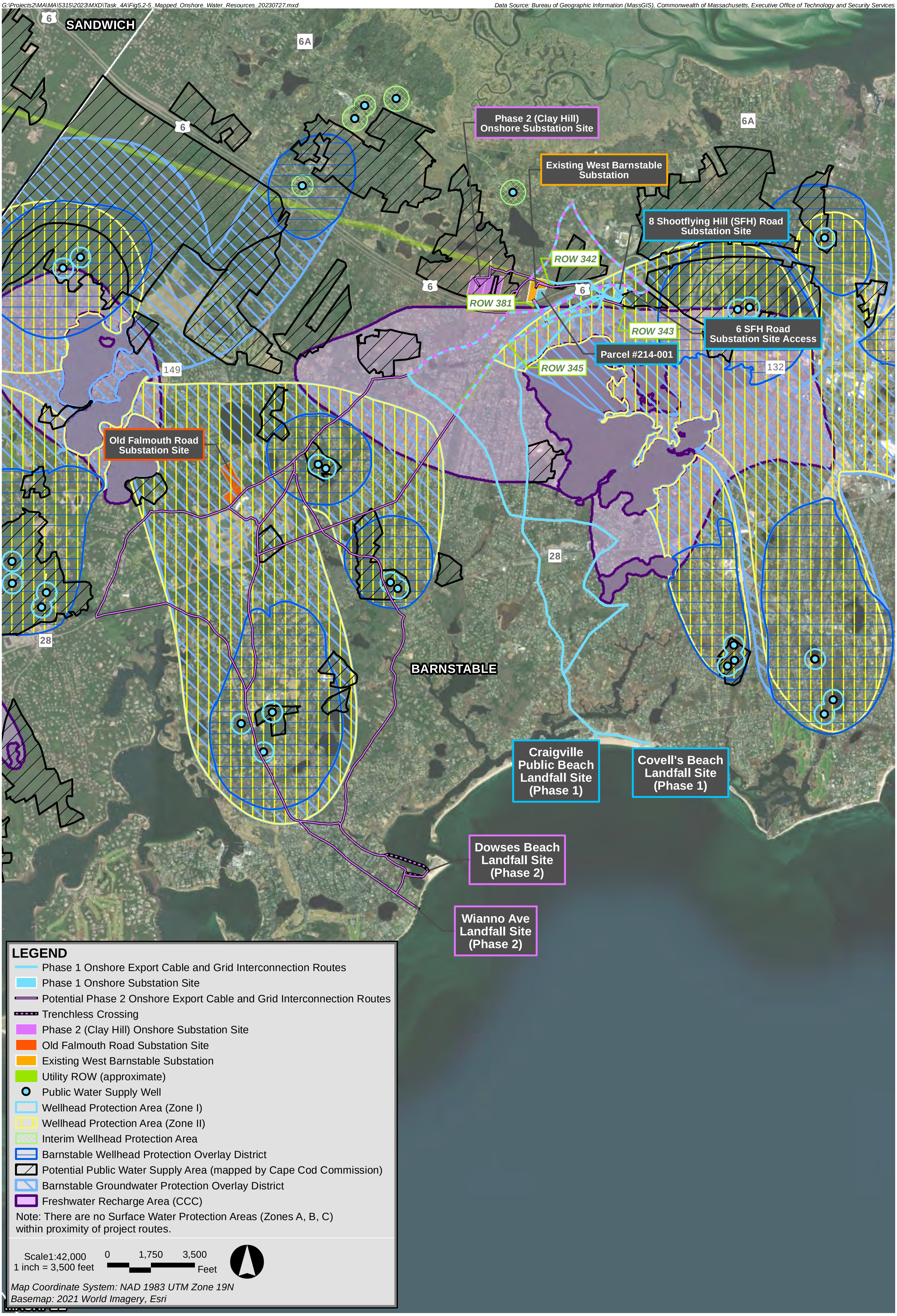

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Figure 5.2-5

Mapped Onshore Water Resources

For Phase 2, the Dowses Beach Landfall Site would also use HDD and the Wianno Avenue Landfall Site would use HDD or open trenching. However, the Proponent only expects to use the Wianno Avenue Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all of some of the Phase 2 offshore export cables. Wianno Avenue is less suited for HDD due to the elevated onshore topography and slope of the parking lot. This landfall site is suitable for open-trenching because the shoreline has already been altered by the installation of a riprap seawall, a portion of which would be temporarily removed and replaced following cable installation. As described in Section 4.3.1.8.2 COP Volume I, open-trenching activities involve the installation of a temporary cofferdam, riprap removal and restoration at the existing seawall, dewatering of the cofferdam and excess trench spoils, installation of the conduit(s) and backfilling with sand and gravel fill within the cofferdam, removal of the cofferdam, and burial of the seaward end of the conduits. Each of these activities (other than those occurring within the cofferdam) may involve temporary increases in suspended sediments, but impacts would be localized and short-term. No permanent impacts to water quality are anticipated.

5.2.2.1.6 Scour Protection and Cable Protection Installation (Phases 1 and 2)

As described further in Sections 3.3.1.2 and 4.3.1.2 of COP Volume I, installation of the rocks or stones for scour protection may occur at each WTG and ESP foundation for both Phases of New England Wind. Similarly, as described further in Sections 3.3.1.3.10 and 4.3.1.3.10 of COP Volume I, cable protection (for example, in the form of rock protection) may be needed if sufficient cable burial is not achieved. Placement of the scour protection or cable protection may yield a temporary increase in suspended sediments due to resuspension of bottom sediments as the rock or other form of cable protection is placed; however, such impacts are anticipated to be a short-term and temporary due to the predominately sandy composition of the upper sediments in the SWDA.

5.2.2.1.7 Discharges (Phases 1 and 2)

For each Phase of New England Wind, some routine releases of liquid wastes are allowed to be discharged from vessels to marine waters in both the SWDA and OECC. These discharges include domestic water, uncontaminated bilge water, treated deck drainage and sumps, uncontaminated ballast water, and uncontaminated fresh or seawater from vessel air conditioning. As defined, these discharges will not pose a water quality impact. Other waste generation such as sewage, solid waste or chemicals, solvents, oils and, greases from equipment, vessels or facilities will be stored and properly disposed of on land or incinerated offshore and will not generate an impact.

At this planning stage for Phase 1 and Phase 2, it expected that nearly all onshore vehicle fueling, and all major equipment maintenance, will be performed offsite at commercial service stations or a contractor’s yard. A few pieces of large, less mobile equipment (e.g. excavators, paving equipment, and generators) will be refueled as necessary onsite. Any such field refueling will not be performed within 30 m (98 ft) of wetlands or waterways, or within 30 m (98 ft) of known private or community potable wells, or within any Town of Barnstable water supply Zone I area.

The fuel transfer operation will be conducted by a competent person knowledgeable about the equipment, the location, and with the use of the work zone spill kit. Proper spill containment gear and absorption materials will be maintained for immediate use in the event of any inadvertent spills or leaks. All operators will be trained in the use and deployment of such spill prevention equipment. During construction, it is expected that equipment will be inspected for incidental leaks (e.g. hydraulic fluid, diesel fuel, gasoline, anti-freeze, etc.) prior to site access and on a daily basis at the commencement of each work shift. Procedures for onshore refueling of construction equipment to promote spill prevention will be finalized during consultations with the appropriate state, regional, and local authorities.

The proposed Phase 1 onshore substation site is located within a Zone II Wellhead Protection Area and the Barnstable Groundwater Protection Overlay District. As described in Section 3.2.2 of COP Volume I, the proposed onshore substation will be equipped with full containment for any components containing dielectric fluid, including all transformers and capacitor banks. Therefore, no discharges are anticipated.

For the Phase 2 onshore substation, the Proponent expects to provide full-volume (110%) containment systems for any substation components using dielectric fluid located at the onshore substation. Further detail is provided in Section 4.2.2 of COP Volume I.

5.2.2.1.8 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

For both Phases of New England Wind, water quality impacts related to suspended sediments from cable installation, dredging, and other construction activities, such as HDD or placement of scour protection, are expected to be short term and localized. Modeling of cable installation activities, including dredging, indicates that suspended sediments will settle out within a matter of hours.

The Proponent will require all vessels to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental spills. All vessels will comply with the United States Coast Guard (USCG) ballast water management requirements at 33 CFR Part 151 and 46 CFR Part 162. The USCG regulations include the same discharge standards as the International Maritime Organization Ballast Water Management Convention standards, but also include requirements that go beyond those of the International Maritime Organization.

All New England Wind vessels will meet USCG bilge water regulations in 33 CFR Part 151, which are based on the Convention for the Prevention of Marine Pollution (MARPOL) Annex I Regulations for the Prevention of Pollution by Oil. Bilge water will either be retained onboard vessels in a holding tank and discharged to an onshore reception facility or treated onboard with an oily water separator, after which the treated water can be discharged overboard. Among several other conditions, bilge water cannot be discharged into the sea unless the oil content of the bilge water without dilution is less than 15 parts per million. For vessels operating within 5.5 km (3 NM) from shore, bilge water regulations under EPA's National Pollutant Discharge

Elimination System (NPDES) program apply to any vessel that is covered by a Vessel General Permit (those that are 24 m [79 ft] or greater in length). Bilge discharges within 5.5 km (3 NM) from shore are subject to the rules in Section 2.2.2 of Vessel General Permit and must occur in compliance with 40 CFR Part 110, 40 CFR Part 116, 40 CFR Part 117, and 33 CFR 151.10.

It is expected that nearly all vehicle fueling, and all major equipment maintenance, will be performed offsite at commercial service stations or a contractor's yard. Field refueling will not be performed within 30 m (98 ft) of wetlands or waterways, or within 30 m (98 ft) of known private or community potable wells, or within any Town of Barnstable water supply Zone I area. Proper spill containment gear and absorption materials will be maintained for immediate use in the event of any inadvertent spills or leaks. Any Phase 1 and Phase 2 substation equipment will be equipped with full containment for any components containing dielectric fluid.

Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are primarily located within existing public roadway layouts or utility rights-of-way, and construction involves standard inert materials such as concrete, polyvinyl chloride conduit, and solid dielectric cable, which will avoid or minimize impacts to any mapped water resource areas along the routes. During each Phase of New England Wind, proper erosion and sedimentation controls will be employed.

The Proponent has also developed a draft Oil Spill Response Plan for New England Wind, which is included in Appendix I-F.

5.2.2.2 Operations and Maintenance

5.2.2.2.1 Impact of Foundations on Currents and Mixing (Phases 1 and 2)

The SWDA is located in the Mid-Atlantic Bight region, which extends from Cape Hatteras, North Carolina to Cape Cod, Massachusetts. Currents are primarily generated by the tides but can be wind-driven at the surface depending on location and wind speed.

Offshore renewable energy facilities may cause hydrodynamic mixing, impacting the formation and maintenance of stratifications in the water column (Segtnan and Christakos 2015). Flow around a vertical cylinder (e.g. the WTG and ESP foundations) and the associated local hydrodynamic effects, such as vortex shedding, have been investigated extensively in marine and coastal engineering fields. These studies have indicated that downstream mixing can occur in both the horizontal and vertical planes. In addition, it is known that wind-induced forcing and wake effect turbulence at the water surface can also influence current circulation and mixing downstream (Tian et al. 2009).

Based on model predictions and observations for the Vineyard Wind 1 project (see the sediment dispersion modeling assessment in Appendix III-A and Section 2.2.2 of COP Volume II-A), currents in the middle of the water column are approximately 0.5 to 0.8 feet/second (ft/s) (0.15 to 0.25 m/s) on average, with maximum current speeds in the range of 1 to 1.3 ft/s (0.3 to 0.4 m/s). It is estimated that the effects of vortex shedding from a foundation would extend less than 0.4 km (0.2 NM) (in comparison to the WTG spacing of one nautical mile [1.85 km]) at a maximum tidal current speed of 1 to 1.3 ft/s (0.3 to 0.4 m/s), after which the tides would turn, the vortices would dissipate, and any new vortices would shed from the foundation in the opposite direction. Thus, the effect of foundations in the flow field is expected to be short-term and localized.

The effect of US offshore wind projects on hydrodynamics at a regional scale is still in the research phase due to the early stage of offshore wind development in the US. There are ongoing research efforts in the Mid-Atlantic region by federal, state, and academic researchers to address the effect of offshore wind infrastructure on the environment, including Bureau of Ocean Energy Management (BOEM) Solicitation Number 140M0119R0015 focused on hydrodynamic modeling and particle tracking in the US Mid-Atlantic Bight in the presence of offshore structures.

Numerical and observational studies have been performed over the last decade to assess the local effect of European offshore wind projects on wake, turbidity, stratification, and fisheries impacts (van Berkel et al. 2020). Most of the studies have been focused on numerical modeling of the hydrodynamic processes; fewer studies provide validation through observations or field studies of actual offshore wind projects. The European studies have shown only minor influence from the offshore wind projects in comparison with natural processes (Floeter et al. 2017; Simpson et al. 1982) and have occasionally shown contradictory results on topics such as whether an offshore wind project leads to decreases or increases in turbidity (van der Molen et al. 2014; Grashorn and Stanev 2016; Rivier et al. 2016). Further, the applicability of the European studies to New England Wind may be limited given different design parameters. The one nautical mile (1.85 km) spacing between the New England Wind WTGs is approximately two to three times greater than the typical WTG spacing for European projects (0.5 km [0.3 NM]). In addition, the potential hydrodynamic effects are a function of water depths in the area, which are generally greater at the SWDA than in Europe. As such, fewer local effects to hydrodynamics are anticipated from New England Wind compared to European offshore wind projects.

5.2.2.2.2 Discharges (Phases 1 and 2)

During operations and maintenance of both Phases of New England Wind, discharges in the form of routine releases from vessels performing operations and maintenance activities, such as crew transfer vessels, are expected. These discharges may include domestic water, bilge water, engine cooling water, deck drainage, and/or ballast water. BOEM (BOEM 2014) determined the following related to potential water quality impacts from routine vessel discharges: "In the WEA, coastal and oceanic circulation and the large volume of water would disperse, dilute, and biodegrade vessel discharges relatively quickly, and the water quality impact would be minor."

The ESP(s) include several complex mechanical and electrical systems that require oil and chemical products and will likely include an oil/water separator. See Tables 3.3-6 and 4.3-6 in COP Volume I for a list of potential oils and chemical products used on the ESP(s). A preventative maintenance schedule similar to that of the WTGs will be followed for the ESP(s).

5.2.2.2.3 Offshore Cable Maintenance (Phases 1 and 2)

Impacts associated with cable maintenance and/or repair could include a temporary increase in suspended sediments during the repair process. The increase in suspended sediments would be caused by the removal of sediments to uncover the damaged portion of the cable, hoisting of the cable after it is cut, laying the cable back down, and then jetting or otherwise removing sediments for reburial of the repaired cable. Such impacts would be confined to the specific area of the repair(s) and, given the limited area(s) where repair(s) may occur, would be considerably less than the impacts during construction.

5.2.2.2.4 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

Similar to the requirements above for construction and installation, the Proponent will require all vessels to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental spills. The Proponent has also developed a draft Oil Spill Response Plan for New England Wind, which is included in Appendix I-F.

5.2.2.3 Decommissioning

The decommissioning of New England Wind facilities and equipment will likely include removing the WTGs and ESPs below the mudline, removal of associated scour protection, and may include retirement in place or removal of offshore export cables. Removal of offshore export cables and scour protection may cause short-term and localized generation of suspended sediments. To the extent feasible and appropriate, the avoidance, minimization, and mitigation measures listed above under construction and installation will also be followed for the decommissioning of New England Wind. Due to the long lifespan of New England Wind, it is also expected that technology will be enhanced by the time decommissioning occurs and impacts reduced.

6.0 BIOLOGICAL RESOURCES

6.1 Terrestrial Fauna Including Inland Birds in the Onshore Development Areas

This section addresses impacts to terrestrial wildlife species, including inland birds, associated with the Onshore Development Areas for Phases 1 and 2. For each Phase, the Onshore Development Area consists of the areas where the onshore facilities could be physically located. Accordingly, the Onshore Development Areas for Phases 1 and 2 consist of: (1) the landfall sites; (2) the Onshore Export Cable Routes, which are the onshore routes from the landfall sites to the onshore substation sites within which the onshore export cables will be installed; (3) the onshore substation sites; (4) the Grid Interconnection Routes, which are the onshore transmission routes that connect the onshore substations to the grid interconnection point; and (5) the grid interconnection point at the West Barnstable Substation.

This section focuses on inland habitats that may be affected by onshore cable installation and onshore substation construction. Coastal and marine birds are discussed in Section 6.2, bats are discussed in Section 6.3, and coastal habitats at the landfall sites are discussed in Section 6.4.

6.1.1 Description of the Affected Environment

The Phase 1 onshore facilities will ultimately include one of two potential landfall sites, one of two potential Onshore Export Cable Routes (with variants), one new onshore substation site, and one of two potential Grid Interconnection Routes (with variants), which are illustrated in Figure 3.1-2. The Phase 2 onshore facilities will ultimately include one or two landfall sites, one or two Onshore Export Cable Routes, and one or two Grid Interconnection Routes. The Proponent has considered two site options for the Phase 2 substation. The potential Phase 2 landfall sites, Onshore Export Cable Routes, onshore substation site options, and Grid Interconnection Routes have been identified (see Figure 3.1-2).

6.1.1.1 Terrestrial Habitats (Phases 1 and 2)

6.1.1.1.1 Onshore Export Cable and Grid Interconnection Routes (Phases 1 and 2)

As described in Sections 3.2.2 and 4.2.2 of COP Volume I and as shown on Figure 3.1-2 of COP Volume III, the Onshore Export Cable Routes and Grid Interconnection Routes for Phases 1 and 2 are expected to be located primarily within public roadway layouts, which will avoid most impacts to terrestrial wildlife habitat. Certain Onshore Export Cable Routes (including variants) and Grid Interconnection Routes (including variants) also utilize existing utility rights-of-way (ROWs). The Phase 1 and Phase 2 onshore routes are further described below.

Onshore Export Cable and Grid Interconnection Routes—Phase 1

Upon making landfall, the Phase 1 onshore export cables would exit the transition vaults and follow one of two potential Onshore Export Cable Routes (with variants) from the Craigville Public Beach Landfall Site or Covell's Beach Landfall Site to the onshore substation site (see Figure 3.1-2). The Phase 1 Onshore Export Cable Routes are approximately 6.5 to 10.5 kilometers (km) (4.0 to 6.5 miles [mi]) in length. For both routes, the onshore export cables will be located underground, primarily within public roadway layouts; however, portions of the routes may also be located within utility ROWs. Both Phase 1 Onshore Export Cable Routes require crossing the Centerville River where Craigville Beach Road crosses that waterway on a fixed bridge (see Figure 6.1-1). Methods of crossing the Centerville River are described in Section 3.3.1.10.2 of COP Volume I. One variant of the Oak Street Onshore Export Cable Route (Variant 2, as shown on Figure 3.2-11 of COP Volume I) would likely require a trenchless crossing within the utility ROW to avoid impacts to a wetland (see Figure 6.1-1), increasing costs and the complexity of construction.

From the onshore substation, the Phase 1 grid interconnection cables will follow one of two potential Grid Interconnection Routes (with variants) to the grid interconnection point at the West Barnstable Substation. The Grid Interconnection Routes are 0.9 to 2.9 km (0.6 to 1.8 mi) long and are shown on Figure 3.1-2. The Grid Interconnection Routes are located within public roadway layouts or utility ROWs.

The Phase 1 Onshore Export Cable Routes and Grid Interconnection Routes do not cross Priority Habitats or Estimated Habitats mapped by the Massachusetts Division of Fish and Wildlife Natural Heritage and Endangered Species Program (NHESP) (see Figure 6.1-2).

Onshore Export Cable and Grid Interconnection Routes—Phase 2

Upon making landfall, the Phase 2 onshore export cables would follow one or two Onshore Export Cable Routes to a new onshore substation. Grid interconnection cables installed along one or two Grid Interconnection Routes would then connect the Phase 2 onshore substation to the grid interconnection point. From each landfall site to the grid interconnection point, the maximum combined length of the Phase 2 Onshore Export Cable Route and Grid Interconnection Route is up to 17 km (10.6 mi). The onshore export and grid interconnection cables are expected to be installed underground primarily within public roadway layouts and utility ROWs.

Wetlands proximate to the Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are shown on Figure 6.1-1. Specialty trenchless crossing methods are expected to be used where the Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes traverse unique features such as busy roadways, wetlands, and waterbodies in order to avoid impacts to those features. The Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

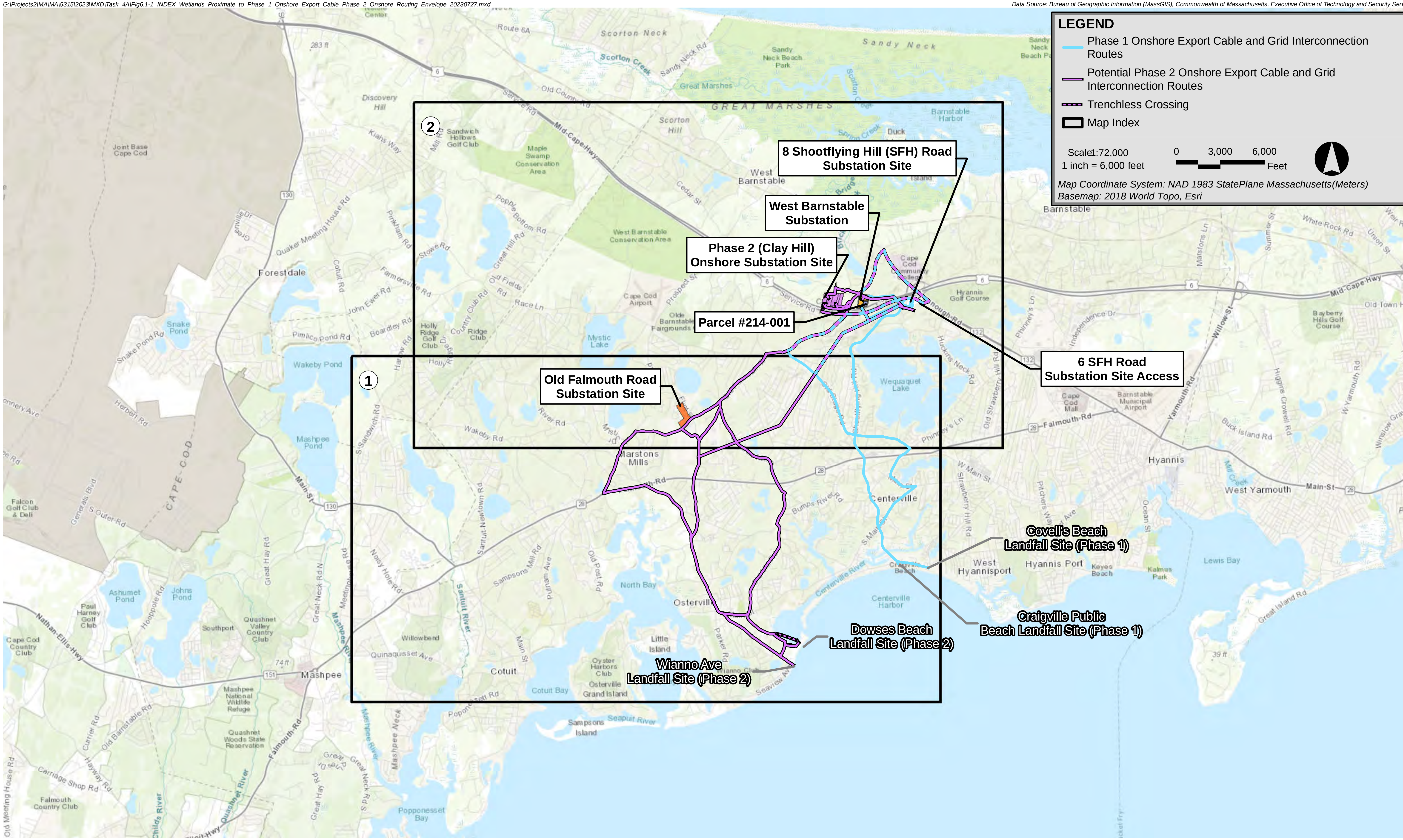

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Figure 6.1-1, Index

Wetlands Proximate to the Phase 1 and Phase 2 Onshore Export Cable and Grid Interconnection Routes

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

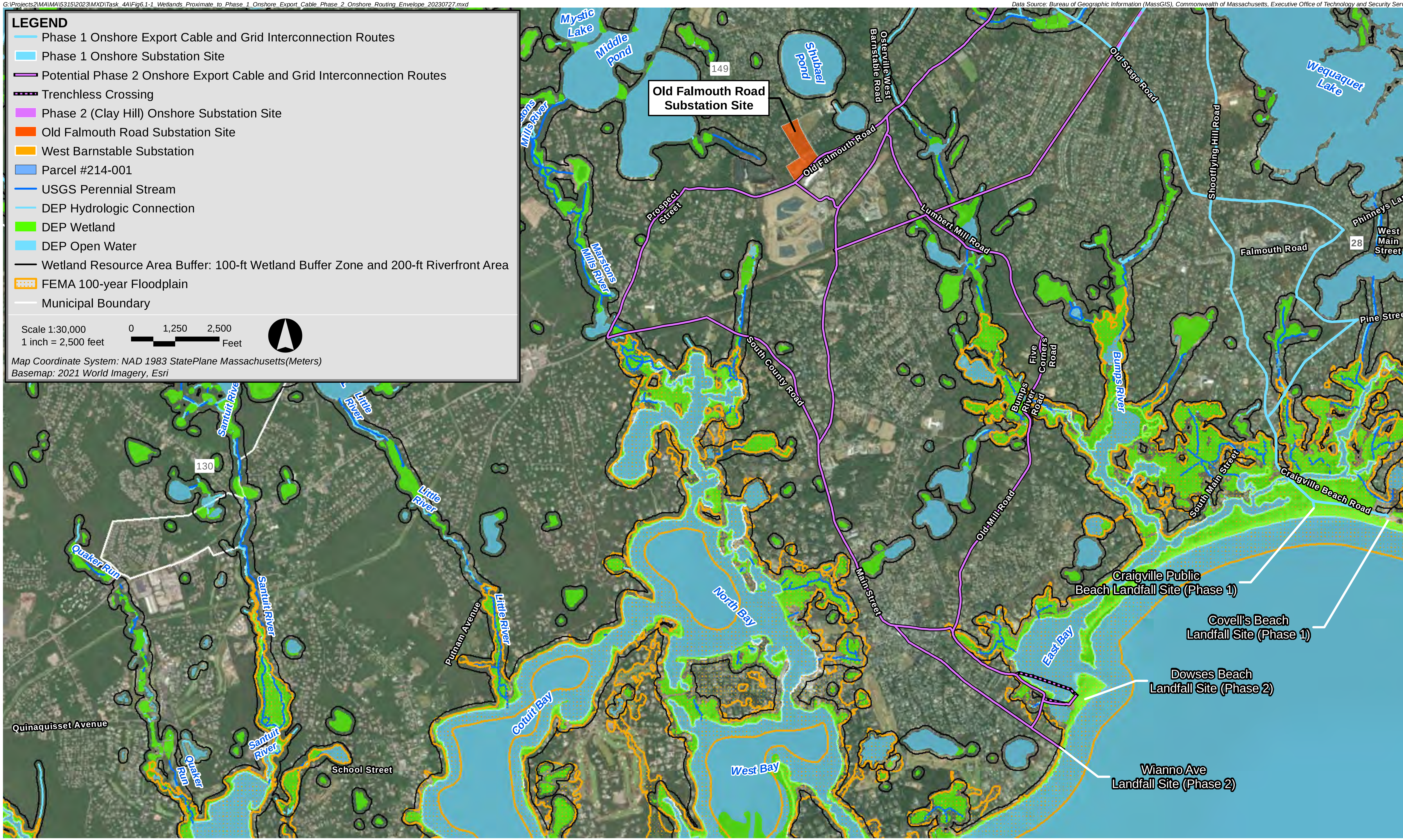

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Figure 6.1-1, Sheet 1 of 2

Wetlands Proximate to the Phase 1 and Phase 2 Onshore Export Cable and Grid Interconnection Routes

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

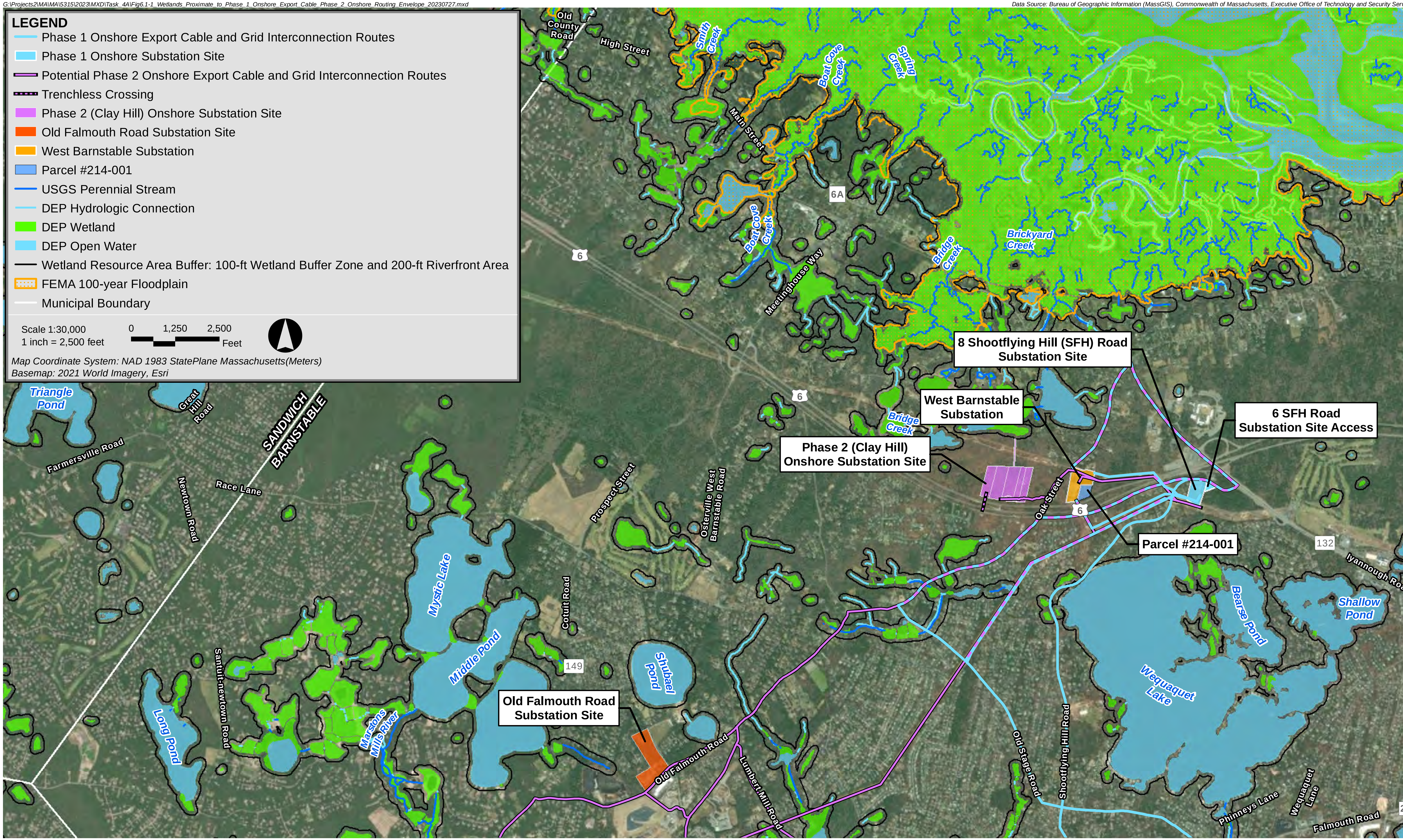

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Figure 6.1-1, Sheet 2 of 2

Wetlands Proximate to the Phase 1 and Phase 2 Onshore Export Cable and Grid Interconnection Routes

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

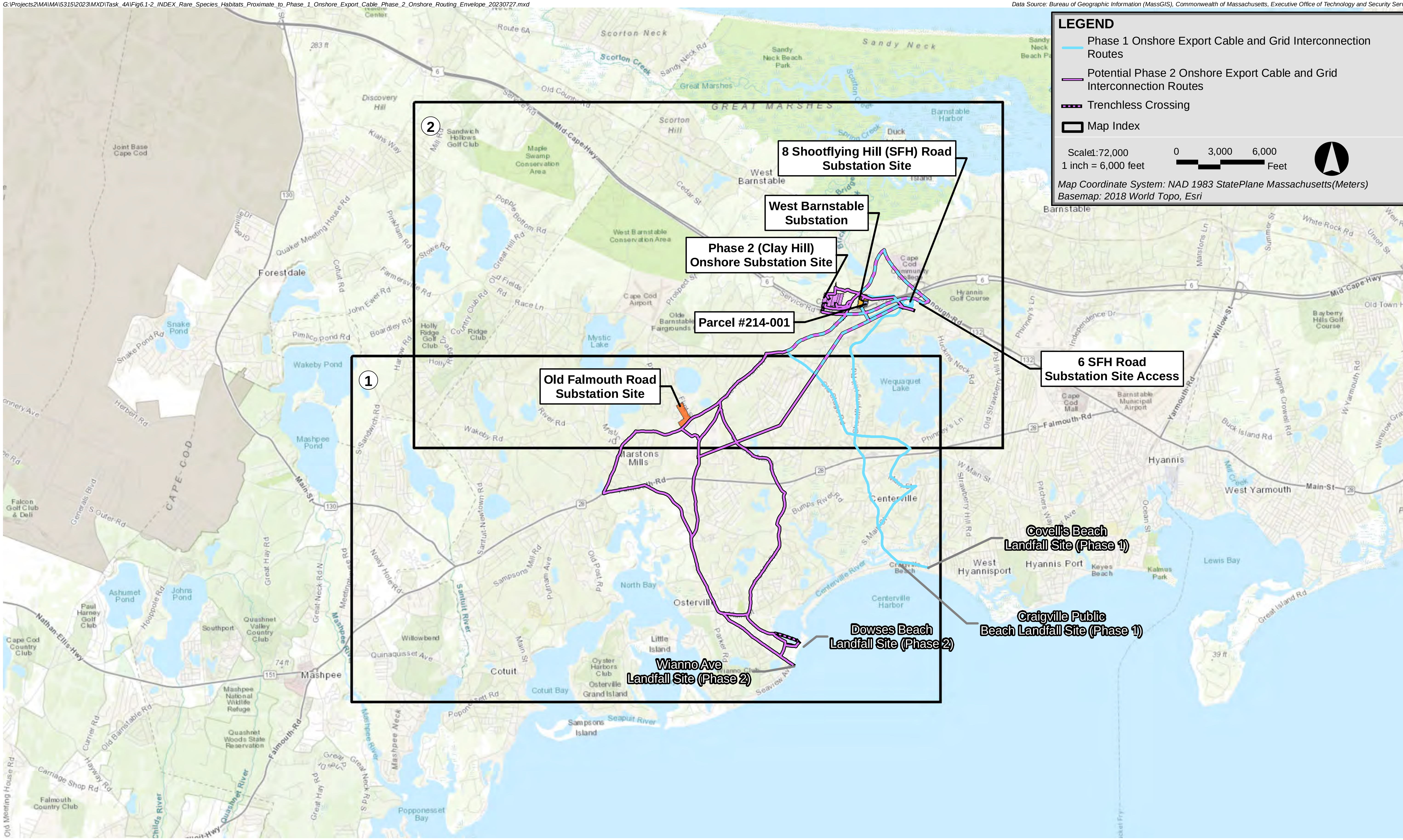

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Figure 6.1-2, Index

Rare Species Habitats Proximate to the Phase 1 and Phase 2 Onshore Export Cable and Grid Interconnection Routes

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

New England Wind
AVANGRID RENEWABLES

Figure 6.1-2, Sheet 1 of 2

Rare Species Habitats Proximate to the Phase 1 and Phase 2 Onshore Export Cable and Grid Interconnection Routes

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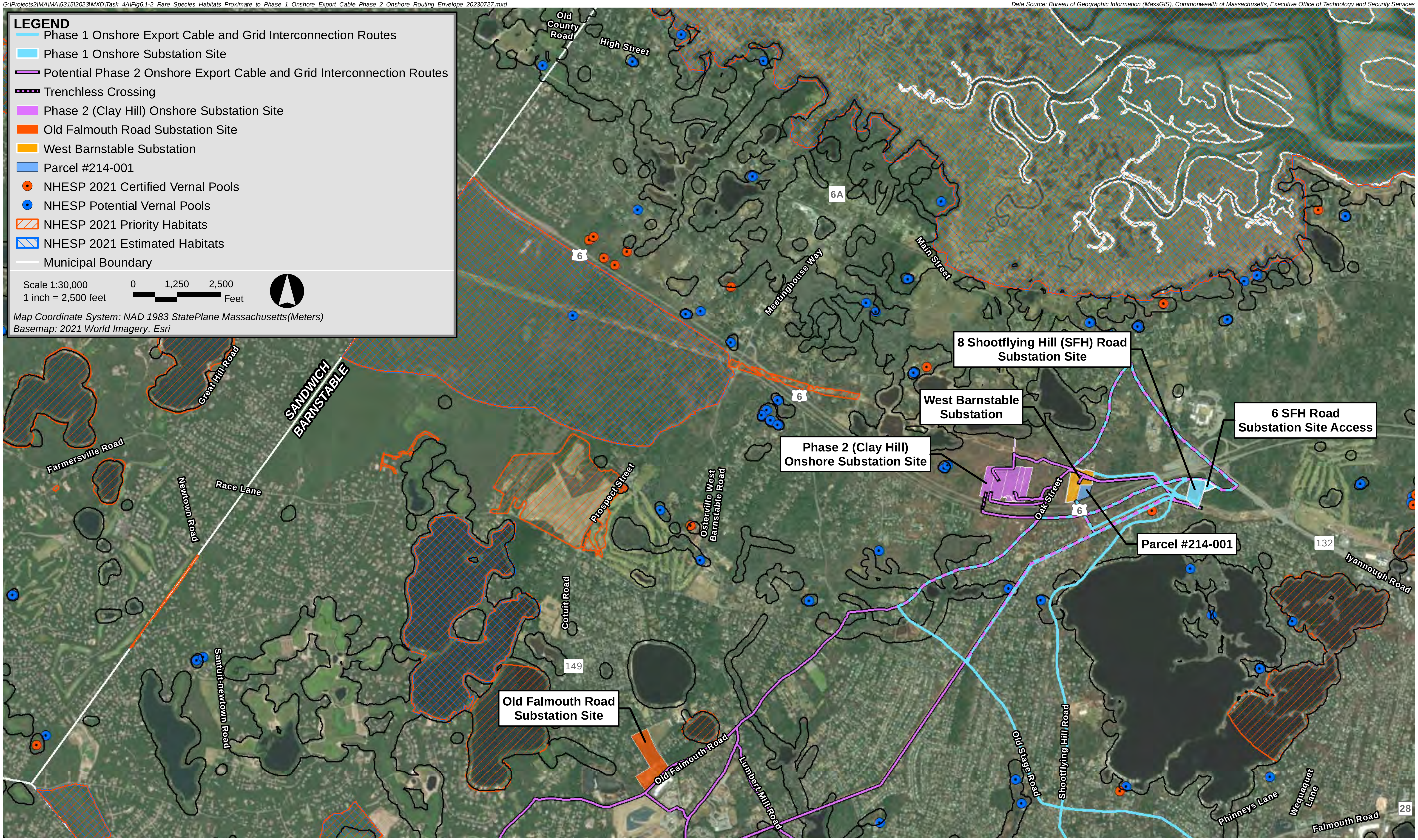
Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



New England Wind
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Figure 6.1-2, Sheet 2 of 2

Rare Species Habitats Proximate to the Phase 1 and Phase 2 Onshore Export Cable and Grid Interconnection Routes

largely outside Priority Habitats or Estimated Habitats mapped by NHESP and within public roadway layout and utility ROWs (see Figure 6.1-2), except near the Phase 2 landfall site(s) (see Section 6.2).

6.1.1.1.2 Onshore Substation Sites (Phases 1 and 2)

Onshore Substation Site—Phase 1

The Phase 1 onshore substation site will be constructed on a 0.027 square kilometer (km^2) (6.7 acre) commercial property near the Route 6-Route 132 highway interchange at 8 Shootflying Hill Road. The 8 Shootflying Hill Road substation site is located approximately 1.3 km (0.8 mi) east of the planned grid interconnection point at Eversource's existing 345 kilovolt West Barnstable Substation. The northern part of the site currently contains a motel building and associated paved access and parking, while the southern part consists of wooded land (except for the portion that is in the utility ROW). An access road to the onshore substation site may be constructed on 6 Shootflying Hill Road, a 0.004 km^2 (1 acre) parcel that is adjacent to the 8 Shootflying Hill Road onshore substation site.

The vegetation within the wooded area at both 8 Shootflying Hill Road and the adjacent 6 Shootflying Hill Road is comprised primarily of pitch pine (*Pinus rigida*) and scarlet oak (*Quercus coccinea*) in the tree layer with oak and pine saplings, black huckleberry (*Gaylussacia bacatta*), and lowbush blueberry (*Vaccinium pallidum*) dominant in the shrub layer. Catbrier (*Smilax rotundifolia*) and bracken fern (*Pteridium aquilinum*) are common in the understory. Pitch pine-oak forests are very common on Cape Cod, often developing in sandy areas that have been subjected to repeated burnings (DeGraaf and Yamasaki 2001). The sites lack any available water source and do not provide suitable habitat for amphibians or other non-avian animal species with limited home range.

Assessor map parcel #214-001 ("Parcel #214-001"), which is approximately 0.011 km^2 (2.8 acre) in size and located immediately southeast of the West Barnstable Substation (see Figure 3.1-2), may be used for Phase 1. This parcel will likely be utilized as the northern terminus of a trenchless crossing across Route 6 (see Section 3.3.1.10.3 of COP Volume I). Parcel #214-001 is entirely forested and is surrounded by Route 6 to the south, Eversource's West Barnstable Substation property to the west and north, and undeveloped land to the east.

The forest community present on Parcel #214-001 is characterized as a pitch pine-oak forest with pitch pine and scarlet oak dominant in the tree layer along with white pine (*Pinus strobus*). The shrub layer is composed primarily of black huckleberry and sheep laurel (*Kalmia angustifolia*) with early low blueberry (*Vaccinium angustifolium*) and American holly (*Ilex opacum*). Teaberry (*Gautheria procumbens*), starflower (*Trientalis borealis*), and wild sarsaparilla (Aralia nudicaulis) are noteworthy ground cover species. The nearest surface water bodies include Garret's Pond, which is approximately 0.5 km (0.3 mi) to the northwest, and Lake Wequaquet, which is approximately 0.6 km (0.4 mi) to the southeast.

Onshore Substation Sites—Phase 2

The Phase 2 onshore export cables will connect to a new onshore substation in the Town of Barnstable. A new onshore substation is required for Phase 2 to step up power from 275-kV to 345-kV for interconnection with the regional power grid at the existing 345-kV West Barnstable Substation. The Proponent has considered two options for the Phase 2 substation site. The preferred option is the Clay Hill site, and an alternate option is the Old Falmouth Road site (see Figure 3.1-2). The largest parcel, or combination of parcels, currently under consideration for each substation is 0.12 km^2 (29 acres) in size.

Onshore Substation - Clay Hill Site

The Clay Hill Site is located west of Oak Street near the Oak Street Bridge overpass of Route 6, approximately 0.4 km (0.25 mi) west of the interconnection location at the existing Eversource West Barnstable Substation (see Figure 3.1-2). The Proponent has site control over eight contiguous privately owned parcels totaling approximately 0.12 km^2 (29 acres), which allows the Proponent to optimize the substation layout and secure additional access rights.

The proposed substation will be sited primarily in the southern and central portions of the four parcels that will be developed. Of the four parcels to be developed, two are undeveloped wooded lots, a third parcel has minor cleared areas and an existing access road/driveway, and the fourth is currently developed with a single-family residence. The approximately 0.02 km^2 (4.2-acre) parcel (Parcel 195-008) located closest to Oak Street will remain undeveloped; however, existing cleared areas within this parcel may be used during construction for temporary construction parking, trailers, or staging and laydown while the existing access road/driveway will also be improved (widened and graded with gravel surface) to support construction and the grid interconnection route. The three small parcels located south of the existing Fire Tower Access Road and east of the existing Department of Conservation and Recreation (DCR) Fire Tower (see parcels 6, 7, and 8 as labeled on Figure 3.1-2) will also remain undeveloped, but may be used as staging and laydown areas during construction.

To accommodate construction of the substation and associated stormwater management, the four parcels that will be developed will be partially cleared. Land and tree clearing will be minimized to the extent practicable. The existing single-family residence will also be removed.

The total area to be disturbed for the substation, including the substation development itself as well as site grading, and stormwater features along with associated access roads, will be approximately 0.06 km^2 (13.6 acres), which includes removal of the existing single-family residential structure. The total area of tree clearing associated with these activities will be approximately 0.05 km^2 (13.3 acres).

The parcels forming the Clay Hill onshore substation site are wooded with a second growth mixed deciduous and conifer forest of scrub oak, pitch pine, beech and red maple with an understory of sassafras, briars and heath shrub (e.g. blueberry and huckleberry). Terrestrial habitat at the Phase 2 onshore substation site is similar to the habitat at the Phase 1 onshore substation site.

Onshore Substation - Old Falmouth Road Site

The Old Falmouth Road Site consists of four parcels of varying size which together total approximately 0.07 km^2 (18.5 acres). Developed portions of the parcels include several existing structures, internal roadways, and a contractor yard(s). Undeveloped portions of the site are wooded. Residential areas are located to the east, west/northwest, and north of the parcels. South/southeast of the parcels across Old Falmouth Road is an existing commercial building with multiple tenants. Multiple ground-mounted solar developments are located west and south of the parcels. The Old Falmouth Road site is located over 4.0 km (2.5 mi) from the West Barnstable Substation.

Of the four parcels that comprise the site, only two were available to the Proponent through option agreements, and those two alone would not provide enough space to accommodate the proposed substation. Based on this, the Proponent would need to secure additional option agreements to allow for use of the Old Falmouth Road Site as the location for the Phase 2 onshore substation.

6.1.1.2 Terrestrial Fauna including Inland Birds (Phases 1 and 2)

Massachusetts hosts a wide assortment of wildlife habitats and the distribution and variety of wildlife species across the state reflects this diversity. Many specialized wildlife species that commonly occur in other parts of the state are virtually absent from Cape Cod, where pitch pine-oak forests and scrub-shrub habitats predominate. Conversely, the coastal portions of the Onshore Development Areas for Phases 1 and 2 are favored by many species that are not present in appreciable numbers farther inland (Swain and Kearsley 2001). The species mentioned in this section are known to commonly occur in the inland habitats that will be affected by onshore cable installation and onshore substation construction. Refer to Section 6.4 for a discussion of wildlife species that are known to commonly occur along the coast and are likely present at or near the landfall sites.

Wildlife expected to be present at the Onshore Development Areas for Phases 1 and 2 include species that inhabit pine-oak forests, which is the dominant forest type found on Cape Cod and southeastern Massachusetts. Common mammals known to occur in this type of habitat include, but are not necessarily limited to, white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), Virginia opossum (*Didelphis virginiana*), woodchuck (*Marmota monax*), striped skunk (*Mephitis mephitis*), common raccoon (*Procyon lotor*), white-footed mouse *(Peromyscus maniculatus),* and other small rodents (DeGraaf and Yamasaki 2001).

Reptiles and amphibians that may be present include, but are not limited to, northern redback salamander *(Plethodon cinereus)*, American toad *(Bufo americanus)*, spring peeper *(Hyla crucifer)*, wood frog *(Rana sylvatica)*, leopard frog *(Rana pipiens)*, green frog *(Rana clamitans)*, snapping turtle *(Chelydra serpentina)*, garter snake *(Thamnophis sirtalis)*, and black racer *(Coluber constricta)* (DeGraaf and Yamasaki 2001).

Inland birds that may be present include turkey vulture *(Cathartes aura)*, sharp-shinned hawk *(Accipiter structus)*, cooper's hawk *(Accipiter cooperii)*, red-tailed hawk *(Buteo jamaicensis)*, wild turkey *(Meleagris gallopavo)*, mourning dove *(Zeneida macroura)*, northern saw-whet owl *(Aegolius acadicus)*, whip-poor-will *(Caprimulgus vociferous)*, downy woodpecker *(Picoides pubescens)*, blue jay *(Cyanocitta cristata)*, American crow *(Corvus brachyrhynchos)*, fish crow *(Corvus ossifragus)*, tufted titmouse *(Beeoloptus bicolor)*, white-breasted nuthatch *(Sitta caroliniensis)*, hermit thrush *(Catharus guttatus)*, ovenbird *(Seiurus aurcopillus)*, eastern towhee *(Pipilo erythro-phtalmus),* yellow-rumped warbler *(Setophaga coronate),* eastern phoebe *(Sayornis phoebe),* and chipping sparrow *(Spizella passerine)* (DeGraaf and Yamasaki 2001).

Representative wildlife species lists developed by the United States Fish and Wildlife Service for a pine-oak forest at the Massasoit National Wildlife Refuge in nearby Plymouth, Massachusetts are provided in Tables 1 through 4 of Appendix III-D (USFWS 2017). While this list was developed specifically for Plymouth, many, if not all, of these species are also anticipated to be present in the pitch pine-oak forest located within the Onshore Development Areas for Phases 1 and 2. Table 5 in Appendix III-D provides a list of common bird types that may be present, which was primarily compiled from eBird citizen science data. Table 6 lists the avian Species of Greatest Conservation Need and their habitat associations.

6.1.2 Potential Impacts of New England Wind

Impact producing factors for Phases 1 and 2 of New England Wind are described below. Short-term construction and installation-related impacts are associated with: (1) physical habitat disturbance, (2) displacement due to construction noise and vibration, or (3) direct mortality from contact with construction equipment. Permanent impacts potentially affecting wildlife are limited to habitat loss or conversion of habitat type. The sections below detail these potential impacts as well as impact avoidance, minimization, and mitigation measures.

Table 6.1-1 Impact Producing Factors for Terrestrial Wildlife

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Temporary habitat alteration			•	•		•
Noise			•	•	•	•
Land disturbance			•	•		•
Permanent habitat alteration			•	•		•

6.1.2.1 Construction and Installation

As already noted, the Phase 1 and Phase 2 onshore routes are sited to maximize the use of public roadway layouts, utility ROWs, and other previously developed lands. This siting avoids alteration or loss of unique or protected habitat and known habitats of rare, threatened, or special concern species. The installation of duct bank and splice vaults within existing utility ROWs will not result in any further fragmentation of forested habitat. Construction of the Phase 1 onshore substation will only affect forested wildlife habitat that is very common in southeastern Massachusetts. Impacts at the Phase 2 onshore substation sites are expected to be similar. The short-term and permanent impacts to terrestrial fauna are discussed further below.

6.1.2.1.1 Temporary Habitat Alteration (Phases 1 and 2)

As described earlier in this section, for both Phases, the Onshore Export Cable Routes (with variants) and Grid Interconnection Route (with variants) include segments located along utility ROWs. Installation of duct bank and splice vaults within these ROWs would require clearing and grading within a corridor wide enough to accommodate excavation and stockpiling of soils and provide space for construction equipment access along the work zone. This will result in some short-term loss of forage and cover for wildlife within utility ROWs. The work, however, will be confined to as narrow a corridor as possible and will not impact adjacent wildlife habitat located outside of that corridor elsewhere within the utility ROW. For construction within the utility ROW, any disturbed vegetated areas will be loamed and seeded to match pre-existing vegetation.

At certain locations along the onshore routes, expanded work zones and construction staging areas may be required to accommodate special construction equipment and materials (see Sections 3.3.1.10.4 and 4.3.1.10.3 of COP Volume I). Wherever possible, these spaces will be located within previously developed areas, such as nearby parking lots, in order to avoid or minimize disturbance to naturally vegetated areas. Any previously undisturbed areas of wildlife habitat affected by expanded work zones or elsewhere along the Onshore Export Cable Routes and Grid Interconnection Routes will be restored in consultation with local officials.

Additionally, temporary impacts to wildlife habitat may occur near the Phase 1 Centerville River crossing depending on the crossing method selected (see Section 3.3.1.10.2 of COP Volume I). Potential temporary wetlands impacts for the Centerville River crossing are described in Table 6.1-2.

Table 6.1-2 Temporary Wetlands Impacts for each Centerville River Crossing Technique (Phase 1)

Crossing Technique	Temporary Impacts to Waters of the United States
Microtunnel	0 m^2 (0 ft^2)
Horizontal Directional Drilling	0 m^2 (0 ft^2)
Direct Pipe	0 m^2 (0 ft^2)
Parallel Utility Bridge	4.5 m^2 (48 ft^2) temporary impacts to salt marsh 3.9 m^2 (42 ft^2) permanent impacts to salt marsh

Temporary impacts to wildlife habitat may also occur near the Phase 2 East Bay crossing depending on the crossing method selected (see Section 4.3.1.10.2 of COP Volume I).

Overall, disturbances to terrestrial habitat will be primarily short-term, localized, and will not affect rare or protected habitat types or species. Furthermore, the utility ROWs and adjacent woodlands would remain viable wildlife habitats for animals that thrive in the managed grass and scrubland and forest edge communities. Accordingly, population level impacts to wildlife resulting from temporary habitat alteration are unlikely.

6.1.2.1.2 Noise (Phases 1 and 2)

Construction equipment may generate noise and vibration at levels sufficient to potentially displace nearby wildlife on a temporary basis, particularly those animals along portions of the Onshore Export Cable Routes and Grid Interconnection Routes that occur within utility ROWs located some distance away from public roadways (and the associated noise generated by local traffic). Regardless of the location, any affected wildlife is expected to return to the area once construction and installation activities are completed; therefore, this short-term impact is unlikely to have population level impacts.

6.1.2.1.3 Land Disturbance (Phases 1 and 2)

Land disturbance is an impact producing factor that can result in direct mortality to terrestrial fauna including inland birds. Although the expectation is that wildlife will leave the immediate area as construction progresses at the onshore substation sites and along the Onshore Export Cable Routes and Grid Interconnection Routes for both Phases, limited direct wildlife mortality may occur as a result of onshore construction activities. This may be more likely to occur where these activities are located within utility ROWs. Impacts are expected to be limited to less mobile animals of commonly occurring species.

6.1.2.1.4 Permanent Habitat Alteration (Phases 1 and 2)

Land clearing and grading associated with the construction of the onshore substations has the potential to permanently displace resident wildlife or disrupt select lifecycle activities (e.g. nesting, breeding, hibernation/aestivation). For Phase 1, the Proponent anticipates that the entire approximately 0.027 km^2 (6.7 acre) onshore substation site at 8 Shootflying Hill Road will need to be cleared and graded; the clearing of vegetation at 8 Shootflying Hill Road will result in the permanent loss of up to ~0.012 km^2 (~3.0 acres) of pitch pine-oak forest habitat. To construct the onshore substation site access road on 6 Shootflying Hill Road, the entire parcel (up to 0.004 km^2 [1 acre]) may need to be graded and cleared. In addition, as noted above, some onshore substation equipment may be relocated from the onshore substation site at 8 Shootflying Hill Rd to Parcel #214-001. Under a maximum build-out scenario, the entire Parcel #214-001 (approximately 0.011 km^2 [2.8 acres]) would be cleared.[35]

For Phase 2, the Proponent has site control over eight contiguous privately owned parcels at the Clay Hill Site totaling approximately 0.12 km^2 (29 acres). Figure 4.1-2 of COP Volume I identifies all eight privately-owned parcels. Of the eight parcels, four will be developed as part of substation construction. Of the four parcels to be developed, two are undeveloped wooded lots, a third parcel has minor cleared areas and an existing access road/driveway, and the fourth is currently developed with a single-family residence. The total area to be disturbed for the substation, including the substation development itself as well as site grading, and stormwater features along with associated access roads, will be approximately 0.06 km^2 (13.6 acres), which includes removal of the existing single-family residential structure. The total area of tree clearing associated with these activities will be approximately 0.05 km^2 (13.3 acres).

For both Phases, minimal tree trimming and/or tree clearing may be required where the onshore routes follow existing roadway layouts, depending on the final duct bank alignment. Some stretches of existing utility ROWs may also require tree clearing where those ROWs have not been maintained to their full widths.

This limited loss of forested habitat during onshore substation construction and onshore cable installation, however, is unlikely to have population level impacts on wildlife. Forest is the dominant natural habitat in Massachusetts, with over 60% of land area currently in a forested state (MADFW 2020). Pitch pine-oak forests are among the most common habitat type on Cape Cod. Accordingly, wildlife species, including birds, mammals, and herptiles, that may be displaced by onshore construction would not be limited regarding the availability of, and access to, similar habitats in the Phase 1 and Phase 2 Onshore Development Areas.

6.1.2.1.5 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are sited primarily within public roadway layouts or existing utility ROWs, thereby avoiding undisturbed forest interiors and other significant wildlife habitat. Routing along public roadway layouts and utility ROWs also minimizes potential construction impacts to adjacent wildlife habitats. Specialty trenchless crossing methods are expected to be used where the Onshore Export Cable Routes and Grid Interconnection Routes traverse unique features such as busy roadways, wetlands, and

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[35] Ground disturbing activities may occur up to 3 m (10 ft) beyond the boundaries of 8 Shootflying Hill Road, 6 Shootflying Hill Road, and Parcel #214-001 to enable construction equipment access and account for minor disturbance associated with activities occurring near the perimeter of the parcel.

waterbodies in order to avoid impacts to those features. Additionally, impacts along any given segment of the Onshore Export Cable Routes and Grid Interconnection Routes will be of short duration.

Wherever possible, expanded work zones and construction staging areas along the onshore routes will be located within previously developed areas, such as nearby parking lots, in order to avoid or minimize disturbance to naturally vegetated areas. Any previously undisturbed areas of wildlife habitat affected by expanded work zones or elsewhere along the Onshore Export Cable Routes and Grid Interconnection Routes will be restored in consultation with local officials. For construction within utility ROWs, any disturbed vegetated areas will be loamed and seeded to match pre-existing vegetation.

Although Phase 1 onshore substation construction may require initial grading and clearing of the entire site at 8 Shootflying Hill Road and Phase 2 onshore substation construction will require grading and clearing of some of the parcels identified at the Clay Hill Site, revegetation along the onshore substation site boundaries would occur outside of the substation boundary/screening wall. Furthermore, construction of the Phase 1 and Phase 2 onshore substations will result in permanent loss of habitat that is common to the region; thus, the loss of habitat is unlikely to have a lasting impact wildlife since large amounts of similar habitat are located nearby. Impacts and mitigation measures during construction of the Phase 1 and Phase 2 onshore substations are expected to be similar.

6.1.2.1.6 Summary

For both Phases, due to the nature and location of the onshore facilities, impacts to terrestrial wildlife will largely be short-term and localized. The Onshore Export Cable Routes and Grid Interconnection Routes are sited primarily within public roadway layouts or existing utility ROWs, thereby avoiding undisturbed forest interiors and other significant wildlife habitat. Permanent loss of forested habitat will be minimal, affecting up to approximately 0.012 km^2 (3.0 acres) of forested habitat at the Phase 1 onshore substation site, up to 0.004 km^2 (1 acre) for a potential access road to the Phase 1 onshore substation site, and up to 0.011 km^2 (2.8 acres) at Parcel #214-001. For Phase 2 the total area to be disturbed for the Clay Hill onshore substation site, including the substation development itself as well as site grading, and stormwater features along with associated access roads, will be approximately 0.06 km^2 (13.6 acres), which includes removal of the existing single-family residential structure. The total area of tree clearing associated with these activities will be approximately 0.05 km^2 (13.3 acres). Impacts to terrestrial wildlife will be reduced further by implementing the above avoidance, minimization, and mitigation measures. Consequently, population level impacts to terrestrial wildlife including inland birds near the onshore facilities are unlikely.

6.1.2.2 Operations and Maintenance

For Phases 1 and 2, operations and maintenance (O&M) of onshore facilities under normal circumstances will not result in further habitat alteration or involve activities expected to have a negative impact on wildlife. The Phase 1 and Phase 2 onshore facilities will be monitored and controlled remotely. In the event that repair work is necessary, a crew would be dispatched to the identified location to complete repairs and restore normal operations. For repairs to the onshore export cables and grid interconnection cables, the cables would typically be accessed through manholes at the installed splice vaults. Repair work at the onshore substation sites would occur within the fenced perimeter of the onshore substations. Thus, repairs would be completed within the installed onshore facilities and without additional impacts to wildlife habitat.

6.1.2.2.1 Noise (Phases 1 and 2)

For Phases 1 and 2, maintenance and repairs to onshore cables and onshore substations could generate noise that temporarily displaces nearby wildlife, but this impact would be short-term and is unlikely to result in population level impacts. The onshore substation transformers will also generate some noise, which might affect nearby terrestrial wildlife. However, for Phase 1, given the location of the onshore substation on a commercial site near a busy highway interchange with other noise sources nearby, any possible noise effects would likely be insignificant.

6.1.2.2.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

For Phases 1 and 2, the Onshore Export Cable Routes and Grid Interconnection Routes are designed to provide points of access at the splice vaults. Maintenance and/or repairs are expected to take place primarily within these vaults, without any disturbance to adjacent wildlife habitat. These measures will avoid or reduce any further impact to terrestrial habitats and wildlife. Consequently, onshore O&M activities associated with Phases 1 and 2 are not anticipated to have population level impacts on terrestrial species.

6.1.2.3 Decommissioning

As described in Sections 3.3.3 and 4.3.3 of COP Volume I, many of the onshore components could be retired in place or retained for future use, although removal of onshore cables via existing manholes may occur if required. The splice vaults, duct bank, and onshore substations will likely remain as valuable infrastructure that would be available for future offshore wind or other projects. To the extent that decommissioning of the onshore facilities occurs, the environmental impacts from these decommissioning activities would be generally similar to the impacts experienced during construction.

6.2 Coastal and Marine Birds

6.2.1 Description of the Affected Environment

6.2.1.1 Overview

The Southern Wind Development Area (SWDA) is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501. The SWDA is within the Massachusetts Wind Energy Area (MA WEA) and is located at a faunal break region between two Large Marine Ecosystems (LMEs): the Scotian Shelf (LME #8) to the north (the Gulf of Maine) and the Northeast United States (US) Continental Shelf (LME #7) to the south (the Mid-Atlantic Bight) (NOAA 2017). This region is used by a suite of breeding birds from both oceanographic regions. In addition, non-breeding summer migrants (e.g. shearwaters and storm-petrels) constitute a significant portion of the marine birds in the region (Nisbet et al. 2013). The SWDA is no exception, with an influx of southern hemisphere breeders present in the area during the boreal summer/austral winter (Veit et al. 2016).

Around 450 avian species are known to occur in Massachusetts (Blodget 2002), but many of these species are rarities or unlikely to occur offshore. Species of migratory, breeding, and wintering birds that may pass through the SWDA include coastal birds, such as shorebirds, waterfowl, wading birds, raptors, and songbirds, and marine birds such as seabirds and sea ducks. The most likely of these to occur in the SWDA are waterfowl, loons and grebes, shearwaters and petrels, gannet and cormorants, shorebirds, gulls, terns, jaegers, and auks (BOEM 2014). Bird use of the SWDA and surrounding area is well-documented with multiple studies providing important information on avian presence and abundances at a series of useful scales (discussed below and in Appendix III-C).

6.2.1.2 Definition of Exposure to the SWDA

Exposure to offshore wind farms has spatial and temporal components. Spatially, birds are exposed on the horizontal (i.e. habitat area) and vertical (i.e. flight height) planes. Temporally, bird exposure is dictated by a species' life history traits and may be limited to diurnal, breeding, staging, migrating, or wintering. For the purposes of the exposure assessment, vertical exposure is considered in the impact assessment within the context of vulnerability.

The exposure assessment was conducted for coastal birds (shorebirds, waterbirds, waterfowl, wading birds, raptors, and songbirds), which are rarely found far offshore, and marine birds (loons and grebes, sea ducks, shearwaters and storm-petrels, gannets and cormorants, gulls and jaegers, terns, and auks), which are more commonly found offshore. For the purposes of the assessment, "offshore" and the "offshore environment" is generally defined as beyond state waters or further than three nautical miles (NM) (5.6 kilometer [km]) from shore. Federally-listed species and species proposed for listing (roseate tern [*Sterna dougalli*], black-capped petrel [*Pterodroma hasitata*], red knot [*Calidris canutus rufa*], piping plover [*Charadrius melodus*], and eagles) are assessed individually.

In addition, the exposure assessment is focused on the SWDA because bird exposure to vessels installing offshore export cables will be transitory and ephemeral (see Sections 3.3.1.3 and 4.3.1.3 of COP Volume I for a discussion of offshore cable installation). Coastal and marine birds may encounter a cable installation vessel, but exposure to the vessel, in any given location, will be limited to a finite temporal period. Nevertheless, temporary impacts along the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]) are described in Section 6.2.2.1. While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[36] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, “the OECC” refers to the OECC that travels along the eastern side of Muskeget Channel.

The exposure of birds to the SWDA was evaluated for each species or species group and categorized as **insignificant**, **unlikely**, **potential**, or **likely** (corresponding to minimal, low, medium, and high categories) based upon available literature and a quantitative assessment. Definitions of exposure levels are provided in Table 6.2-1. For marine birds, two data sources were used to assess local and regional marine bird use of the SWDA: the Massachusetts Clean Energy Center (MassCEC) seabird surveys (Veit et al. 2016), herein referred to as “MassCEC aerial survey,” and the Marine-life Data and Analysis Team (MDAT) marine birds abundance and occurrence models (Curtice et al. 2016), herein referred to as “MDAT abundance models.” In addition, Biodiversity Research Institute conducted one year (October 2018 to September 2019) of monthly boat surveys in the SWDA (herein referred to as “New England [NE] Wind boat surveys”),[37] from which detection corrected density estimates were calculated for each marine bird species encountered. Further details on each data set are available in Appendix III-C. For species where SWDA-specific data was not available, a determination of exposure was made by synthesizing relevant information from species accounts in the literature.

To quantitatively assess the exposure of marine birds to the SWDA, both the MassCEC aerial surveys and the MDAT abundance models were used to develop an annual exposure score for species groups. The species group annual exposure scores were developed from species- and seasonal-specific exposure scores and maps. A full description of the methods and the quantitative results are available in Appendix III-C.

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[36] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 Construction and Operations Plan (COP) and has already been thoroughly reviewed and approved by the Bureau of Ocean Energy Management (BOEM) as part of that COP.

[37] The NE Wind boat survey was conducted prior to the segregation of Lease Area OCS-A 0501 into Lease Area OCS-A 0501 and Lease Area OCS-A 0534 and did not include the entire SWDA footprint. Survey data were supplemented with the MassCEC aerial surveys, MDAT models, published literature, species accounts, and assessments conducted for Vineyard Wind 1.

The final exposure scores for each species and season, as well as the aggregated scores (e.g. the annual scores for each species and taxonomic group), should be interpreted as a measure of the relative importance of the SWDA for a species/group, as compared to other surveyed areas in the region and in the Northwest Atlantic. It does not indicate the absolute number of individuals likely to be exposed (see density estimates in Appendix III-C developed from the MassCEC aerial survey and the NE Wind boat surveys). Rather, the exposure score provides a regional and population-level context for each taxon (see Appendix III-C for further details) that help informs professional judgement. The following sections provide a summary of the results for each species group.

Table 6.2-1 Definition of Exposure Levels

Final Exposure Level[1]	Definition
Insignificant	Insignificant seasonal exposure scores in all seasons or insignificant score in all but one season OR Based upon the literature—and, if available, other locally available tracking or survey data—little to no evidence of use of the SWDA or offshore environment for breeding, wintering, or staging, and low predicted use during migration
Unlikely	Unlikely exposure scores in two or more seasons, or Potential exposure score in one season OR Based upon the literature—and, if available, other locally available tracking or survey data—low evidence of use of the SWDA or offshore environment during any season
Potential	Potential exposure scores in two or more seasons, or Likely exposure score in one season OR Based upon the literature—and, if available, other locally available tracking or survey data—moderate evidence of use of the SWDA or use of the offshore environment during any season
Likely	Likely exposure scores in two or more seasons OR Based upon the literature—and, if available, other locally available tracking or survey data—high evidence of use of the SWDA or offshore environment, and the offshore environment is a primary habitat during any season

Notes:
1. These exposure levels are equivalent to rankings of minimal, low, medium, and high, respectively.

6.2.1.3 Coastal Birds

The SWDA is far enough offshore to be beyond the range of most terrestrial or coastal bird species. Coastal birds that may forage in the SWDA occasionally, visit the area sporadically, or pass through on their spring or fall migrations, include shorebirds (e.g. sandpipers, plovers), waterbirds (e.g. cormorants, grebes), waterfowl (e.g. scoters, mergansers), wading birds (e.g. herons, egrets), raptors (e.g. falcons, eagles), and songbirds (e.g. warblers, sparrows). Exposure is considered by calendar season (defined as Spring [March, April, May], Summer [June, July, August], Fall [September, October, November], and Winter [December, January, February]). As birds using the region may vary by life stage in a given season (i.e. terns in summer will be breeding, while southern hemisphere breeders such as shearwaters are technically in their wintering season while in the area), these seasonal breakpoints are the most generalized way to describe exposure.

6.2.1.3.1 Shorebirds

Shorebirds are coastal breeders and foragers that generally avoid straying out over deep waters during breeding. Few shorebird species breed locally on the US Atlantic coast. Most of the shorebirds that pass through the region are northern or Arctic breeders that migrate along the US Atlantic coast on their way to and from wintering areas in the Caribbean islands, Central America, and South America. Some species are clearly capable of crossing vast areas of ocean and may traverse the SWDA during migrations.

The NE Wind boat surveys detected a few small flocks of shorebirds in the second half of May 2019 and a few individuals at the end of August and in September 2019 (see Section 3.1.1. of Appendix III-C). Given that shorebird exposure will be primarily limited to migration and there is little evidence of shorebird use of the SWDA, exposure is expected to be **insignificant** to **unlikely**. See Table 6.2-1 for the definitions of exposure levels.

The Atlantic population of the piping plover and the *rufa* subspecies of the red knot are both federally-protected under the Endangered Species Act (ESA) and are thus addressed in Section 6.2.1.5, below.

Table 6.2-2 Shorebirds Listed in Massachusetts and their Federal Status

Common Name	Scientific Name	Massachusetts (MA) Status[1]	Federal Status
Red knot	*Calidris canutus rufa*	T	T
Piping plover	*Charadrius melodus*	T	T
Upland sandpiper	*Bartramia longicauda*	E	

Notes:
1. E = endangered; T = threatened; SC = special concern.

6.2.1.3.2 Waterbirds

Waterbirds is a general term used for species associated with all manner of aquatic habitats. For the purposes of the assessment, this group includes species that are generally restricted to freshwater or use saltmarshes, beaches, and other strictly coastal habitats, and that are not captured in other broad groupings. Given that these species spend most of their life in freshwater aquatic and associated terrestrial habitats, that they were not observed during the NE Wind boat surveys, and that there is little or no evidence of offshore migration in the literature or in the MassCEC aerial survey data, overall exposure of this group to the SWDA is expected to be **insignificant**.

Table 6.2-3 Waterbirds Listed in Massachusetts and their Federal Status

Common Name	Scientific Name	MA Status	Federal Status
American bittern	*Botaurus lentiginosus*	E	
Least bittern	*Ixobrychus exilis*	E	
King rail	*Rallus elegans*	T	
Common moorhen	*Gallinula chloropus*	SC	

6.2.1.3.3 Waterfowl

Waterfowl comprises a broad group of geese and ducks, most of which spend much of the year in terrestrial or coastal wetland habitats (Baldassarre and Bolen 2006). The diving ducks generally winter on open freshwater as well as brackish or saltwater. Species that regularly winter on saltwater, including mergansers, scaup, and goldeneyes, usually restrict their distributions to shallow, very nearshore waters (Owen and Black 1990). Given that coastal waterfowl spend much of the year in freshwater aquatic systems and nearshore marine systems, and there is little evidence of coastal waterfowl use of the SWDA in the literature or the MassCEC aerial survey data (see Section 3.1.6 of Appendix III-C),[38] overall exposure of this group to the SWDA is expected to be **insignificant**.

A subset of the diving ducks, however, have an exceptionally strong affinity for saltwater either year-round or outside of the breeding season. These species are known as sea ducks and are described separately in Section 6.2.1.4 below.

[38] There were three observations of "unidentified duck" in the December NE Wind boat surveys that were likely scoters, and not coastal waterfowl.

6.2.1.3.4 Wading Birds

Like the smaller shorebirds, long-legged wading birds, such as herons and egrets, are coastal breeders and shallow water foragers that generally avoid straying out over deep water (Frederick 2001). Most long-legged waders breeding along the Atlantic coast migrate south to the Gulf coast, the Caribbean islands, Central America, and South America (Heron Conservation 2017); thus, they are capable of crossing large areas of ocean and may traverse the SWDA during spring and fall migration periods. Given that long-legged wading birds spend much of the year in freshwater aquatic systems and coastal marine systems, that they were not observed during the NE Wind boat surveys, and that there is little evidence of wading bird use of the SWDA in the literature or in the MassCEC aerial survey data (see Section 3.1.3 of Appendix III-C), overall exposure of this group to the SWDA is expected to be **insignificant**.

6.2.1.3.5 Raptors (Non-Eagle)

Overall, use of the SWDA by most raptors is **insignificant** during breeding or winter seasons and will be limited to falcons and possibly osprey (*Pandion haliaetus*) during migration. Raptor exposure to the SWDA during migration will be dictated by a species' body design and general flight strategy (i.e. flapping versus soaring), which influences a species' ability or willingness to cross large expanses of open water where thermal formation is poor (Kerlinger 1985). Species that use soaring flight depend upon thermals and generally do not cross large expanses of water. *Buteo* hawks (i.e. the red-tailed hawk [*Buteo jamaicensis*], broad-winged hawk [*Buteo platypterus*], and red-shouldered hawk [*Buteo lineatus*]) that depend upon soaring flight during migration are rarely observed in offshore settings (DeSorbo et al. 2012). *Accipiter* hawks (i.e. the northern goshawk [*Accipiter gentilis*], Cooper's hawk [*Accipiter cooperii*], and sharp-shinned hawk [*Accipiter striatus*]), which use a mixture of powered and soaring flight, are encountered at offshore islands but only in low numbers and they are rarely observed offshore (Desorbo et al. 2017). Most owls do not utilize the offshore environment, although there is evidence of northern saw-whet owls (*Aegolius acadicus*) passing over islands in Maine during migration (DeSorbo et al. 2012) and long-eared owls (*Asio otus*) are known to migrate along the coast. No raptors were observed during the NE Wind boat surveys (see Section 3.1.4 of Appendix III-C). The exposure of this group of raptors is expected to be **insignificant** and will not be discussed further.

Among raptors, falcons are the most likely to be encountered in offshore settings (Cochran 1985; DeSorbo et al. 2012; DeSorbo, Persico, et al. 2018). Merlins (*Falco columbarius*) are the most abundant diurnal raptor observed at offshore islands during fall migration (DeSorbo et al. 2012; DeSorbo, Persico, et al. 2018). Peregrine falcons (*Falconidae peregrinus*) fly hundreds of kilometers offshore during migration and have been observed on vessels and oil drilling platforms located considerable distances from shore (McGrady et al. 2006; Johnson et al. 2011; DeSorbo et al. 2015). Recent individual tracking studies in the eastern US indicate that migrating peregrine falcons (predominantly hatching year birds), likely originating from breeding areas in the Canadian Arctic and Greenland, commonly used offshore habitats during fall migration (DeSorbo et al. 2015; DeSorbo, Persico, et al. 2018), while breeding adults from New Hampshire either used inland migration routes or were non-migratory (DeSorbo, Martin, et al. 2018). There were detections of peregrine falcons tracked with satellite tags (trapping station on Block Island [n = 33]) offshore of Martha's Vineyard and Nantucket, but none within the SWDA (see Section 3.1.4 of Appendix III-C). Two fall migrant peregrines fitted with satellite transmitters in Maine did not fly through the SWDA. Instead, the birds flew west of Cape Cod through central Massachusetts toward Narragansett Bay, Rhode Island, and only flew offshore once they reached the mid-Atlantic (DeSorbo et al. 2012). Nevertheless, the number of individual birds exposed to the SWDA during fall migration probably represents a small proportion of the overall population.

Ospreys exhibit a wing morphology that enables open water crossings (Kerlinger 1985). However, satellite telemetry data from ospreys in New England and the mid-Atlantic suggest that these birds generally follow coastal or inland migration routes (see Section 3.1.4 of Appendix III-C). In some instances, individual birds will fly offshore (Bierregaard 2019), but exposure of peregrine falcons, merlins, and ospreys is expected to be **unlikely** because the passage of individual birds through the SWDA likely represents a relatively small proportion of the overall populations.

Bald eagles (*Haliaeetus leucocephalus*) are federally protected under the Bald and Golden Eagle Protection Act and are thus addressed in Section 6.2.1.5 below.

Table 6.2-4 Raptors Listed in Massachusetts and their Federal Status

Common Name	Scientific Name	MA Status	Federal Status
Bald eagle	*Haliaeetus leucocephalus*	T	
Northern harrier	*Circus cyaneus*	T	
Peregrine falcon	*Falco peregrinus*	T	
Barn owl	*Tyto alba*	SC	
Long-eared owl	*Asio otus*	SC	
Short-eared owl	*Asio flammeus*	E	

6.2.1.3.6 Songbirds

Songbirds almost exclusively use terrestrial, coastal, and aquatic habitats and do not use the offshore marine system except during migration. Many North American breeding songbirds migrate to the tropical regions of Mexico, the Caribbean islands, Central America, and South America. On their migrations, these Neotropical migrants mostly travel at night and at high altitudes, where favorable winds can aid them along their trip. Songbirds regularly cross large bodies of water, such as the Mediterranean Sea or the Gulf of Mexico (Bruderer and Lietchi 1999; Gauthreaux and Belser 1999), and there is some evidence that species migrate over the northern Atlantic as well (Drury and Keith 1962). Some birds may briefly fly over the water while others, like the blackpoll warbler (*Setophaga striata*), can migrate non-stop over vast expanses of ocean (Faaborg et al. 2010; Deluca et al. 2015).

Landbird migration may occur across broad geographic areas rather than in narrow "flyways" as has been described for some waterbirds (Faaborg et al. 2010). Evidence for a variety of species suggests that over-water migration in the Atlantic is much more common in fall than in spring, when the frequency of overwater flights increases perhaps due to consistent tailwinds (Morris et al. 1994; Hatch et al. 2013; Deluca et al. 2015). The blackpoll warbler is the species that is most likely to fly offshore during migration (Faaborg et al. 2010; Deluca et al. 2015). Migrating songbirds have been detected at or near smaller offshore wind developments in Europe (Kahlert et al. 2004; Krijgsveld et al. 2011; Pettersson and Fågelvind 2011) and may have greater passage rates during the middle of the night (Huppop and Hilgerloh 2012). During the NE Wind boat surveys, a few individual songbirds were observed in the spring, summer, and fall, specifically American goldfinch (*Spinus tristis*), barn swallow (*Hirundo rustica*), dark-eyed junco (*Junco hyemalis*), pine siskin (*Spinus pinus*), red-breasted nuthatch (*Sitta canadensis*), white-throated sparrow (*Zonotrichia albicollis*), and yellow warbler (*Setophaga petechia*) (see Section 3.1.5 of Appendix III-C). Given that songbirds do not use the offshore marine system as habitat and there is little evidence of songbird use of the SWDA outside of the migratory period, exposure is expected to be **insignificant** to **unlikely**.

Table 6.2-5 Songbirds Listed in Massachusetts and their Federal Status

Common Name	Scientific Name	MA Status	Federal Status
Sedge wren	*Cistothorus platensis*	E	
Golden-winged warbler	*Vermivora chrysoptera*	E	
Northern parula	*Parula americana*	T	
Blackpoll warbler	*Dendroica striata*	SC	
Mourning warbler	*Oporornis philadelphia*	SC	
Vesper sparrow	*Pooecetes gramineus*	T	
Grasshopper sparrow	*Ammodramus savannarum*	T	
Eastern whip-poor-will	*Caprimulgus vociferous*	SC	

6.2.1.4 Marine Birds

Marine bird distributions are generally more pelagic and widespread than coastal birds. Eighty-three marine bird species are known to regularly occur off the Eastern Seaboard of the US (Nisbet et al. 2013). Many of these marine bird species use the SWDA during multiple time periods, either seasonally or year-round, including loons and grebes, shearwaters and petrels, gannets, gulls and terns, and auks. A summary of marine birds in the region and listing status is in Table 6.2-6.

6.2.1.4.1 Loons and Grebes

Both common loons (*Gavia immer*) and red-throated loons (*Gavia stellata*) use the Atlantic Outer Continental Shelf (OCS) in winter. Analysis of satellite-tracked red-throated loons captured and tagged in the mid-Atlantic area found their winter distributions to be largely inshore of the mid-Atlantic Wind Energy Areas (WEAs), although they did overlap with the mid-Atlantic WEAs somewhat during their migration periods, particularly in spring (Gray et al. 2017). Wintering common loons generally show a broader and more dispersed distribution offshore in winter (Johnson et al. 2015). During migration, red-throated loons use Nantucket Shoals, which is east of the SWDA, as a stopover site (Gray et al. 2017).

The regional MDAT abundance models show that the birds are concentrated closer to shore and in the mid-Atlantic (see Section 5 of Appendix III-C). During the NE Wind boat surveys, loons were observed in the fall, winter, and spring (see Section 3.2.1 of Appendix III-C). On an annual basis, loons had low densities within the survey area (1st quartile of all species observed year-round). The annual exposure analysis score for the loons and grebes group (three species) was **insignificant.** The horned grebe (*Podiceps auritus*) is expected to have **insignificant** exposure during all seasons. Both the red-throated loon and common loon are expected to have **unlikely** exposure during the fall and **insignificant** exposure during all other seasons.

6.2.1.4.2 Sea Ducks

Sea ducks include the eiders, scoters, and long-tailed ducks (*Clangula hyemalis*), all of which are northern boreal, Gulf of Maine, or Arctic breeders that winter along the US Atlantic coast. In winter, sea ducks can gather in large flocks in areas of appropriate habitat, sometimes in mixed species groups. Most sea ducks forage on mussels, other shellfish, and benthic invertebrates. They generally winter in shallower inshore waters or out over large offshore shoals, where they can access their benthic prey. Sea ducks generally forage in depths shallower than 30 meters (m) (98 feet [ft]) (Loring et al. 2014; Meattey et al. 2019), though long-tailed ducks have been documented foraging in substantially deeper areas (60 m [197 ft]) (Cottam 1939; Schorger 1947).

The western side of the Nantucket Shoals, approximately 29 km (18 mi) to the east of the SWDA (excluding the two separate aliquots that are closer to shore), is a well-recognized important area for wintering sea ducks (Silverman et al. 2013; Meattey et al. 2019), particularly for long-tailed ducks (White et al. 2009) and other marine bird species (Veit et al. 2016). Long-tailed ducks and other sea ducks winter on the Nantucket Shoals in large aggregations from November to April; as much as 30% of the continental population of long-tailed ducks (White et al. 2009) and a significant proportion of the Atlantic population of white-winged scoters (*Melanitta deglandi*) can spend the winter in that location (Silverman et al. 2012).

Analysis of satellite-tracked surf scoters (*Melanitta perspicillata*), which were captured and tagged in the mid-Atlantic region, revealed their winter distributions to be largely well inshore of the mid-Atlantic WEAs, although they did exhibit a smaller core wintering area in Nantucket Sound (Berlin et al. 2017). Core use areas of wintering white-winged scoters were identified across the Nantucket Shoals, east of the SWDA (see Section 3.2.2 of Appendix III-C). Satellite-tracked movements of these birds highlighted several within-winter movements throughout the southern New England coastal area, suggesting the possibility that white-winged scoters could cross the SWDA during these movements (Meattey et al. 2019). Satellite tracking indicated that black scoters (*Melanitta americana*) were concentrated closer to the islands and long-tailed ducks were concentrated around Nantucket (see Section 3.2.2 of Appendix III-C). The regional MDAT abundance models and mid-winter aerial waterfowl surveys (Silverman et al. 2012) show that most sea ducks are concentrated close to shore and between Nantucket Island, Martha's Vineyard, and Cape Cod (see Section 5 of Appendix III-C).

During the NE Wind boat surveys, sea ducks were observed in the fall, winter, and spring (see Section 3.2.2 of Appendix III-C). On an annual basis, sea ducks had moderate densities within the survey area (2nd quartile of all species observed year-round). Long-tailed duck and white-winged scoter were the most common species. The annual exposure for the sea duck group (six species) ranged from **insignificant** to **unlikely**. On a seasonal basis, long-tailed duck and surf scoter are expected to have **insignificant** exposure in all seasons; common eiders (*Somateria mollissima*) and black scoter have **unlikely** exposure in the fall; white-winged scoter have **unlikely** exposure in spring and winter; and red-breasted merganser (*Mergus serrator*) is expected to have **unlikely** exposure in the winter.

6.2.1.4.3 Shearwaters, Petrels, Storm-Petrels

Petrels and shearwaters that breed in the southern hemisphere visit the northern hemisphere during the austral winter (boreal summer) in vast numbers. These species use the US Atlantic OCS region, including areas offshore of Massachusetts, so heavily that they greatly outnumber the locally breeding species and year-round residents at this time of year (Nisbet et al. 2013). Several of these species (e.g. great shearwater [*Puffinus gravis*], Cory's shearwater [*Calonectris diomedea*], and Wilson's storm-petrel [*Oceanites oceanicus*]) are found in high densities across the broader region (Veit et al. 2015) and within the MA WEA (Veit et al. 2016) in summer. The regional MDAT abundance models show that the birds are concentrated offshore south of Maine and Nova Scotia.

During the NE Wind boat surveys, Wilson's storm-petrels were observed in the fall, spring, and summer, with the highest densities during the summer (see Section 3.2.3. of Appendix III-C). Shearwaters, primarily great shearwater, were observed in the fall, winter, spring, and summer. On an annual basis, the shearwaters, petrels, and storm-petrels had high densities within the survey area (4th quartile of all species observed year-round). The annual exposure score for the shearwater, petrel, and storm-petrel group (nine species) ranged from **insignificant** to **potential**. Sooty shearwater (*Puffinus griseus*), Leach's storm-petrel (*Oceanodrama leucorhoa*), Audubon's shearwater (*Puffinus Iherminieri*), black-capped petrel, great shearwater, and Manx shearwater (*Puffinus puffinus*) had overall annual exposure scores of **insignificant**, though great shearwaters, Manx shearwaters, and Wilson's storm-petrels had **unlikely** exposure in the summer. The northern fulmar (*Fulmarus glacialis*) had an annual exposure score of **unlikely**, with expected **potential** exposure in the fall. Cory's shearwater had an annual exposure score of **unlikely**, resulting from expected **unlikely** exposure in the summer and **potential** in the fall.

The black-capped petrel is currently proposed for federal listing as threatened in the US (USFWS 2018a) and is thus addressed in Section 6.2.1.5 below.

6.2.1.4.4 Gannets and Cormorants

The northern gannet (*Morus bassanus*) breeds in southeastern Canada and winters along the US Atlantic OCS, particularly in the mid-Atlantic region and the Gulf of Mexico. Based on analysis of satellite-tracked northern gannets captured and tagged in the mid-Atlantic region, these birds show a preference for shallower, more productive waters and are mostly found inshore of the mid-Atlantic WEAs in winter (Stenhouse et al. 2017). In Massachusetts, the tracking data indicates the birds concentrate around Cape Cod and surrounding islands; during spring migration, the bird's 50% core use area (i.e. 50% probability of occurrence) overlaps with the northern portion of the SWDA (see Section 3.2.4 of Appendix III-C). They are opportunistic foragers capable of long-distance oceanic movements and generally migrate on a broad front, all of which may increase their exposure to offshore wind facilities, compared with species that are truly restricted to inshore habitats (Stenhouse et al. 2017).

During the NE Wind boat surveys, northern gannets were observed in the fall, winter, spring, and summer (see Section 3.2.4 of Appendix III-C). On an annual basis, northern gannets had high densities within the survey area (4th quartile of all species observed year-round). The regional MDAT abundance models show that northern gannets use the US Atlantic OCS to the south of the SWDA. The annual exposure score for northern gannets is **unlikely** with **potential** exposure expected during the spring, and **insignificant** exposure during the other seasons.

The double-crested cormorant (*Phalacrocorax auritus*) is the most likely species of cormorant that may have limited exposure to the SWDA. While great cormorants (*Phalacrocorax carbo*) could possibly pass through the SWDA during the non-breeding season, they are likely to remain in coastal waters (Hatch et al. 2000) and were not observed during the NE Wind boat surveys. Double-crested cormorants tend to forage and roost close to shore. The regional MDAT abundance models show that cormorants are concentrated closer to shore and to the south. This aligns with the literature, which indicates that these birds rarely use the offshore environment (Dorr et al. 2014). During the NE Wind boat surveys, cormorants were observed in the fall and summer (see Section 3.2.4 of Appendix III-C). On an annual basis, cormorants had moderate densities within the survey area (3rd quartile of all species observed year-round). The annual exposure score for double-crested cormorant is **insignificant**, with **unlikely** exposure expected in the summer.

6.2.1.4.5 Gulls, Skuas, and Jaegers

The gulls present in the region are a large and varied group. The larger gull species (herring gull [*Larus argentatus*] and great black-backed gull [*Larus marinus*]) are resident to the region year-round, but roam further offshore outside of the breeding season (Veit et al. 2016). While gulls tend to be coastal, they will follow fishing vessels offshore. Jaegers and skuas are a highly pelagic group of dark, gull-like species. The jaegers (pomarine jaeger [*Stercorarius pomarinus*], parasitic jaeger [*Stercorarius parasiticus*], and long-tailed jaeger [*Stercorarius longicaudus*]) are all Arctic breeders that regularly migrate through the western North Atlantic region. Although their wintering ranges are poorly understood, they are known to occur in the Caribbean and off the coast of South America (Wiley and Lee 1999; Wiley and Lee 2000) or as far as southwest Africa (long-tailed jaeger) (Wiley and Lee 1998). The parasitic jaeger is often observed closer to shore during migration than the other species (Wiley and Lee 1999). The great skua (*Stercorarius skua*) is also a northern breeder that may pass along the Atlantic OCS outside the breeding season. In recent decades, skuas observed in the western North Atlantic have increasingly been identified as South Polar skuas (*Stercorarius maccormicki*) (Lee 1989), which breed in the southern hemisphere and wander north during the austral winter. The regional MDAT abundance models show that these birds have a wide distribution ranging from near shore (gulls) to offshore (jaegers).

During the NE Wind boat surveys, skuas and jaegers were observed in the fall and summer (see Section 3.2.5 of Appendix III-C). On an annual basis, skua and jaegers had low densities within the survey area (1st quartile of all species observed year-round). Herring gull and great black-backed gulls were among the most common gulls and were observed in the fall, winter, spring, and summer. On an annual basis, gulls had low to high densities within the survey area (2nd – 4th quartile of all species observed year-round), depending upon the species sub-group. The annual exposure score for the gull, skua, and jaeger group (multiple species) ranged from **insignificant** to **potential**. The pomarine jaeger, great skua, and south polar skua are expected to have **insignificant** exposure over all seasons. The parasitic jaeger is expected to have **insignificant** annual exposure, with **unlikely** exposure expected only during summer. The laughing gull (*Larus atricilla*), ring-billed gull (*Larus delawarensis*), and great black-backed gull had **insignificant** annual exposure scores, with each having expected **unlikely** exposure in the fall, summer, or winter, respectively. The herring gull had an annual exposure score of **unlikely**, with **unlikely** exposure expected in the spring, summer, and winter. The black-legged kittiwake (*Rissa tridactyla*) had an annual exposure score of **potential**, with **potential** exposure expected in the fall and **unlikely** exposure in the winter and spring.

6.2.1.4.6 Terns

The roseate tern, common tern (*Sterna hirundo*), least tern (*Sterna antillarum*), and Artic tern (*Sterna paradisae*) breed in Massachusetts, though other tern species may be present during other times of the year. Terns, all migratory, generally restrict themselves to coastal waters during breeding, although they may pass through the SWDA on their migratory journeys. This is especially true of a few tern species (common tern and roseate tern), which are known to aggregate around the Nantucket Shoals, particularly in spring (Veit et al. 2016). The regional MDAT abundance models show that terns are generally concentrated closer to shore than near the SWDA.

During the NE Wind boat surveys, terns were observed in the fall, spring, and summer (see Section 3.2.6 of Appendix III-C). The two species observed were the common tern and roseate tern (discussed further below). On an annual basis, terns had low densities within the survey area (2nd quartile of all species observed year-round). The annual exposure score for the tern group (multiple species) was **insignificant** to **unlikely**. The Arctic tern, least tern, bridled tern

(*Onychoprion anaethetus*), royal tern (*Thalasseus maximus*), and sooty tern (*Onychoprion fuscatus*) had **insignificant** exposure in all seasons. Both the common tern and roseate tern had expected **unlikely** exposure in the fall, with roseate tern exposure also **unlikely** in the spring.

The roseate tern is federally-listed as well as state-listed and is thus addressed in Section 6.2.1.5 below.

6.2.1.4.7 Auks

The auk species present in the region are generally northern or Arctic-breeders that winter along the US Atlantic OCS, including offshore waters off Massachusetts. However, the annual abundance and distribution of auks along the Eastern Seaboard in winter is erratic, depending upon broad climatic conditions and the availability of prey (Gaston and Jones 1998). In winters with prolonged harsh weather, which may prevent foraging for extended periods, these generally pelagic species often move inshore or are driven considerably farther south than usual. As a group, auks are commonly impacted in this way during severe storms, although die-off events also regularly impact the petrels and shearwaters and occasionally northern gannets (Fraser 2017). The regional MDAT abundance models show that auks are concentrated offshore and south of Nova Scotia.

During the NE Wind boat surveys, auks were observed in the fall, winter, and spring (see Section 3.2.7 of Appendix III-C). Unidentified large auk (razorbill [*Alca torda*] or murre) was the most common type of observation. On an annual basis, auks had moderate densities within the survey area (3rd quartile of all species observed year-round). The annual exposure score for the auk group (six species) ranged from **insignificant** to **potential**. Overall, the Atlantic puffin (*Fratercula arctica*), black guillemot (*Cepphus grylle*), and thick-billed murre (*Uria lomvia*) are expected to have **insignificant** exposure during all seasons. Both the common murre (*Uria aalge*) and dovekie (*Alle alle*) are expected to have **unlikely** exposure during the winter, with **insignificant** exposure during the rest of the year. The razorbill is expected to have **unlikely** exposure in the fall and winter, with **potential** exposure during the spring.

Table 6.2-6 Basic Ecological Traits of Marine Birds in the Region and Their Conservation Status at State, Federal, and Global Scales[1]

Species	Scientific Name	Map	Regional Presence	Distribution		Diet		Conservation Status[2]			Global Distribution	Breeding Region
				In/Offshore	At sea	Feeds at	Feeds on	State	Federal	Global		
Loons & Grebes												
Common loon	*Gavia immer*	*	winter	pelagic	dispersed	mid-water	fish, inverts	SC	.	LC	circumpolar	temperate
Red-throated loon	*Gavia stellata*	*	winter	inshore	dispersed	mid-water	fish, inverts	.	BCC	LC	circumpolar	subArctic
Horned grebe	*Podiceps auritus*		winter	coastal	dispersed	surf-mid	fish, inverts	.	BCC	VU	circumpolar	temp-subArc
Red-necked grebe	*Podiceps grisegena*	*	winter	coastal	dispersed	surface	fish, inverts	.	.	LC	circumpolar	temp-subArc
Sea Ducks												
King eider	Somateria spectabilis		winter	coastal	aggregated	benthos	inverts	.	.	LC	circumpolar	Arctic
Common eider	Somateria mollissima	*	year-round	coastal	aggregated	benthos	inverts	.	.	LC	circumpolar	Arc-subArc
Surf scoter	Melanitta perspicillata	*	winter	coastal	aggregated	benthos	inverts	.	.	LC	N America	subArctic
White-winged scoter	Melanitta fusca	*	winter	coastal	aggregated	benthos	inverts	.	.	LC	circumpolar	subArctic
Black scoter	Melanitta nigra		winter	coastal	aggregated	benthos	inverts	.	.	LC	circumpolar	subArctic
Long-tailed duck	Clangula hyemalis	*	winter	coastal	aggregated	benth-mid	inverts	.	.	VU	circumpolar	Arctic
Shearwaters, Petrels, & Storm-Petrels												
Northern fulmar	*Fulmarus glacialis*	*	winter	pelagic	disp-aggreg	surface	fish, squid	.	.	LC	circumpolar	Arctic
Cory's shearwater	*Calonectris diomedea*	*	summer	pelagic	disp-aggreg	surface	fish, inverts	.	.	LC	circumpolar	subAntarctic
Great shearwater	*Puffinus gravis*		summer	pelagic	disp-aggreg	surface	fish, inverts	.	BCC	LC	N & S Atlantic	subAntarctic
Sooty shearwater	*Puffinus griseus*	*	summer	pelagic	disp-aggreg	surface	fish, inverts	.	.	NT	circumpolar	subAntarctic
Manx shearwater	*Puffinus*	*	summer	pelagic	dispersed	surface	fish, inverts	.	.	LC	N & S Atlantic	temperate
Audubon's shearwater	*Puffinus lherminier*		summer	pelagic	dispersed	surface	fish, inverts	.	BCC	LC	N America	temp-trop
Wilson's storm-Petrel	*Oceanites oceanicus*	*	summer	pelagic	dispersed	surface	plankton	.	.	LC	circumpolar	subAntarctic
Leach's storm-Petrel	*Oceanodroma leucorhoa*		summer	pelagic	dispersed	surface	plankton	E	.	VU	circumpolar	subArctic
Gannets & Cormorants												
Northern gannet	*Morus bassanus*	*	winter	coast-pelagic	dispersed	mid-water	fish	.	.	LC	N Atlantic	subArctic
Double-crested cormorant	*Phalacrocorax auritus*	*	year-round	coast-inland	dispersed	mid-water	fish	.	.	LC	N America	subArc-temp
Great cormorant	*Phalacrocorax carbo*		year-round	coast-inland	dispersed	benthos	fish	.	BCC	LC	Eurasia, Africa	subArc-subAnt
Gulls & Jaegers												
Black-legged kittiwake	*Rissa tridactyla*	*	winter	pelagic	dispersed	surface	fish, inverts	.	.	LC	circumpolar	Arctic
Bonaparte's gull	*Larus philadelphia*	*	winter	pelagic	dispersed	surface	fish, inverts	.	.	LC	N America	subArctic
Black-headed gull	*Chroicocephalus ridibundus*		rare	coastal	dispersed	surface	fish, inverts	.	.	LC	W Europe	temperate
Little gull	*Hydrocoloeus minutus*		rare	coastal	dispersed	surface	fish, inverts	.	.	LC	circumpolar	subArctic
Laughing gull	*Larus atricilla*	*	summer	coastal	dispersed	surface	fish, inverts	.	.	LC	Americas	temp-trop
Ring-billed gull	*Larus delawarensis*		year-round	coastal	dispersed	surface	fish, inverts	.	.	LC	N America	temperate
Herring gull	*Larus argentatus*	*	year-round	coastal	dispersed	opportunistic		.	.	LC	circumpolar	temperate
Iceland gull	*Larus glaucoides*	*	winter	coastal	dispersed	opportunistic		.	.	LC	circumpolar	Arctic
Lesser black-backed gull	*Larus fuscus*		rare	coastal	dispersed	opportunistic		.	.	LC	W Europe	temperate
Glaucous gull	*Larus hyperboreaus*		winter	coastal	dispersed	opportunistic		.	.	LC	circumpolar	Arctic
Great black-backed gull	*Larus marinus*		year-round	coastal	dispersed	opportunistic		.	.	LC	circumpolar	temperate
Pomarine jaeger	*Stercorarius pomarinus*	*	passage	pelagic	dispersed	surface	fish, inverts	.	.	LC	circumpolar	Arctic
Parasitic jaeger	*Stercorarius parasiticus*		passage	pelagic	dispersed	surface	fish, inverts	.	.	LC	circumpolar	Arctic
Long-tailed jaeger	*Stercorarius longicaudus*		passage	pelagic	dispersed	surface	fish, inverts	.	.	LC	circumpolar	Arctic

Table 6.2-6 **Basic Ecological Traits of Marine Birds in the Region and Their Conservation Status at State, Federal, and Global Scales[1] (Continued)**

Species	Scientific Name	Map	Regional Presence	Distribution		Diet		Conservation Status[2]			Global Distribution	Breeding Region
				In/Offshore	At sea	Feeds at	Feeds on	State	Federal	Global		
Terns												
Least tern	*Sternula antillarum*		summer	coastal	dispersed	surface	fish, inverts	SC	SC	LC	N. America	temp-trop
Caspian tern	*Sterna caspia*		summer	coastal	dispersed	surface	fish, inverts	.	.	LC	N Am, Eura, Afr	temp-trop
Black tern	*Chlidonias niger*		passage	coastal	dispersed	surface	inverts, fish	.	.	LC	N/S Am, Euro, Afr	inland temp
Roseate tern	*Sterna dougalli*	*	summer	coastal	dispersed	surface	fish, inverts	E	E	LC	N/S Am, Asia, Afr	temp-trop
Common tern	*Sterna hirundo*	*	summer	coastal	dispersed	surface	fish, inverts	SC	.	LC	circumpolar	subArc-trop
Arctic tern	*Sterna paradisae*		passage	coastal	dispersed	surface	fish, inverts	SC	BCC	LC	circumpolar	Arctic
Forster's tern	*Sterna forsteri*		summer	coastal	dispersed	surface	fish, inverts	.	.	LC	N America	inland temp
Royal tern	*Sterna maxima*		summer	coastal	dispersed	surface	fish, inverts	.	.	LC	N/S Am, Africa	temp-trop
Auks												
Dovekie	*Alle*	*	winter	pelagic	dispersed	mid-water	plankton	.	.	LC	circumpolar	Arctic
Common murre	*Uria aalge*	*	winter	pelagic	dispersed	mid-water	fish, inverts	.	.	LC	circumpolar	Arc-subArc
Thick-billed murre	*Uria lomvia*		winter	pelagic	dispersed	mid-water	fish, inverts	.	.	LC	circumpolar	Arctic
Razorbill	*Alca torda*	*	winter	pelagic	dispersed	mid-water	fish, inverts	.	.	NT	N Atlantic	sub-Arctic
Black guillemot	*Cepphus grylle*		year-round	coastal	dispersed	benth-mid	fish, inverts	.	.	LC	circumpolar	Arc-temp
Atlantic puffin	*Fratercula artica*		winter	pelagic	dispersed	mid-water	fish	.	.	VU	N Atlantic	subArc-temp
Shorebirds												
Red-necked phalarope	*Phalaropus lobatus*		passage	pelagic	dispersed	surface	plankton	.	.	LC	circumpolar	Arctic
Red phalarope	*Phalaropus fulicarius*	*	passage	pelagic	dispersed	surface	plankton	.	.	LC	circumpolar	Arctic

Notes:

1. Adapted from eBird data (from BOEM, 2014) and cross-referenced with the US Fish and Wildlife Service IPaC database (https://ecos.fws.gov/ipac/).
2. Conservation Status: E = endangered; T = threatened; SC = special concern; BCC = bird of conservation concern; VU = vulnerable; NT = near threatened; LC = least concern.

6.2.1.5 Federally-Listed Species

6.2.1.5.1 Roseate Tern

Species General Description

The roseate tern is a small tern species that breed colonially on coastal islands. The northwest Atlantic Ocean population of roseate terns breeds in the northeastern US and Atlantic Canada and winters in South America, primarily in eastern Brazil (USFWS 2010; Nisbet et al. 2014). Roseate terns generally arrive at their northwest Atlantic breeding colonies in late April to late May, with nesting occurring between roughly mid-May and late July. They commonly forage during the breeding season in shallow water areas (i.e. less than 5 m [16.4 ft] water depth), such as sand bars (USFWS 2010; Nisbet et al. 2014). Roseate terns forage by shallow plunge-diving or surface-dipping to catch small fish, such as sand lance (*Ammodytes spp.*) (Goyert et al. 2014; Nisbet et al. 2014).

Over 90% of roseate terns in this population breed at three colony locations in Massachusetts (Bird Island, Ram Island, and Penikese Island in Buzzards Bay), and one colony location in New York (Great Gull Island, near the entrance to Long Island Sound) (Nisbet et al. 2014; Loring et al. 2017). Breeding roseate terns generally stay within about 10 km (6.2 mi) of the colony while foraging for food, but may travel up to 30–50 km (18.6–31 mi) from the colony while provisioning chicks (USFWS 2010; Burger et al. 2011; Nisbet et al. 2014; Loring et al. 2017). The closest roseate tern nesting colony to the SWDA is located at Norton Point Beach in Edgartown, approximately 35 km (22 mi) from the northernmost edge of the SWDA (excluding the two separate aliquots that are closer to shore) where common and roseate terns attempted to nest in 2020. However, the birds abandoned the site due to an unknown predation event (USFWS 2020).

Following the breeding season, adult and hatch year roseate terns move to post-breeding coastal staging areas from approximately late July to mid-September (USFWS 2010). There are roughly 20 staging areas in southeastern Cape Cod and nearby islands, which represent the majority of the breeding population for the northwest Atlantic (USFWS 2010). Foraging activity during the staging period is known to occur up to 16 km (10 mi) from the coast, though most foraging activity occurs much closer to shore (Burger et al. 2011). Monomoy Island and surrounding areas, known as one of the primary pre-migratory staging areas for the species, are about 72 km (45 mi) from the SWDA. The nearest pre-migratory staging area to the SWDA (excluding the two separate aliquots that are closer to shore) is located at Katama Beach on the south side of Martha's Vineyard (approximately 35 km [22 mi] from the SWDA).

Roseate tern migration routes are poorly understood, but they appear to migrate primarily well offshore (Nisbet 1984; USFWS 2010; Burger et al. 2011; Mostello et al. 2014; Nisbet et al. 2014). Six roseate terns tracked with data loggers in the 2000's flew directly between Massachusetts and eastern Caribbean islands during spring and fall migrations, crossing the ocean near the edge of the continental shelf and in some cases spending several days at sea (USFWS 2010; Mostello et al. 2014; Nisbet et al. 2014). The trip from Cape Cod to Puerto Rico in the fall took 1.5 to 2.5 days on average (900–1,500 km/day [559–932 mi/day]), with birds flying all night and stopping to feed at times during the day (Mostello et al. 2014; Nisbet et al. 2014). Spring migration from South America to breeding locations occurred more quickly overall, but migration between the northeastern Caribbean and Massachusetts was less direct, tended to be farther west than in fall (though still well offshore), and included nocturnal as well as diurnal stopover periods (Mostello et al. 2014; Nisbet et al. 2014). Spring pre-breeding staging locations appear to be similar to post-breeding staging areas (Mostello et al. 2014). A recent nanotag tracking study found movements of common terns and roseate terns primarily occurred from Cape Cod to Long Island Sound and that track densities were highest within 50 km (31 mi) of nesting colonies. During post-breeding, the terns dispersed to staging areas in southeastern Massachusetts, with high densities on Monomoy Island, Nantucket, and Muskeget Island. One roseate tern made a long-distance (greater than 250 km [155 mi]) flight during the post-breeding period to New Jersey (Loring et al. 2019).

Listing and Population Status

The northwest Atlantic Ocean population of roseate terns has been federally-listed as endangered under the ESA since 1987. Other breeding populations of roseate terns, such as the Caribbean breeding population, are unlikely to occur in the SWDA (BOEM 2014). Declines in the northwest Atlantic population have been largely attributed to low reproductive productivity, partially related to predator impacts on breeding colonies, and habitat loss and degradation, though adult roseate tern survival is also unusually low for a small tern species. As of 2017, approximately 50% of the Northeast US population's 4,446 pairs nested in Massachusetts (Mostello et al. 2019).

Regional Information

Areas around Cape Cod that have been identified as important for roseate tern foraging activity in past years have largely been concentrated in Buzzard's Bay, Vineyard Sound, and along the southern coast of the Cape in Nantucket Sound (MMS 2008), though foraging locations can be highly dynamic. Non-breeding individuals, including juveniles and non-reproductive adults, are thought to: (1) move between foraging and staging areas more frequently, and (2) move over longer distances than breeding individuals (USFWS 2017).

Aerial survey data suggest that Nantucket Shoals may also be an important area for common terns and roseate terns in spring (during the month of May), prior to initiation of breeding (Veit et al. 2016). In aerial surveys of the MA WEA and vicinity in 2015, Sterna terns were observed offshore most commonly during the spring season, though median estimates of terns per square kilometer remained low in all seasons (Veit et al. 2016).

SWDA-Specific Information

Overall, the regional and site-specific information indicate low use of the SWDA by roseate terns during spring, summer, and fall (terns are not present in the winter). During the NE Wind boat surveys, two roseate terns were observed on May 16 (see Section 3.2.6 of Appendix III-C).[39] Roseate terns were not observed in any of the other spring, summer, or fall surveys. In a separate 2018 spring boat survey conducted in the Vineyard Wind 1 Wind Development Area (WDA) (April 22, April 28, May 6, and May 10), no roseate terns were observed in the survey area, although they were observed both northwest and south of Muskeget Channel. The MassCEC aerial survey data only has one record of two terns (not identified to species) in the SWDA for all seasons and years combined (Veit et al. 2016), and the survey data suggest that roseate terns and other terns are most commonly observed around the Muskeget Channel, between Martha's Vineyard and Nantucket (BOEM 2014; Veit et al. 2016).

A recent movement study used nanotags to track roseate terns tagged in Massachusetts and New York. While the movement models are not representative of the entire breeding and post-breeding period for many individuals (due to incomplete spatial coverage of the receiving stations and tag loss), as shown in Section 3.2.6 of Appendix III-C, none of the tracked birds (*n*=145) were estimated to pass through Lease Area OCS-A 0501 (which at the time of the study included Lease Area OCS-A 0534)[40] (Loring et al. 2019). The MDAT abundance models suggest that roseate tern occupancy and abundance in the SWDA is likely to be much lower than in Nantucket Sound in all seasons examined—spring, summer, and fall (Kinlan et al. 2016)—and during the breeding and post-breeding periods, very few, if any, roseate terns are predicted to occur within the SWDA (BOEM 2014; Kinlan et al. 2016). It should be noted that the models are based upon relatively few roseate tern observations (*n* = 1,541) and that the model explains 59% of the variation in the data set (about average for the MDAT models) (see Section 5 of Appendix III-C).

Roseate terns may occur at the SWDA ephemerally during spring and fall migration as well as during post-breeding as they move towards staging areas (Burger et al. 2011; BOEM 2014), although the NE Wind boat surveys suggest that the occurrence of terns is probably sporadic and more likely to occur in the spring during migration and just after arrival at breeding areas. Tracking data shows that in July and August, individuals move between staging locations on islands in Nantucket Sound, Block Island, and Montauk, including potential movements through the MA WEA, Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), and Block Island Wind Farm (Loring et al. 2017). There is no evidence of post-breeding movements through the SWDA (Loring et al. 2017), likely due to its location to the south of known breeding and staging locations.

[39] A total of 39 common terns and 19 unidentified terns were observed during the May 16 survey.

[40] After the study, in June 2021, Lease Area OCS-A 0501 was segregated into Lease Area OCS-A 0534 and Lease Area OCS-A 0501.

In sum, roseate terns are expected to have low use of the SWDA during all seasons, and any exposure will probably occur only during migration. The NE Wind boat surveys only observed two roseate terns in the spring, the MassCEC aerial survey data included only one record of two unidentified terns in the SWDA, and the annual exposure analysis for roseate tern was **unlikely**. The MDAT abundance models predict low use of the SWDA, with birds concentrated generally closer to shore than near the SWDA. Since roseate terns generally forage in shallow water they would not be expected to use the SWDA as foraging habitat. Given that terns are rarely observed in the SWDA and exposure is likely limited to migration, the expected exposure of roseate terns is **unlikely**. These conclusions are consistent with those determined by the Bureau of Ocean Energy Management (BOEM) in comprehensive risk assessments conducted for Vineyard Wind 1, which is adjacent to New England Wind (BOEM 2018; BOEM 2019).

6.2.1.5.2 Piping Plover

Species General Description

The piping plover is a small shorebird that nests on beaches, sand flats, and alkali wetlands along the Atlantic coast of North America, the Great Lakes, and in the Midwestern plains (Elliott-Smith and Haig 2004). Piping plovers feed on terrestrial and aquatic invertebrates, particularly in the intertidal zone and along wrack lines, and spend most of their time on the ground rather than aloft (Elliott-Smith and Haig 2004). The Atlantic coast-breeding subspecies of piping plovers, which is the only population likely to occur in Massachusetts waters, breeds as individual pairs on sandy beaches from Newfoundland to North Carolina (Elliott-Smith and Haig 2004; BOEM 2014). Breeding generally occurs in May through early August, with variation in the onset of breeding related to local pair densities as well as seasonal weather conditions (Elliott-Smith and Haig 2004). Non-migratory movements in May to August appear to be exclusively coastal (Burger et al. 2011). Nocturnal activities during the breeding period are less well known, but appear to be similar to daytime activities in many respects, including foraging, incubating nests, and short local flights when birds are disturbed (Staine and Burger 1994). Band recovery data suggest that there may be several distinct breeding populations within the Atlantic coast subspecies, with individuals largely returning to the areas where they were hatched or known to breed in previous years (USFWS 2009; Amirault-Langlais et al. 2014).

Migration periods are primarily April to May and August to September (BOEM 2014), though breeding piping plovers arrive in Massachusetts beginning around mid-March. Post-breeding movements of fledged chicks (≤50 km [31.1 mi]) and adults can occur prior to initiation of migration (Elliott-Smith and Haig 2004), and post-breeding migratory movements can begin as early as June, with adult birds departing Massachusetts by late August (Elliott-Smith and Haig 2004; Loring et al. 2017). There is some suggestion that hatch year birds may be delayed on their first fall migration, arriving at wintering grounds several months after adults, but little data are available (Elliott-Smith and Haig 2004). Migration occurs primarily during nocturnal periods when winds are blowing to the south to southwest with takeoff during the early evening (Loring et al. 2017). Both breeding and wintering habitats include islands >5 km [3.1 mi] from the coast, including the Bahamas, which is greater than 160 km (99.4 mi) from the US Atlantic coastline (Normandeau Associates Inc. 2011). This, along with the infrequency of observations of migratory flocks along the Atlantic coast, may indicate that many Atlantic-breeding piping plovers, like the inland-breeding subspecies, may make nonstop long-distance migratory flights (Normandeau Associates Inc. 2011).

The species winters in the coastal southeastern US and Caribbean (Elliott-Smith and Haig 2004; USFWS 2009; BOEM 2014). The winter range is imperfectly understood, particularly for US Atlantic breeders and for wintering locations outside the US, but includes the southeastern coast of the US from North Carolina to Texas, as well as Mexico, and several Caribbean islands (USFWS 2009). Within the US wintering range, the Atlantic subpopulation appears to primarily winter along the southern Atlantic coast and the Gulf coast of Florida, though Massachusetts-breeding birds are known to winter in Texas as well (Elliott-Smith and Haig 2004; USFWS 2009).

Listing and Population Status

The Atlantic population is listed as threatened under the ESA, with approximately 1,698 nesting pairs in the US as of 2018 (USFWS 2018d), and breeding grounds are heavily managed to promote population recovery (Elliott-Smith and Haig 2004). Coastal habitat loss and degradation, as well as human-related disturbance, represent some of the greatest threats to the population; predation is also an issue on the breeding grounds and, in Massachusetts, this issue is exacerbated in association with anthropogenic disturbance (Elliott-Smith and Haig 2004; USFWS 2009; BOEM 2014). The viability of the species is heavily dependent upon adult and juvenile survival rates (USFWS 2009). However, the New England recovery unit of the population has exceeded or nearly met the US Fish and Wildlife Service (USFWS)-defined minimum abundance goal for recovery (625 pairs) every year since 1998 (USFWS 2009). The Massachusetts population, which is by far the largest of the New England states, was estimated to be 688 pairs in 2018 (USFWS 2018c).

Regional Information

Piping plovers are present in Massachusetts during spring and fall migratory periods and during the breeding season (mid-March to late August or early September) (Elliott-Smith and Haig 2004; BOEM 2014). Large numbers of piping plovers have been observed in pre-migratory staging in southeastern Cape Cod in late summer (BOEM 2014).

Only recently have data started to become available on the potential for macro-scale exposure of migrating piping plovers to WEAs along the Atlantic coast. Piping plovers breeding in Rhode Island and in the Monomoy National Wildlife Refuge in Massachusetts were tracked with nanotags (a type of very high frequency [VHF] transmitter; *n*=150) and monitored using automated telemetry stations in terrestrial areas. The telemetry stations' standard detection range did not extend into the SWDA. Migration trajectories in areas well offshore are interpolated from observed flight trajectories in coastal areas as well as subsequent detections of individuals at other telemetry stations. The tracked individuals chose both offshore and coastal migration routes from their nesting locations (Loring et al. 2019). Maps from the study are available in Section 3.1.2 of Appendix III-C.

These recent data present evidence for offshore migratory “hops” between coastal areas, such as Cape Cod, Long Island, coastal New Jersey/Delaware, and the Outer Banks of North Carolina. Large flocks of piping plovers have been observed during migratory stopover in Virginia, Cape May, New Jersey, and Cape Lookout, North Carolina (Elliott-Smith and Haig 2004), providing additional evidence in support of this hypothesis.

SWDA-Specific Information

The nanotag movement study estimated that three tracked piping plovers (tagged in Massachusetts) passed through Lease Area OCS-A 0501 (which at the time of the study included Lease Area OCS-A 0534)[41] (Loring et al. 2019). A probability density analysis conducted with the data indicates higher use of the area to the west of Martha’s Vineyard (outside the SWDA) (see Section 3.1.2 of Appendix III-C). The exposure estimates are considered a minimum estimate because of lost tags and incomplete coverage of the offshore environment by land-based receivers (Loring et al. 2019). Piping plovers were not observed during the NE Wind boat surveys. In sum, since piping plover exposure to the SWDA would hypothetically only occur during migration and there is no breeding or foraging habitat for the species in the SWDA, the expected exposure is **insignificant** to **unlikely**. These conclusions are consistent with those determined by comprehensive risk assessments conducted for Vineyard Wind 1, which is adjacent to New England Wind (BOEM 2018; BOEM 2019).

Landfall Site-Specific Information

For Phase 1, the potential landfall sites are Craigville Public Beach or Covell’s Beach in the Town of Barnstable (see Section 3.2.2 of COP Volume I). Covell’s Beach is located approximately 0.6 km (0.4 mi) east of Craigville Public Beach. These potential landfall sites are located within or in close proximity to beach/dune habitat and Priority Habitats of Rare Species as mapped by the Natural Heritage and Endangered Species Program (NHESP) but are not within or in close proximity to any Audubon Important Bird Areas. NHESP has confirmed that the mapped Priority Habitat is for piping plover at the Phase 1 landfall sites.

Craigville Public Beach and Covell’s Beach are situated in developed areas frequented by people. These beaches are typical of those along Cape Cod with small areas of dune grass located adjacent to roads, houses, power lines, and parking areas. Craigville Public Beach and Covell’s Beach are

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[41] After the study, in June 2021, Lease Area OCS-A 0501 was segregated into Lease Area OCS-A 0534 and Lease Area OCS-A 0501.

mapped as NHESP Priority Habitat of Rare Species, and the federally-listed piping plover may forage, nest, or stage for migration in the area. Craigville Public Beach and Covell's Beach are located in the Upper Cape Region, a region that includes many beaches and accounted for 19% of piping plover breeding pairs in 2020 (MassWildlife 2021). One pair of piping plovers was documented nesting at Craigville Public Beach in 2017 (MassWildlife 2018), 2018 (MassWildlife 2019), and 2020 (MassWildlife 2021). No piping plover pairs were documented nesting at Covell's Beach in 2017 (MassWildlife 2018), 2018 (MassWildlife 2019), or 2020, while 5 pairs fledged 5 chicks at Long Beach (situated west of the Craigville Public Beach and Covell's Beach) in 2020 (MassWildlife 2021).

For Phase 2, the potential landfall sites are Dowses Beach or Wianno Avenue in the Town of Barnstable (see Section 4.2.2.1 of COP Volume I). Like Phase 1, both of these potential landfall sites are located within or in close proximity to beach/dune habitat and Priority Habitats of Rare Species as mapped by the NHESP but are not within or in close proximity to any Audubon Important Bird Areas. NHESP has confirmed that the mapped Priority Habitat is for piping plover and least tern at the Phase 2 potential landfall sites.

Like Craigville Public Beach and Covell's Beach, Dowses Beach and Wianno Avenue are both developed areas that are frequented by people. Dowses beach is in the Upper Cape Region, which, as mentioned above, represented 19% of piping plover breeding pairs in 2020 (MassWildlife 2021). One piping plover pair was documented nesting at Dowses Beach in 2017 (MassWildlife 2018), 2 pairs in 2018 (MassWildife 2019), and 1 pair in 2020 that fledged 3 chicks (MassWildlife 2021). Wianno Avenue is also in the Upper Cape Region, located approximately 0.5 km (0.3 mi) south of Dowses Beach. The shoreline at the Wianno Avenue Landfall Site lacks dune habitat due to the installation of a riprap seawall, and likely does not contain suitable habitat for piping plover.

6.2.1.5.3 Red Knot

Species General Description

The red knot is a medium-sized shorebird with one of the longest migrations in the world, undertaking a nonstop flight of up to 8,000 km (4,970 mi) on its circumpolar travels between breeding and wintering locations (Baker et al. 2013). When not actively migrating, red knots feed exclusively in terrestrial locations, primarily in the intertidal zone, on mussels, clams, and other invertebrates, and spend most of their time on the ground rather than aloft.

Red knots tend to: (1) embark on migratory flights a few hours before sunset, on sunny days and days with tailwinds, and (2) migrate in flocks numbering in the dozens to hundreds of individuals (Baker et al. 2013). Migration routes appear to be highly diverse. Some individuals fly over the open ocean from the northeastern US directly to stopover and wintering sites in the Caribbean and South America, while others make the ocean "jump" from farther south or follow the US Atlantic coast for the duration (Baker et al. 2013; BOEM 2014). Some of this variation may be due to birds avoiding large storms in the Atlantic (Baker et al. 2013).

Listing and Population Status

The *rufa* subspecies of the red knot is listed as threatened under the ESA, primarily because the Atlantic flyway population decreased by approximately 70% from 1981 to 2012 to less than 30,000 individuals (Burger et al. 2011; Baker et al. 2013; USFWS 2015). This subspecies appears to include three distinct populations in the western Hemisphere, with individuals wintering in the southeastern US and Caribbean, northern Brazil, and Tierra del Fuego (Baker et al. 2013). All three populations breed in the high Arctic and share several key migration stopover areas along the eastern coast of the US, particularly in Delaware Bay and coastal islands of Virginia (Burger et al. 2011). Increasingly limited food resources in these staging areas, as well as breeding conditions in the Arctic and habitat degradation on the wintering grounds, are thought to be contributing to the population's decline (Baker et al. 2013). Climate change impacts on habitats, food availability, and migration are also expected to negatively influence red knot populations. Population status is thought to be strongly influenced by adult survival and recruitment rates, conditions on the breeding grounds, and food availability on stopover sites (97 to 98% of individuals are estimated to use the same small number of stopover locations in some areas) (Baker et al. 2013).

Regional Information

The red knot is present in Massachusetts only during migratory periods (BOEM 2014). All three populations of *rufa* are known to stop over on Monomoy Island during southward migration in the fall (Baker et al. 2013). The fall migration period is July to October and is characterized by a concentration of migrant activity and departures in Massachusetts, particularly Cape Cod, in August (Burger et al. 2011; Baker et al. 2013). In addition to arriving and departing at slightly different times, adults and juveniles appear to use different stopover locations in Cape Cod and mainland Massachusetts (Baker et al. 2013).

During northward migration in spring, all three wintering populations of *rufa* use Delaware Bay as a key stopover location in late April to June before undertaking long flights to locations in Canada (Baker et al. 2013). Birds in the southeastern US wintering population may also make multiple stops along the eastern seaboard, including in Massachusetts; spring migration through Massachusetts may thus include both offshore migratory activity and more coastal activity after birds make landfall farther south (BOEM 2014). Reports from the 1800s suggest many thousands of red knots stopping over in Massachusetts in late May and early June, but relatively few birds are observed in Massachusetts Bay today (Baker et al. 2013). While at stopover locations, red knots make local movements (e.g. commuting flights between foraging locations related to tidal changes), but are thought to remain within 5 km (3.1 mi) of shore (Burger et al. 2011).

SWDA-Specific Information

The Northwest Atlantic Seabird Catalog has no records of the red knot in the SWDA and none were observed during the NE Wind boat surveys (see Section 3.1.2 of Appendix III-C). Most adult *rufa* fly offshore over the Atlantic from Canadian or US staging areas to South America (Baker et al. 2013); this is the period in which red knots could potentially move through the SWDA (BOEM

2014). In a recent telemetry study, two birds tagged in Massachusetts (*n*=99) were detected as potentially crossing Lease Area OCS-A 0501 (which at the time of the study included Lease Area OCS-A 0534).[42] Migration flights are generally undertaken at night in good weather conditions, lessening any risk of collision (Loring et al. 2018). Since red knot exposure to the SWDA is limited to migration and there is no habitat for the species in the SWDA, the expected exposure is **insignificant** to **unlikely**. These conclusions are consistent with those determined by comprehensive risk assessments conducted for Vineyard Wind 1, which is adjacent to New England Wind (BOEM 2018; BOEM 2019).

6.2.1.5.4 Black-Capped Petrel (Proposed for Listing)

Species General Description

The black-capped petrel is a pelagic seabird that breeds in small colonies on remote forested mountainsides of Caribbean islands, although breeding is now thought to be mostly restricted to the islands of Hispaniola (Haiti and the Dominican Republic) and possibly Cuba (Simons et al. 2013). During their breeding season (January–June), black-capped petrels travel long distances to forage over deep waters (200–2,000 m [650–6,500 ft]) of the southwestern North Atlantic, the Caribbean basin, and the southern Gulf of Mexico (Simons et al. 2013). Outside the breeding season, they regularly spend time in US waters along the shelf edge of the South Atlantic Bight, commonly as far north as Cape Hatteras and occasionally beyond (Jodice et al. 2015), but are rarely seen in waters offshore of Massachusetts.

Listing and Population Status

The small, declining global population, which is likely less than 2,000 breeding pairs, has been listed as endangered on the International Union for Conservation of Nature's Red List since 1994 (BirdLife International 2018) and is currently proposed for federal listing under the ESA as threatened (USFWS 2018a) due to its heavy use of the Gulf Stream within US waters (USFWS 2018b). The black-capped petrel was pushed to the edge of extinction in the late 1800s due to hunting and harvest for food (Simons et al. 2013). Predation of adults and eggs by invasive mammals as well as breeding habitat loss and degradation remain major threats to their existence, while the effects of climate change on the biology of the species and its prey are largely unknown (Goetz et al. 2012). Nevertheless, an increase in the frequency and intensity of hurricanes due to climate change is expected to drastically increase mortality in breeding black-capped petrels (Hass et al. 2012). Given the small size of the breeding population, the species' resiliency (i.e. the ability to withstand normal environmental variation and stochastic disturbances over time) is considered to be low (USFWS 2018a).

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[42] After the study, in June 2021, Lease Area OCS-A 0501 was segregated into Lease Area OCS-A 0534 and Lease Area OCS-A 0501.

Regional Information

The black-capped petrel is extremely uncommon in areas not directly influenced by the warmer waters of the Gulf Stream (Haney 1987) and is thought to be found in coastal waters of the US only as a result of tropical storms (Lee 2000). The Northwest Atlantic Seabird Catalog contains approximately 5,000 individual observations of black-capped petrels at sea from 1979–2006 (O'Connell et al. 2009; Simons et al. 2013), with some observations off of Long Island (see Section 3.2.3 of Appendix III-C). Recent tracking of black-capped petrels with satellite transmitters confirms that the birds primarily use areas beyond the shelf break (Atlantic Seabirds 2019) (see Section 3.2.3. of Appendix III-C).

SWDA-Specific Information

Black-capped petrels were not observed during the NE Wind boat surveys or during the MassCEC aerial surveys and other data sources (i.e. tracking studies, see Appendix Section 3.2.3.3.1) indicate that the birds are unlikely to pass through the SWDA. Therefore, annual exposure to the SWDA is expected to be **insignificant**. These conclusions are consistent with those determined by comprehensive risk assessments conducted for Vineyard Wind 1, which is adjacent to New England Wind (BOEM 2018; BOEM 2019). Black-capped petrels will not be addressed further.

6.2.1.5.5 Bald and Golden Eagle

Species General Description

The bald eagle is broadly distributed across North America. The species generally nests and perches in association with water (lakes, rivers, bays) in both freshwater and marine-based habitats, often remaining within roughly 500 m (1,640 ft) of the shoreline (Buehler 2000). Foraging habits are seasonally opportunistic, but individuals generally prefer fish when available. In some regions, the diets of bald eagles nesting in offshore coastal settings are dominated by birds (i.e. waterfowl, cormorants, and gulls), whereas the diets of inland nesters in New England largely consists of fish (Murie 1940; Todd et al. 1982). Bald eagles commonly scavenge dead birds, fish, and mammals, particularly during the winter when live fish prey is often scarce.

The golden eagle (*Aquila chrysaetos*) diet is generally comprised of small mammals, such as rabbits, mice, and prairie dogs, but numerous other prey items have also been reported (Kochert et al. 2002). Golden eagles are generally associated with open habitats, particularly in the western US, but satellite-tracked individuals wintering in the eastern US have also been documented to heavily utilize forested regions (Katzner et al. 2012). In addition to breeding populations in Europe and Asia, golden eagles are broadly distributed across western North America, but are comparatively rare in the eastern US (Kochert et al. 2002). Golden eagles commonly winter in the southern Appalachians and are regularly observed in the mid-Atlantic US, spanning coastal plain habitat in Virginia, Delaware, North Carolina, South Carolina, and other southeastern US states.

Individuals migrating between Appalachian states and easternmost breeding populations in Canada generally use inland migration routes following the Appalachian Mountains, rather than coastal migration flyways (Katzner et al. 2012).

Unlike many groups of birds, such as falcons, gulls, and shorebirds, eagles have a high weight to wing area ratio (Mendelsohn et al. 1989). This wing-loading characteristic causes eagles to rely heavily on thermals during long-distance movements and to generally avoid large water crossings (Kerlinger 1985). Bald eagles will, however, travel to islands to nest, forage (i.e. seabird colonies) (Todd et al. 1982), and presumably to stopover during long-distance movements (Mojica et al. 2008).

Listing and Population Status

The bald eagle was removed from the federal list of threatened and endangered species in 2007 but is currently listed as threatened in Massachusetts. Breeding populations of golden eagles are extirpated in the eastern US (Katzner et al. 2012). The nearest known breeding populations are in Canada, where they are common in several eastern Provinces (i.e. Québec, Newfoundland, and Labrador) (Katzner et al. 2012). Both bald eagles and golden eagles remain federally protected under the Bold and Golden Eagle Protection Act.

Regional Information

Bald eagles are present year-round in Massachusetts, including Martha's Vineyard, Nantucket, and other nearby islands (eBird 2018). In a study evaluating the spatial distribution of bald eagles captured in Chesapeake Bay, the Cape Cod region was associated with very low levels of use (Mojica et al. 2016). Between 2012 and 2013, a large offshore area in the mid-Atlantic US was surveyed, using both boat-based and digital aerial surveys, and only four bald eagles were detected, all less than 6 km (3.7 mi) from shore (Williams et al. 2015). Given that the study area was near one of the largest bald eagle population centers in North America (Chesapeake Bay), this finding supports the hypothesis that bald eagles rarely venture large distances offshore. Eagles were not seen in or near the SWDA in the MassCEC aerial surveys and NE Wind boat surveys, and there were no records of eagles near the SWDA in the Northwest Atlantic Seabird Catalog.

SWDA-Specific Information

The general morphology of both bald eagles and golden eagles dissuades regular use of offshore habitats. These two species generally rely on thermals, which are poorly developed over the ocean, during migration movements. Golden eagle exposure in the SWDA is expected to be **insignificant** due to their dietary habits, limited distribution in the eastern US, and reliance on terrestrial habitats (BOEM 2014). Bald eagle exposure in the SWDA is also expected to be **insignificant** because the SWDA is not located along any likely or known bald eagle migration route, they tend not to fly over large water bodies, and features that might potentially attract them offshore (i.e. islands) are absent nearby. Since exposure is expected to be **insignificant** for both species and there is no evidence that they will be exposed to the SWDA, eagles will not be addressed further.

6.2.2 Potential Impacts of New England Wind

Potential direct and indirect impacts were evaluated by considering how vulnerable species will be exposed (see Section 6.2.1) to impact producing factors (IPFs). IPFs are defined as the changes to the environment caused by New England Wind activities during each offshore wind farm development phase (i.e. hazards) (BOEM 2012; Goodale and Milman 2016). IPFs for coastal and marine birds are summarized in Table 6.2-8. To be at risk of a direct or an indirect impact, a species must be both exposed to a wind farm and be vulnerable to either displacement or collision (Goodale and Stenhouse 2016). Vulnerability is defined as behavioral factors (e.g. flight, height, and avoidance) that increase the likelihood that a bird will either collide with a wind turbine generator (WTG) or be displaced from the SWDA (Goodale and Stenhouse 2016). For non-marine migratory species, vulnerability was evaluated based upon existing assessments (e.g. Furness et al. 2013) and documented behavioral response to offshore wind farms in the literature. For marine birds, a ranking of relative vulnerability to operation of New England Wind was developed for displacement and collision. The ranking was done for the maximum dimensions (tip height and rotor diameter) and the minimum tip clearance (also known as air gap) of the WTGs under consideration.[43] Section 3.2 in Appendix III-C provides flight heights of marine birds in five-meter intervals relative to the WTG parameters. Accordingly, the following assessments of impacts during construction, operations and maintenance (O&M), and decommissioning are relevant for both Phases of New England Wind.

Details on the vulnerability ranking methods are provided in Section 2.1.2 of Appendix III-C, and rankings for both Phases are provided for each marine species in Section 3.2 of Appendix III-C. Levels of behavioral vulnerability are defined in Table 6.2-7.

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[43] Prior to the April 2022 COP revision that updated the Phase 1 WTG dimensions to match the Phase 2 WTG dimensions, the vulnerability rankings were performed separately for the Phase 1 WTGs and the Phase 2 WTGs.[43] For all species, the range in maximum WTG dimensions included in the Phase 1 and Phase 2 Envelopes did not change the vulnerability rankings because the minimum tip clearance (distance between the water and lowest blade position) was the same for both Phases (27 m [89 ft]).

Table 6.2-7 Definitions of Behavioral Vulnerability

Behavioral Vulnerability Level	Definition[1]
Insignificant	0–0.25 ranking for collision or displacement risk in vulnerability scoring OR No evidence of collisions or displacement in the literature. Unlikely to fly within the rotor-swept zone (RSZ).
Unlikely	0.26–0.5 ranking for collision or displacement risk in vulnerability scoring OR Little evidence of collisions or displacement in the literature. Rarely flies within the RSZ.
Potential	0.51–0.75 ranking for collision or displacement risk in vulnerability scoring OR Evidence of collisions or displacement in the literature. Occasionally flies within the RSZ.
Likely	0.76–1.0 ranking for collision or displacement risk in vulnerability scoring OR Significant evidence of collisions or displacement in the literature. Regularly flies within the RSZ.

Notes:
1. See Section 2.1.2 of Appendix III-C for details on the vulnerability ranking methods.

Table 6.2-8 Impact Producing Factors for Coastal and Marine Birds

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Structure strikes hazard	•			•	•	•
Noise	•		•	•		•
Vessel lights	•	•		•	•	•
Structure lights	•			•	•	•
Vessel traffic	•	•		•	•	•
Suspended sediments	•	•		•		•
Permanent habitat alteration[1]	•			•	•	•
Temporary habitat alteration[1]			•	•		

Notes:
1. Permanent alteration of habitat can lead to long-term displacement while temporary alteration of habitat can lead to short-term disturbance.

The impacts of operating offshore wind farms on birds are generally characterized as direct effects (collision) that cause injury or death and indirect effects (displacement) that may cause habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Milman 2016). While rare for projects built offshore (Skov et al. 2018), collisions have been recorded at wind farms built directly adjacent to seabird colonies (Everaert and Stienen 2007). These collisions generally occur in one of two ways: (1) birds collide with the superstructure or rotors during operation, or (2) birds are forced to the ground due to the vortex created by the moving rotors (Drewitt and Langston 2006; Fox et al. 2006). Certain groups of birds are displaced by offshore wind developments through avoidance behavioral responses (Fox et al. 2006; Krijgsveld et al. 2011; Lindeboom et al. 2011), which has been documented for sea ducks, gannets, auks, geese, and loons (Desholm and Kahlert 2005; Larsen and Guillemette 2007; Percival 2010; Lindeboom et al. 2011; Plonczkier and Simms 2012; Langston 2013; Garthe et al. 2017; Mendel et al. 2019). Birds that avoid the wind farm area completely experience effective habitat loss (Drewitt and Langston 2006; Masden et al. 2009; Petersen et al. 2011; Langston 2013). This avoidance, however, only results in a small increase in energy expenditure (Masden et al. 2009) and there is little evidence to suggest that avoidance and potential displacement from wind developments are reducing fitness, leading to critical habitat loss, or adversely affecting populations.

The risk of impacts caused by collision and displacement occurs when vulnerable species are exposed to the hazard of the wind farms. The offshore wind farm hazards most likely to cause adverse effects for birds are the rotors (collision) and the project’s footprint (displacement) (Goodale and Milman 2016). Individual species vulnerability is based on intrinsic or innate behaviors that will increase exposure rates, such as basic feeding, breeding, migrating, or sheltering behaviors. Behaviors contributing to collision vulnerability are primarily flight behaviors that increase the likelihood that a bird will be struck by a WTG blade. Species vulnerability can also be caused by a species’ response to the presence of an offshore wind farm. For some species, this may be avoidance that can lead to partial or complete displacement from an offshore wind farm, whereas for others, it may involve an attraction to wind farm structures (Furness et al. 2013).

While long-term impacts are related to the O&M period of New England Wind, temporary impacts may also occur during construction. Coastal and marine birds may encounter installation vessels within the SWDA or along the OECC (including the Western Muskeget Variant), but such exposure, in any given location, will be limited to a finite temporal and ephemeral period. Coastal and marine birds may also experience temporary impacts from cable installation activities occurring along the OECC (including the Western Muskeget Variant), which may cause short-term, localized increases in suspended sediments.

6.2.2.1 Construction and Installation

Construction period impacts are expected to be similar for Phases 1 and 2. For the analysis below, the full range of dimensions for WTGs that may be used by Phases 1 and 2 of New England Wind are considered; therefore, this assessment includes both Phases. During construction, temporary IPFs can range from vessel traffic to structure strikes hazard, as summarized in Table 6.2-8. It is assumed that foundation type will not significantly change the IPFs during construction.

Spatially, seasonal bird exposure to the SWDA will be similar during both construction and O&M. However, exposure to all construction activities is temporary and will be short-term. Birds are expected to have the same basic behavioral vulnerability to both Phases (i.e. interacting with or being displaced by construction vessels or operating WTGs) and, thus, the same bird behavioral vulnerability rankings are provided in both the construction and O&M sections. During construction, the primary hazards to birds that may lead to mortality or displacement are the following (as adapted from MMS 2007):

- Temporary hazards potentially causing mortality or injury:
  - Vertical structures of construction equipment and WTGs that could be a collision hazard
  - Lighting of construction vessels that may attract birds
- Temporary hazards potentially causing displacement and habitat modification or loss:
  - Noise generated by pile-driving that could lead to avoidance
  - Boat traffic that could lead to attraction or avoidance

6.2.2.1.1 Potential Direct and Indirect Impacts (Phases 1 and 2)

Potential direct IPFs include structure strikes hazard, noise, vessel lights, structure lights, vessel traffic, and suspended sediments. Habitat loss presents an indirect IPF.

Construction period impacts are expected to be similar for both Phases of New England Wind. Although very few studies have assessed the effects on birds during the construction period, increased boat traffic, noise, and lighting within the SWDA or along the OECC are likely to be disruptive (Fox and Petersen 2019). Overall, below water activities in the SWDA and along the OECC, including, but not limited to, foundation and cable installation, are not expected to be a long-term hazard for birds (BOEM 2018). The potential direct impacts are mortality or injury due to collision with construction equipment. For most bird species, the primary impact of concern is collisions during operations rather than during construction, because the construction period is of relatively short duration (Fox and Petersen 2019). There is a small possibility of collision with lighted structures (vessels, construction equipment, and WTGs) during construction in low light conditions and in severe or poor weather. The minimization and mitigation measures described in Section 6.2.2.1.2 will reduce any impacts to insignificant levels because most birds, with the exception of gulls, are less likely to be attracted to vessels during fair weather conditions. The potential indirect impact is displacement due to disturbance by construction vessels or pile driving noise and is discussed below. Higher levels of boat traffic and human activity, including operation of large machinery during construction, could cause temporary displacement or avoidance in some species.

Coastal and Marine Birds

Coastal birds (shorebirds, waterfowl, waterbirds, wading birds, falcons, and songbirds) are expected to have **insignificant** to **potential** behavioral vulnerability to collision with construction equipment and an **insignificant** to **unlikely** behavioral vulnerability to displacement (see further discussion in Section 6.2.2.2 about coastal bird vulnerability). While birds may encounter the construction equipment during migration and may land on vessels, mortality from collision is unlikely. The potential for colliding with lit structures in the marine environment may increase if there is substantial lighting (e.g. Hüppop et al. 2006), but lighting can be minimized by using best management practices. It is also important to consider the context with the marine space being used by many other users. Any avoidance behavior that coastal birds exhibit would reduce vulnerability to collision; furthermore, exposure of coastal birds will generally be limited to migration (see Section 6.2.1). Any below water disturbance from offshore export cable installation activities is not expected to affect coastal birds because the offshore marine environment is not critical foraging habitat for these species.

In summary, coastal birds are expected to have short-term **insignificant** to **unlikely** exposure, primarily during migration, to construction activities in the SWDA. In the unlikely event that they would be temporarily exposed to construction IPFs, they are expected to have **insignificant** to **potential** behavioral vulnerability. Because of the limited exposure, and short-term duration of the IPFs, population level impacts are expected to be unlikely. Risks will be further minimized through mitigation measures, as discussed in Section 6.2.2.1.2 below.

Marine birds (loons and grebes, sea ducks, gannets, cormorants, jaegers and gulls, terns, shearwaters and petrels, and auks) as a group have **insignificant** to **potential** behavioral vulnerability to collision with construction equipment, and an **unlikely** to **likely** vulnerability to displacement by construction activities (see further discussion in Section 6.2.2.2 about marine bird vulnerability). Marine birds are known to be attracted to offshore vessels and structures, especially when lighted (Wiese et al. 2001; Montevecchi 2006). Shearwaters and petrels forage on vertically migrating bioluminescent prey and are instinctively attracted to light sources of any kind (Imber 1975). This may be particularly true during periods of poor visibility, when collision risk is likely to be highest. However, there is little data on avian behavior in the marine environment during such periods, as surveys are limited to periods of good weather during daylight hours. Gulls may be attracted to and perch on construction equipment.

In contrast, some marine birds (e.g. sea ducks and loons) may be disturbed by vessels, equipment, and activities, which may lead to temporary displacement from cable installation and wind farm construction areas (MMS 2007). Noise from pile driving may cause birds to avoid the construction area and can disturb the local prey base. When pile driving occurs close to tern colonies (within 2 km [1.24 mi]), pile driving noise may disperse the local abundance of prey fish (e.g. herring). The decreased abundance of prey can reduce seabird foraging success and may cause reduced reproductive success for multiple years (Perrow et al. 2011). However, the SWDA does not appear to be in a regionally important seabird foraging area (see Section 6.2.1), the footprint of any displacement (should it occur) is small for each piling event compared to available habitat, and the SWDA is far from the nearest tern colony. Any short-term reduction in the prey base would be expected to recover completely once construction was completed. In addition, birds may be displaced by boat and helicopter traffic (Fox et al. 2006; Petersen et al. 2006). Offshore export cable installation will generate minimal suspended sediments that will be temporary and localized. For foraging marine birds, the suspended sediments could temporarily inhibit detecting prey in the bottom few meters of the water column and could locally displace prey. However, water quality is expected to return to prior conditions within several hours (see Appendix III-A). Therefore, any effects are expected to be temporary, and, if displaced by cable installation activities, the birds will likely only need to fly a short distance to alternate foraging locations to find prey. While there may be short-term disturbance of resident birds during offshore wind farm construction, most birds that are initially disturbed return to the area after construction activities are completed (Adams et al. 2016). Overall, bird exposure to construction IPFs will be ephemeral and limited because the SWDA is located far offshore.

In summary, marine birds are expected to have short-term **insignificant** to **potential** exposure to construction activities in the SWDA and varying levels of behavioral vulnerability. Because of the limited exposure and short-term duration of the IPFs, population level impacts are expected to be unlikely. Overall, these findings are consistent with the Vineyard Wind 1 Draft Environmental Impact Statement (DEIS), which concluded that impacts from construction would be "negligible" (BOEM 2018). Risks will be further minimized through mitigation measures.

Federally-Listed Species

Because the construction period of New England Wind is temporary, federally-listed birds are unlikely to collide with construction equipment and will not be permanently displaced.

<u>Roseate Tern:</u> The roseate tern has **unlikely** behavioral vulnerability to collision with construction equipment and a **potential** to **likely** behavioral vulnerability to displacement (see further discussion in Section 6.2.2.2 about marine bird vulnerability). As described in the above section, marine birds can be attracted to offshore structures that are illuminated, especially during periods of poor visibility. However, there are limited data on roseate tern behavior during periods of poor visibility, including inclement weather and nocturnal time periods (MMS 2008; USFWS 2008). Data on roseate tern flight height indicates that non-migrating birds are generally flying below the WTGs' lowest blade position (27 m [89 ft]) (MMS 2008; Nisbet et al. 2014). A study of roseate

tern movements using nanotags indicated that offshore, birds were generally flying below a hypothetical rotor-swept zone (RSZ) of 25 to 250 m (82 to 820 ft) in the summer and fall (Loring et al. 2019). While not well studied, terns may also fly at higher altitudes (1,000 to 3,000 m [3,281 to 10,843 ft]) during some migration flights (Alerstam 1985 *in* P.H.P. Loring et al. 2019).

Evidence suggests that tern colonies located in areas with high boat traffic are not impacted (Burger et al. 2011). As discussed above, pile driving can reduce the prey base for terns if construction occurs close to colonies (Perrow et al. 2011). Roseate terns have a more specialized diet than common terns, including a higher dependence on small schooling fishes, and, like many tern species, are highly dependent on food availability for successful reproduction (Nisbet et al. 2014). Construction-related disturbance to prey populations, particularly American sand lance (*Ammodytes americanus*), could have potential indirect effects on roseate tern populations if construction were to occur in key foraging areas or close to a breeding colony. Sand lance are capable of hearing low-frequency sounds (Strobel and Mooney 2012), including sounds in the range produced by pile driving. However, since the SWDA is located far from the nearest roseate tern colony and the SWDA is not identified as an important foraging area for breeding roseate terns (e.g. none were observed during the NE Wind boat surveys in June and July), construction activities are expected to have little effect on the prey base.

Unless technical, logistical, grid interconnection, or other unforeseen issues arise, all New England Wind offshore export cables will be installed within a shared OECC that travels from the northwestern corner of the SWDA northward along the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable (see Figure 3.0-1). However, as described above, the Proponent is reserving the fallback option to install one or two Phase 2 cables along the Western Muskeget Variant (see Figure 3.0-2). Sections of the OECC (including the Western Muskeget Variant) contain sand waves, which may need to be removed by dredging prior to cable installation. The majority of the offshore export cables are expected to be installed using simultaneous lay and bury via jetting techniques (e.g. jet plow or jet trenching) or mechanical plow.

A sediment dispersion modeling study of dredging and cable installation activities for the entire OECC (including the Western Muskeget Variant) is provided in Appendix III-A, including the portion of the OECC that falls within the avian hot spot identified by Veit et al. (2016) in Muskeget Channel. Suspended sediments generated during dredging and disposal activities and subsequent cable installation activities within Muskeget Channel will be temporary and localized. During these activities, a very limited portion (<1%) of the avian hot spot identified by Veit et al. (2016) is impacted at any one time. Excess suspended sediments at any given point are only present for a short duration (typically less than 6 hours, and only 1-3 hours for cable installation), and will only occupy the bottom few meters of the water column during and after cable installation. As described in Sections 6.5 and 6.6, these concentrations and durations of exposure from suspended sediments are below those causing sub-lethal or lethal effects to fish and benthic organisms, including sand lance. Accordingly, suspension of sediments from dredging and cable installation operations are expected to have little to no effect on mobile organisms and many burrowing invertebrates (see Section 6.6).

Roseate terns, particularly those nesting in southern New England and the Gulf of Maine are highly reliant on sand lance as their primary food source. For example, chick diets at a nesting colony in Long Island Sound, New York (Great Gull Island) consisted of 97% sand lance species, while those on Bird Island in Buzzard's Bay, Massachusetts averaged 69% (Goyert et al. 2015; Staudinger et al. 2020). As roseate terns generally feed by shallow plunge-diving or surface-dipping, temporary increased turbidity in the bottom few meters of the water column caused by offshore export cable installation is unlikely to adversely affect foraging behavior or efficiency. Furthermore, of the two sand lance species most prevalent in the region (American sand lance and Northern sand lance [*Ammodyte dubius*]), the American sand lance is more likely to occupy nearshore, shallow habitats (<20 m [66 ft] but often <2 m [6.6 ft]) (Staudinger et al. 2020) outside the deeper parts of the channel where the cables will be installed. This predicted shallower distribution of the American sand lance matches the observed distribution of breeding and staging terns in the area, which appear to spend most of their time foraging close to the shores of Tuckernuck and Muskeget Island and surrounding shoals, and not in the deeper waters of the Muskeget Channel itself (Veit and Perkins 2014).

In summary, roseate terns are expected to have **unlikely** exposure to construction activities occurring in the SWDA, and exposure to offshore export cable installation activities will be temporary and localized. In the unlikely event that they would be exposed to construction IPFs, they are expected to have **unlikely** behavioral vulnerability to collision, **potential** to **likely** vulnerability to displacement, and **insignificant** vulnerability to offshore export cable installation. Any avoidance behavior would reduce collision vulnerability and is unlikely to impact foraging opportunities because there are abundant foraging areas available closer to breeding colonies. Because of the limited exposure and short-term duration of the IPFs, the loss or disturbance of individual roseate terns is unlikely. This finding is consistent with BOEM's Biological Assessment for Vineyard Wind 1, which concluded that roseate tern mortality from collision would be zero and that the likelihood of collision fatalities would be "insignificant and discountable" (BOEM 2019). The Biological Assessment also found that impacts from pile driving and noise related to construction would be "insignificant and discountable" (BOEM 2019). Risks will be further minimized through mitigation measures.

<u>Red Knot (SWDA):</u> Red knots have **unlikely** behavioral vulnerability to collision with construction equipment and **insignificant** behavioral vulnerability to displacement. Red knots are thought to migrate at flight heights well above the RSZ (i.e. greater than 300 m [984.2 ft]) under most circumstances, thus greatly reducing exposure to collisions with WTGs, construction equipment, or other structures. Offshore radar studies have recorded shorebirds flying at 1,000 to 2,000 m (3,000 to 6,500 ft) (Richardson 1976; Williams and Williams 1990 *in P*.H.P. Loring et al. 2019), while nearshore radar studies have recorded lower flight heights of 100 m (330 ft) (Dirksen et al.

2000 *in* P.H.P. Loring et al. 2019). Flight heights can vary with weather; for example, during times of poor visibility, the birds may fly lower (Dirksen et al. 2000 *in* P.H.P. Loring et al. 2019). During long-distance flights, red knots are generally considered to migrate at flight heights well above the RSZ (Burger et al. 2012), reducing exposure to collisions with WTGs, construction equipment, or other structures, but a movement study using nanotags did indicate that they can also fly within a hypothetical RSZ of 20–200 m (65–656 ft) (Loring et al. 2018). Of note, the flight heights of birds captured during the same study from Delaware Bay in 2016 were estimated to be higher; in the spring and fall, mean flight heights were 502 m (1,647 ft) and 475 m (1,558 ft), respectively, when red knots flew over proposed Atlantic OCS WEAs (Loring et al. 2018). Flight heights during long-distance migrations are thought to normally be 1,000–3,000 m (3,000–10,000 ft), except during takeoff and landing at terrestrial locations (Burger et al. 2011), but red knots likely adjust their altitude to take advantage of local weather conditions, including flying at lower altitudes in headwinds (Baker et al. 2013) or during periods of poor weather and high winds (Burger et al. 2011). Red knots also have good visual acuity and maneuverability in the air (Burger et al. 2011), and there is no evidence to suggest that they are particularly vulnerable to collisions or displacement.

In summary, red knots are expected to have **insignificant** to **unlikely** exposure to construction activities occurring in the SWDA. In the unlikely event that they would be exposed to construction IPFs, they are expected to have **unlikely** behavioral vulnerability to collision and **insignificant** vulnerability to displacement. Because of the limited exposure, short-term duration of the IPFs, and the lack of behavioral vulnerability, anticipated loss of or disturbance to red knot individuals is unlikely. These findings are supported by the results of a collision risk model carried out by BOEM for red knots potentially passing through the adjacent Vineyard Wind 1 WDA, which estimated the annual number of fatalities as zero and found that any extra energy expenditure resulting from the avoidance of an offshore wind farm would be insignificant (BOEM 2019). Risks will be further minimized through mitigation measures.

<u>Piping Plovers (SWDA):</u> Piping plovers have **insignificant** to **unlikely** behavioral vulnerability to collision with construction equipment and **insignificant** behavioral vulnerability to displacement. Piping plovers are thought to migrate at flight heights well above the RSZ (i.e. greater than 300 m [984.2 ft]) under most circumstances, thus greatly reducing exposure to collisions with WTGs, construction equipment, or other structures. Loring (2019) found that migratory flight heights of piping plovers tagged with nanotags were generally above the hypothetical RSZ (250 m [820 ft]), with 15.2% of birds flying between 25 to 250 m (82 to 820 ft) in WEAs. Offshore radar studies have recorded shorebirds flying at 1,000 to 2,000 m (3,000 to 6,500 ft) (Richardson 1976; Williams and Williams 1990 *in P*.H.P. Loring et al. 2019), while nearshore radar studies have recorded lower flight heights of 100 m (330 ft) (Dirksen et al. 2000 *in* P.H.P. Loring et al. 2019). Flight heights can vary with weather; for example, during times of poor visibility, the birds may fly lower (Dirksen et al. 2000 *in* P.H.P. Loring et al. 2019). Since piping plovers are generally expected to migrate at flight heights above the RSZ, potential exposure to collisions with WTGs, construction equipment,

or other structures is reduced. Piping plovers also have good visual acuity and maneuverability in the air (Burger et al. 2011), and there is no evidence to suggest that they are particularly vulnerable to collisions or displacement.

In summary, piping plovers are expected to have **insignificant** to **unlikely** exposure to construction activities occurring in the SWDA. In the unlikely event that they would be exposed to construction IPFs, they are expected to have **insignificant** to **unlikely** behavioral vulnerability to collision and **insignificant** vulnerability to displacement. Because of the limited exposure, short-term duration of the IPFs, and the lack of behavioral vulnerability based on flight height during migration, anticipated loss of or disturbance to piping plover individuals is unlikely. These findings are supported by the results of a collision risk model carried out by BOEM for piping plovers potentially passing through the adjacent Vineyard Wind 1 WDA, which estimated the annual number of fatalities as zero and found that any extra energy expenditure resulting from the avoidance of an offshore wind farm would be insignificant (BOEM 2019). Risks will be further minimized through mitigation measures.

Piping Plovers (Landfall Sites): NHESP has established Priority Habitat along the Centerville Harbor shoreline that includes the beach and some of the dunes adjacent to the paved parking lots at the potential Phase 1 and Phase 2 landfall sites (see Figure 6.1-2). NHESP has confirmed that the mapped Priority Habitat is for piping plover at the Phase 1 landfall sites (Craigville Public Beach and Covell's Beach). Mapped Priority Habitat near the Phase 2 landfall sites (Dowses Beach and Wianno Avenue) is for piping plover and least tern.

With the exception of Wianno Avenue, disturbance of the beach at the landfall sites will be largely avoided as the cables will pass under the beach, intertidal zone, and nearshore areas via horizontal directional drilling (HDD). The cables will come ashore in an existing paved parking area or other previously disturbed area and thus, will avoid disturbing beach or dune habitat that might be used by piping plovers, other migratory shorebirds, or seabirds. The Wianno Avenue Landfall Site is more suited for open trenching than HDD due to the parking lot's elevated topography and the steep slope of the shoreline, which would require challenging bends in the HDD bore holes. The shoreline at the Wianno Avenue Landfall Site has already been altered by the installation of a riprap seawall, a portion of which would be temporarily removed and replaced following cable installation. The Proponent only expects to use the Wianno Avenue Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all or some of the Phase 2 offshore export cables.

Nonetheless, due to the proximity of the coastal dune to the paved parking lots at the Phase 1 landfall sites where HDD staging activities would occur, the Proponent is developing a draft Piping Plover Protection Plan for construction activities at either Phase 1 landfall site that will mirror a similar plan assembled for Vineyard Wind 1 that was approved by NHESP (see Appendix III-R). The Proponent expects to develop a similar plan for the Phase 2 landfall sites. Based on consultations with NHESP for Vineyard Wind 1 activities at the Covell's Beach landfall site, the Proponent expects that activities at the landfall sites will begin in advance of April 1, or will not begin until after August 31, to avoid and minimize noise impacts to piping plover during the breeding season.

6.2.2.1.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The location of the SWDA far offshore avoids exposure of birds to construction activities in the SWDA. To further minimize potential bird mortality from collision, the Proponent will reduce lighting as much as is practicable during construction. The Proponent will follow BOEM and Federal Aviation Administration (FAA) recommendations to use red aviation obstruction lights on WTGs (unless current guidance is modified by the time Phase 2 proceeds). In addition, whenever practicable, the Proponent will down-shield lighting or use down-lighting to limit bird attraction and disorientation (Poot et al. 2008). Anti-perching is incorporated in the design of the WTGs using tubular WTG support towers (see Sections 3.2.1 and 4.2.1 of COP Volume I). In accordance with safety and engineering requirements, the Proponent will consider anti-perching devices on WTGs and electrical service platforms (ESPs) for New England Wind, where and if appropriate, to reduce potential bird perching locations. Per federal requirements, and using a standardized protocol for New England Wind, the Proponent will document any dead or injured birds found on vessels and structures during construction.

6.2.2.2 Operations and Maintenance

During O&M, IPFs can range from the collision and displacement risks associated with WTGs to maintenance activities. IPFs for the offshore cable system during O&M are only expected to include the potential for a limited increase in vessel traffic during maintenance activities; this IPF is considered within the discussion of increased vessel traffic for the SWDA. WTGs require regular maintenance and occasional repair, which may necessitate the use of support vessels and possibly helicopters.

Potential impacts are assessed below for the maximum size of the SWDA assuming the total buildout of Phases 1 and 2, which includes a maximum of 130 WTG and ESP positions. The assessment considers the proposed layout, where all WTGs and ESP(s) in the SWDA (for both Phases) will be oriented in an east-west, north-south grid pattern with one nautical mile (1.85 km) spacing between positions. Impacts are assessed for the maximum WTG tip height of 357 m (1,171 ft), with a maximum top of nacelle height of 221 m (725 ft). The minimum tip clearance is 27 m (89 ft). Potential impacts from collisions and displacement are not likely to be significantly different between each Phase because tip clearance will be no lower than 27 m (89 ft) for both Phases and the WTGs will be spaced at the same distance for both Phases.[44] As described in COP Volume I, the Phase 1 and Phase 2 WTG and ESP foundation types include monopile, jacket, or

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[44] Prior to the April 2022 COP revision that updated the Phase 1 WTG dimensions to match the Phase 2 WTG dimensions, the vulnerability rankings were performed separately for the Phase 1 WTGs and the Phase 2 WTGs. For all species, the range in maximum WTG dimensions included in the Phase 1 and Phase 2 Envelopes did not change the vulnerability rankings because the minimum tip clearance (distance between the water and lowest blade position) was the same for both Phases (27 m [89 ft]). Since marine bird collision vulnerability is strongly related to the tip clearance (seabirds generally are flying close to the water surface and generally fly in the lower portion of the RSZ) and is not as dependent on tip height, there is no difference in the collision vulnerability ranking between the Phase 1 and Phase 2 WTGs

bottom-frame foundations (for Phase 2 WTGs only). Except for species known to use offshore WTGs for perching (e.g. gulls and cormorants), the hazards of the different foundation types are not likely to be different for most species of birds. Unless otherwise noted, the hazards associated with the possible foundation types are considered the same in the impact assessment below.

During O&M, the primary hazards to birds that may lead to mortality or displacement are the following:

- Hazards potentially causing mortality or injury (direct impacts)
    - WTGs
    - ESPs
    - FAA and US Coast Guard-required lighting (see Sections 3.2.1 and 4.2.1 of COP Volume I)
    - Hazards potentially causing displacement and habitat modification/loss (indirect impacts)
    - Total area of the SWDA
    - Maintenance vessels and helicopters

6.2.2.2.1 Potential Direct Impacts of Operations and Maintenance (Phases 1 and 2)

Potential direct IPFs are structure strikes hazard, noise, vessel lights, structure lights, and vessel traffic. The primary potential direct impact of each Phase of New England Wind to birds is mortality or injury due to collision with offshore WTGs. The mortality from collisions is dependent on many different factors, including site, species, season, weather, and lighting. Collision risk with offshore WTGs for a bird species can vary depending on age, behavior, and timing within a breeding cycle (e.g. while feeding chicks) (Drewitt and Langston 2006). Birds can collide with the uperstructure (nacelle and tower) or the rotating WTG blades and can be forced to the ground by the vortex created by the moving rotors (Drewitt and Langston 2006; Fox et al. 2006; AWWI 2016). With the exception of a wind development built on a breakwater located close to a tern colony in Zeebrugge, Belgium (Everaert and Stienen 2007) and the collision of a few individual gulls at the Thanet Offshore Wind Farm in Kent, United Kingdom (Skov et al. 2018), few direct mortalities have been observed at operating offshore wind farms (Pettersson 2005; Petersen et al. 2006) or at levels that materially increase the background mortality levels. There has been very little research on the effects on birds during the construction and maintenance of offshore wind farms, though marine bird species vary in their reactions to operational WTGs and the associated vessel and helicopter traffic that may be required during maintenance and repair activities. This increased vessel traffic has the potential to affect distributions of birds foraging in the area (Fox et al. 2006; Furness et al. 2013).

Coastal Birds

The primary groups of coastal birds that will be exposed to the SWDA are shorebirds, waterfowl, wading birds, falcons, and songbirds. The SWDA (excluding the two separate aliquots that are closer to shore) is just over 32 km (20 mi) from the southwest corner of Martha's Vineyard and approximately 38 km (24 mi) from Nantucket.[45] Therefore, exposure of coastal birds is limited and will most likely occur during spring and fall migration (see Section 6.2.1). The findings in the assessment below are consistent with those determined by comprehensive risk assessments conducted for Vineyard Wind 1, which is adjacent to New England Wind (BOEM 2018; BOEM 2019).

Shorebirds, Coastal Waterfowl, Waterbirds, and Wading Birds: Shorebirds, coastal waterfowl, and wading birds are expected to have **insignificant** to **unlikely** behavioral vulnerability to collision. There is little empirical evidence that shorebirds, coastal waterfowl (i.e. ducks, geese, and swans; excluding sea ducks), or wading birds are vulnerable to collision with offshore WTGs. During migration, shorebirds will likely fly significantly above the RSZ (i.e. greater than 300 m [984.2 ft]). They are considered to fly high during migration off Cape Cod (Nisbet 1963) and have been documented to fly at a mean altitude of 2,000 m (6,562 ft) (5% of birds flew above 4,400 m [14,436 ft] and a maximum height recorded was 6,650 m [21,818 ft] in a radar study conducted over New Brunswick and Nova Scotia) (Richardson 1979).

No shorebirds are described as being observed with the Visual Automatic Recording System at the Alpha Ventus Offshore Wind Farm in Germany (Hill et al. 2014). Studies indicate that waterfowl avoid offshore wind farms and therefore have **unlikely** vulnerability to collision. Radar studies indicate that geese avoid offshore wind farms both in the vertical and horizontal planes (Plonczkier and Simms 2012) and Global Positioning System tracking of swans suggest the birds gain altitude to avoid wind farms (Griffin et al. 2011).

Avoidance behavior has also been documented for tufted duck (*Aythya fuligula*), common pochard (*Aythya ferina* [a species similar to redhead or canvasback]), and greater scaup (*Aythya marila)* (Dirksen and van der Winden 1998 *in* Langston 2013). There is little information on wading bird interactions with terrestrial and offshore WTGs, but some studies suggest wading birds have lower densities around terrestrial WTGs (Leddy et al. 1999) and thus would have lower vulnerability to collision. No wading birds are described as being observed with Visual Automatic Recording System at the Alpha Ventus Offshore Wind Farm in Germany (Hill et al. 2014).

In summary, shorebirds, waterfowl, waterbirds, and wading birds are expected to have **insignificant** to **unlikely** exposure, primarily during migration, to operational activities in the SWDA. If this low likelihood event occurred, where they would be exposed to operational IPFs,

[45] Within the SWDA, the closest WTG is approximately 34 km (21 mi) from Martha's Vineyard and 40 km (25 mi) from Nantucket. At this time, the Proponent does not intend to develop the two positions in the separate aliquots located along the northeastern boundary of Lease Area OCS-A 0501 as part of New England Wind.

they are expected to have **insignificant** to **unlikely** have behavioral vulnerability to collision. Because of the limited exposure and lack of vulnerability, population level impacts to this species group are expected to be unlikely. Risks will be further minimized through mitigation measures.

Raptors: The raptors exposed to the SWDA are probably limited to fall migrating peregrine falcons, merlins, and ospreys (see Section 6.2.1) that are expected to have **unlikely** to **potential** behavioral vulnerability to collisions. There is little information on how osprey respond to WTGs, but falcons may be attracted to WTGs as perching sites and peregrine falcons and kestrels have been observed landing on the platform deck of offshore WTGs (Hill et al. 2014; Skov et al. 2016). A radar and laser rangefinder study found evidence indicating that multiple migrating raptor species were attracted to offshore WTGs in Denmark (Skov et al. 2016), and satellite-tagged ospreys and peregrine falcons have been confirmed to perch on offshore barges and structures.

Little information exists documenting peregrine falcon mortalities, especially in offshore settings. However, peregrine falcon moralities have not been documented at European offshore wind developments, such as during the monitoring effort at the Thanet Offshore Wind Farm (Skov et al. 2018). Jensen et al. (2014) considered peregrine falcons to have low collision risk vulnerability at the proposed Horns Rev 3 wind development based on visual observations and radar data collated from two nearby existing wind farms. While peregrine falcon collisions with transmission lines have been documented (Olsen and Olsen 1980; White et al. 2002), only a few accounts of mortalities are associated with terrestrial-based WTGs in Europe (Meek et al. 1993; Hötker et al. 2006; Dürr 2011) and one in New Jersey (Mizrahi et al. 2009). Breeding adults and several young peregrine falcons were killed after colliding with a three-WTG terrestrial wind energy facility located close to their urban nest site in Massachusetts (T. French, MassWildlife, pers. comm., March 7, 2018). Carcasses were not detected in post-construction mortality studies at several terrestrial projects in the US (West Virginia and California) and New Zealand with falcon activity (Bull et al. 2013; Hein et al. 2013; DiGaudio and Geupel 2014).

In terrestrial habitats providing foraging and nesting opportunities not present offshore, American kestrel (*Falco sparverius*) carcasses have been found in post-construction monitoring of much smaller terrestrial WTGs (1.8 MW) in Washington State (Erickson et al. 2008), but American kestrel mortality has been demonstrated to decrease as WTG size increases (Smallwood 2013). Evidence of nocturnal soaring, perching, and feeding under lighted structures in terrestrial and offshore settings has been noted in peregrine falcons (Voous 1961; Cochran 1985; Johnson et al. 2011; Kettel et al. 2016), and these behaviors increase the exposure risk in this species. However, observations of raptors at the Anholt Offshore Wind Farm in the Baltic Sea (20 km [12.4 mi] from the coast) indicate macro (i.e. avoiding entire wind farm) avoidance behavior (13–59% of birds observed depending on the species), which has the potential to cause a barrier for migrants in some locations, but may also reduce collision risk. Birds may also exhibit meso-avoidance, which involves significant changes in flight height prior to entering a wind farm. The percentage of merlins and kestrels showing macro-/meso-avoidance behavior was 14/36 % and 46/50%, respectively (Jacobsen et al. 2019).

In summary, falcons and osprey are expected to have **insignificant** to **unlikely** exposure, primarily during migration, to operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **unlikely** to **potential** behavioral vulnerability to collision. Because exposure is probably limited to individual migrants, population level impacts to falcons and osprey are expected to be unlikely. Risks will be further minimized through mitigation measures.

<u>Songbirds:</u> Songbirds are expected to have **unlikely** to **potential** behavioral vulnerability to collision. Mortalities of songbirds are documented at terrestrial WTGs (Erickson et al. 2014). In some instances, songbirds may be able to avoid colliding with offshore WTGs (Petersen et al. 2006), but are known to collide with illuminated terrestrial and marine structures (Fox et al. 2006). Movement during low visibility periods creates the highest collision risk conditions; at an offshore research station with substantial lighting, songbird mortalities have been documented during poor weather conditions (Hüppop et al. 2006). While avian fatality associated with terrestrial WTGs ranges from three to five birds per MW per year (AWWI 2016), direct comparisons between morality rates recorded at terrestrial and offshore wind developments should be made with caution because collisions with offshore WTGs could be lower either due to differing behaviors or lower exposure (NYSERDA 2015). At the Thanet Offshore Wind Farm, thermal imaging did not detect any songbird collisions (Skov et al. 2018). At Nysted, Denmark, in 2,400 hours of monitoring with an infrared video camera, only one collision of an unidentified small bird was detected (Petersen et al. 2006).

Passerines (songbirds) typically migrate at between 90 to 600 m (295 to 1,968.5 ft) (NYSERDA 2010), but can fly lower during inclement weather or with headwinds. In a study in Sweden, nocturnal migrating songbirds flew on average at 330 m (1,083 ft) above the ocean during the fall and 529 m (1,736 ft) during the spring (Pettersson 2005). Given the limited understanding of songbird migration, exposure of migratory songbirds to the SWDA is uncertain, but some birds will likely cross the SWDA during fall migration. Under poor weather conditions, individual vulnerability to collision may increase as birds fly at lower altitudes and may be more likely to fly through RSZs. Mortality is likely to be stochastic and infrequent. However, the mortality from all terrestrial WTGs in the US and Canada combined is predicted to have a small effect on passerine populations (Erickson et al. 2014).

In summary, songbirds are expected to have **insignificant** to **unlikely** exposure, primarily during migration, to operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **unlikely** to **potential** behavioral vulnerability to collision during migration. Because exposure is probably limited to individual migrants, and terrestrial wind farms are considered to have a small effect on most songbird populations, population level impacts to songbirds are expected to be unlikely. Risks will be further minimized through mitigation measures.

Marine Birds

The primary groups of marine birds that will be exposed to SWDA are loons, grebes, and sea ducks; gannets, cormorants, jaegers, and gulls; and terns, shearwaters, petrels, auks. The findings in the assessment below are consistent with those determined by comprehensive risk assessments conducted for Vineyard Wind 1 (BOEM 2018; BOEM 2019).

<u>Loons, Grebes, and Sea Ducks:</u> Loons, grebes, and sea ducks (excluding the red-breasted merganser [*Mergus serrator*], which was not detected in the SWDA) are expected to have **insignificant** to **unlikely** behavioral vulnerability to collision because these birds have consistently been documented to strongly avoid offshore wind projects and are widely considered to have low vulnerability to collision (Furness et al. 2013). Pre- and post-construction monitoring at offshore developments demonstrates that red-throated loons consistently avoid wind farms and do not habituate to the development (Percival 2010; Lindeboom et al. 2011). Consequently, due to consistent avoidance behavior, red-throated loons are not likely to collide with offshore WTGs. There is little empirical evidence on how common loons will respond to offshore wind developments, but they will likely respond similarly to red-throated loons and are not considered vulnerable to collision. The collision vulnerability score for loons was **unlikely**, but a lower range was added to the score (**insignificant**) because of the birds' strong avoidance response. Grebes rank low for collision risk because they only fly 3% of the time and are flying between 20 to 150 m (66 to 492 ft) 4% of the time (Furness et al. 2013).

Sea ducks are generally not considered vulnerable to collision (Furness et al. 2013) because the birds fly primarily below the RSZ (0–2% within the RSZ depending on species [excluding red-breasted merganser] and WTG option) and have strong avoidance behavior. Avoidance behavior has been documented for black scoter, common eider (Desholm and Kahlert 2005; Larsen and Guillemette 2007), and greater scaup (Dirksen and van der Winden 1998 *in* Langston 2013).

In summary, the loon, grebe, and sea duck groups are expected to have **insignificant** to **unlikely** exposure to operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **insignificant** to **unlikely** behavioral vulnerability to collision. Because of their limited exposure and because this species group has been documented to avoid offshore wind farms, population level impacts to this species group is expected to be unlikely. Risks will be further minimized through mitigation measures (see Section 6.2.2.2.3).

<u>Northern Gannet:</u> The northern gannet is expected to have **unlikely** behavioral vulnerability to collision. While northern gannets are considered by some to be vulnerable to collision risk (Furness et al. 2013; Garthe et al. 2014; Cleasby et al. 2015), many studies indicate that they avoid wind developments (Hartman et al. 2012; Vanermen, Onkelinx, Courtens, et al. 2015; Garthe et al. 2017). Satellite tracking studies indicate near complete avoidance of active wind developments by northern gannets (Garthe et al. 2017). For example, avoidance rates have been estimated to be 64 to 84% (macro) and 99.1% (total) (Krijgsveld et al. 2011; Cook et al. 2012; Vanermen, Onkelinx, Verschelde, et al. 2015; Skov et al. 2018). When northern gannets enter a

wind development, they fly between 20 to 150 m (66 to 492 ft) only 9.6% of the time (Cook et al. 2012), and models indicate a low proportion of birds fly at risk height (Johnston et al. 2014). For the WTGs under consideration for Phases 1 and 2, gannets were estimated to fly in the RSZ 4% of the time (see Section 3.2.4 of Appendix III-C). Combined, the studies from Europe suggest that northern gannets exhibit unlikely vulnerability to collision.

In summary, northern gannets are expected to have **unlikely** exposure to operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **unlikely** behavioral vulnerability to collision. Because northern gannets have been documented to avoid offshore wind farms and populations have been generally increasing, population level impacts to this species group are expected to be unlikely. Risks will be further minimized through mitigation measures (see Section 6.2.2.2.3).

<u>Double-Crested Cormorant:</u> The double-crested cormorant is expected to have **potential** behavioral vulnerability to collision. Cormorants have been documented to be attracted to WTGs because of an increase in food resources and newly available loafing habitat (i.e. perching areas) (Krijgsveld et al. 2011; Lindeboom et al. 2011), but are not considered to have high vulnerability to collisions because they infrequently fly between 20 to 150 m (65.6 to 92.1 ft) above sea level (Furness et al. 2013). For the WTGs under consideration for Phases 1 and 2, double-crested cormorants were estimated to fly in the RSZ 29% of the time (see Section 3.2.4 of Appendix III-C). WTGs with jacket foundations may provide additional perching sites for cormorants, which have the potential to increase attraction and possibly intensify vulnerability to collision.

In summary, double-crested cormorants are expected to have **insignificant** exposure to the operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **potential** behavioral vulnerability to collision. Because double-crested cormorants will have **insignificant** exposure to the SWDA and **potential** behavioral vulnerability, population level impacts to this species group are unlikely because of the minimal exposure and cormorants received the lowest population vulnerability score (see Section 3.2.4 of Appendix III-C). Risks will be further minimized through mitigation measures (see Section 6.2.2.2.3).

<u>Jaegers and Gulls:</u> Jaegers and gulls are expected to have **unlikely** to **potential** behavioral vulnerability to collisions. Little is known about how jaegers respond to offshore WTGs, but the birds generally fly low (0–10 m [0–32.8 ft] above the sea surface), although they could fly higher during kleptoparasitic chases (Wiley and Lee 1999). For the WTGs under consideration for Phases 1 and 2, jaegers were estimated to fly in the RSZ 5% of the time (see Section 3.2.5 of Appendix III- C).

Gulls ranks at the top of collision vulnerability assessments because they can fly within the RSZ (Johnston et al. 2014), have a documented attraction to WTGs (Vanermen, Onkelinx, Courtens, et al. 2015), and individual birds have been documented to collide with WTGs (Skov et al. 2018). Herring gulls recorded during boat-based surveys around existing and proposed European wind farms have been detected within the RSZ (20–150 m [66–492 m]) during 28.4% of observations and recorded great black-backed gulls were detected within the RSZ during 33.1% of observations (Cook et al. 2012). For the WTGs being considered for Phases 1 and 2, gulls were estimated to fly in the RSZ 1–24% of the time (see Section 3.2.5 of Appendix III-C). At European offshore wind developments, gulls have been documented to be attracted to WTGs, which may be due to attraction to increased boat traffic, new food resources, or new loafing habitat (i.e. perching areas) (Fox et al. 2006; Vanermen, Onkelinx, Courtens, et al. 2015), but interaction with offshore wind developments varies by season (Thaxter et al. 2015). Recent research suggests that some gull species may not exhibit macro-avoidance of a wind farm, but will preferentially fly between WTGs, suggesting meso-avoidance that would reduce overall collision risk (Thaxter et al. 2018). Furthermore, gulls may be disproportionately attracted to certain WTGs at the edge of a wind farm array, potentially limiting collision risk to a small subset of WTGs (Vanermen et al. 2019).

While the collision risk is thought to be greater for gulls, total avoidance rates are estimated to range from 98% (Cook et al. 2012) to 99% (Skov et al. 2018). At Horns Rev, Denmark, gull numbers increased at the wind development, possibly due to their attraction to boat traffic, new food resources, or new loafing habitat (i.e. perching areas) (Fox et al. 2006). In Belgium, numbers of lesser black-backed gulls increased by a factor of 5.3 and herring gulls by 9.5 within the Bligh Bank wind farm area (Vanermen, Onkelinx, Courtens, et al. 2015).

However, there can be inter- and intra-annual variation in the degree that birds interact with offshore wind developments. Lesser black-backed gulls are found to be present at differing levels per year, and their use of the offshore environment was highest during chick-rearing and lowest before breeding and during incubation. In addition, males and females use the area differently, with males present more in the late breeding season (Thaxter et al. 2015). WTGs with jacket foundations may provide additional perching sites for gulls, which has the potential to increase attraction and possibly intensify vulnerability to collision.

Based upon jaegers and gulls consistently ranking high in collision vulnerability assessments, gulls' attraction to WTGs, and the amount of time they fly within RSZs, individual vulnerability to collision is expected to be **unlikely** to **potential**. Jaegers have minimal exposure to the SWDA, and resident gull populations are robust and generally show high reproductive success (Good 1998; Pollet et al. 2012; Burger 2015; Nisbet et al. 2017).

In summary, jaegers are expected to have **insignificant** exposure to the operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **potential** behavioral vulnerability to collision. Because jaegers have stable populations, population level impacts to this species are expected to be unlikely. Gulls are expected to have **insignificant** to **potential** exposure to operational activities in the SWDA and **unlikely** to **potential** behavioral vulnerability to collision. Because gull populations are generally stable, population level impacts to this species group are expected to be unlikely. Risks will be further minimized through mitigation measures.

Terns: As a group, terns are expected to have **unlikely** behavioral vulnerability to collisions. Terns rank in the middle of collision vulnerability assessments (Garthe and Hüppop 2004; Furness et al. 2013) because they fly 2.8–12.7% of the time in the marine environment between 20–150 m (65.6–92.1 ft), have a 30–69.5% macro-avoidance rate (Cook et al. 2012), and have been demonstrated to avoid rotating WTGs (Vlietstra 2007). For the WTGs under consideration for Phases 1 and 2, common terns were estimated to fly in the RSZ 0.67% of the time (see Section 3.2.6 of Appendix III-C). A recent movement study using nanotags estimated that common terns primarily flew below the RSZ (<25 m [<82 ft]) and that the frequency of common terns flying offshore between 25–250 m (82–820 ft) ranged from 0.9–9.8 % (Loring et al. 2019). While the nanotag flight height estimated birds flying below 164 ft (50 m), radar and observational studies provide evidence that terns in some instances can initiate migration at higher altitudes of 3,000–10,000 ft (1,000–3,000 m) (Loring et al. 2019). For common terns and arctic terns, the probability of mortality is predicted to decline as the distance from the colony increases. Based upon one year of nanotag data collected at Petit Manan Island, Maine, tests of a decision support model for offshore wind farm siting suggest that the probability of occupancy and mortality rates at a turbine project drops to near zero beyond 15 km (9.3 mi) from a tern colony (Cranmer et al. 2017). This finding is corroborated by mortality monitoring of small to medium WTGs (200 and 600 kilowatts [kW]) in Europe, where mortality rates rapidly declined with distance from the colony (Everaert and Stienen 2007). Most observed tern mortalities in Europe have occurred at WTGs within 30 m (98 ft) from nests (Burger et al. 2011).

In summary, terns are expected to have **insignificant** to **unlikely** exposure to the operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **unlikely** behavioral vulnerability to collision. Because exposure will be limited and the birds generally do not fly through the RSZ, population level impacts to terns are expected to be unlikely. Risks will be further minimized through mitigation measures.

Shearwaters, Storm-Petrels, Petrels, and Auks: Shearwaters, storm-petrels, and petrels are expected to have **unlikely** behavioral vulnerability to collision. Shearwaters, storm-petrels, and auks all rank extremely low for collision risk (Furness et al. 2013), and the flight height data indicates extremely limited exposure, if any, to the RSZ (0–0.02% within the RSZ) (see Section 3.2.3 of Appendix III-C). Some species within this group forage at night on vertically migrating bioluminescent aquatic prey and are instinctively attracted to artificial light sources (Imber 1975; Montevecchi 2006). This may be particularly true during periods of poor visibility when collision risk is likely to be highest. However, there is little data on avian behavior in the marine environment during such periods as surveys are limited to good weather during daylight hours. Studies that exist indicate that light-induced mass mortality events are primarily a land-based, juvenile issue involving fledging birds leaving their colonies at night (Le Corre et al. 2002; Rodríguez et al. 2014; Rodríguez et al. 2015; Rodríguez et al. 2017). Responses to intermittent light-emitting diode (LED) lights, likely to be used at offshore wind farms, are largely unknown at this point, but are unlikely to have population-level effects.

Auks are expected to have **insignificant** to **unlikely** behavioral vulnerability to collision. Auks have a 45 to 68% macro-avoidance rate and a 99.2% total avoidance rate (Cook et al. 2012). At considerably smaller WTGs than those being considered for New England Wind, Atlantic puffins (*Fratercula arctica*), razorbills, and common murres were estimated to fly between 20–150 m (66–492 ft) 0.1%, 0.4%, and 0.01% of the time, respectively (Cook et al. 2012). For the WTGs being considered for Phases 1 and 2, auks were estimated to fly in the RSZ 0 to 0.09% of the time (see Section 3.2.7 of Appendix III- C).

In summary, shearwaters, petrels, storm-petrels, and auks are expected to have **insignificant** to **potential** exposure to the operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **insignificant** to **unlikely** behavioral vulnerability to collision. Because these species have **insignificant** to **potential** exposure and **insignificant** to **unlikely** behavioral vulnerability, population level impacts to these species are expected to be unlikely. Risks will be further minimized through mitigation measures (see Section 6.2.2.2.3).

Federally-Listed Species

During O&M, federally-listed birds are unlikely to collide with WTGs, ESP(s), or maintenance vessels and helicopters. Roseate terns, piping plovers, and red knots may have a low potential to fly through the SWDA during migration but are unlikely to fly within RSZs under most circumstances. None of these species are expected to occur in the SWDA during breeding or wintering seasons.

<u>Roseate Tern:</u> As discussed in Section 6.2.1, roseate terns are unlikely to occur in the SWDA except possibly during migration and post-breeding dispersal to staging sites. The NE Wind boat surveys only detected two roseate terns during one survey in May. The MassCEC aerial survey data only has one record of two terns (not identified to species) in the SWDA for all seasons and years combined, and the majority of the SWDA is outside tern high use areas (Veit et al. 2016) (see Section 6.2.1.4.6). Roseate terns may fly through the SWDA during migration (primarily during the spring) but are unlikely to fly within the RSZ; moreover, terns have been observed to regularly exhibit micro-avoidance behaviors to avoid actively spinning WTG blades. If roseate terns are exposed to the SWDA, they are expected to have **unlikely** behavioral vulnerability to collisions because terns do not rank high in collision vulnerability assessments (Furness et al. 2013), common terns were estimated to fly in the RSZ only 0.67% of the time for the WTGs being considered by New England Wind (see Section 3.2.6 of Appendix III-C), and terns avoid rotating WTGs (Vlietstra 2007).

Data on roseate tern flight height indicates that non-migrating birds are generally flying below the WTG's lowest blade position (27 m [89 ft]). Flight height during foraging typically varies from 1 to 12 m (3.3 to 39.4 ft) above the water's surface and is most commonly less than 6 m (19.7 ft) (Nisbet et al. 2014). Roseate terns do conduct courtship flights (high flights) that can range from 30 to 300 m (98.4 to 984 ft) in altitude and may continue throughout much of the breeding season (Nisbet et al. 2014); such displays are most common near the breeding grounds, although they have also been observed at foraging locations (MMS 2008). European studies of related tern species have suggested that approximately 4 to 10% of birds may fly at rotor height (20–150 m [65.6–492.1 ft] above sea level) during local flights (Jongbloed 2016). In the US, data on roseate terns from a single 660 kW terrestrial WTG in Buzzard's Bay, Massachusetts, suggested that most roseate terns flew below the RSZ of the small WTG when flying over land (9–21 m [29.5–68.9 ft]) (Burger et al. 2011). Estimates of tern flight height from surveys in the Nantucket Sound area suggested that 95% of common and roseate terns flew below Cape Wind's proposed RSZ of 23 to 134 m (75.5 to 439.6 ft) (MMS 2008).

While data on roseate tern flight during migration is limited, a recent movement study using nanotags estimated that terns primarily flew below a hypothetical RSZ of 25 to 250 m (82 to 820 ft), and that roseate terns flying offshore only occasionally flew within the lower portion of the hypothetical RSZ (federal waters, 6.4%; WEAs, 0%) (Loring et al. 2019). The study also indicated increased offshore movements in fair weather (Loring et al. 2019). Roseate terns tracked with immersion sensors frequently rested on the water's surface during migration and wintering periods (two to three hours/day on average, including at night) (Nisbet et al. 2014). Data from other tern species suggest that flight height during migration varies with weather; headwinds may constitute optimal weather conditions for combining foraging with low-altitude migration (Jongbloed 2016), while terns may choose to fly at higher altitudes in tailwinds.

There is limited nocturnal and crepuscular data available, but it appears that nocturnal flights during breeding and post-breeding periods are limited to travel to and from foraging areas and occur only at time periods near dusk and dawn (MMS 2008). Peak exposure of birds tracked with nanotags to federal offshore waters was in the morning, and common terns have been documented to initiate post-breeding movements within two hours prior to sunrise (Loring et al. 2019). Terns in nocturnal transit between roosting and daytime use areas (e.g. shoals and other foraging locations, coastal loafing locations) may fly at higher altitudes (e.g. 37 to 60 m [121.4 to 196.9 ft]) (MMS 2008).

Studies conducted at operational WTGs indicate that terns exhibit avoidance behavior. Common terns were estimated to have a 69.5% avoidance rate of 2 MW WTGs at Horns Rev, Denmark (Petersen et al. 2006; Cook et al. 2012) and were determined to have a 30% macro-avoidance of WTGs at Egmond aan Zee, the Netherlands (Cook et al. 2012). In Europe, terns have been documented to lower their flight altitude when approaching wind developments to avoid RSZs (Krijgsveld et al. 2011). At the 660 kW terrestrial WTG in Buzzard's Bay, Massachusetts, no tern mortalities were found during a multi-year study even though common terns regularly flew within 50 m (164 ft) of the WTG (Burger et al. 2011). There was little evidence of terns reducing avoidance of this WTG in fog, but micro-avoidance of actual RSZs occurred when WTGs were spinning. Terns may detect WTG blades during operation, both visually and acoustically, and avoid flying between WTG rotors while they are in motion (Vlietstra 2007; MMS 2008).

In summary, roseate terns are expected to have **unlikely** exposure to the operational activities occurring in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **unlikely** behavioral vulnerability to collision. Because the exposure will be limited, and the birds generally avoid, or do not fly through, the RSZ, the anticipated loss of roseate tern individuals is unlikely. This finding is consistent with BOEM's Biological Assessment for Vineyard Wind 1, which concluded that roseate tern mortality from collision would be zero and that the likelihood of collision fatalities would be "insignificant and discountable" (BOEM 2019). Risks will be further minimized through mitigation measures (see Section 6.2.2.2.3).

Piping Plover and Red Knot: The piping plover and red knot will have **insignificant** to **unlikely** exposure to the SWDA (see Section 6.2.1.5). If piping plovers and red knots are exposed to the SWDA, based upon the literature, piping plover are expected to have **insignificant** to **unlikely** behavioral vulnerability to collisions and red knots are expected to have **unlikely** behavioral vulnerability to collisions.

Piping plovers are not present in the SWDA during breeding and nonbreeding seasons. The average flight height for non-courtship flights among breeding piping plovers was estimated in one study to be less than 3 m (9.8 ft) (Stantial 2014). Males conduct high, fluttering courtship flights prior to and during breeding, but these are located over their land-based territories (Elliott-Smith and Haig 2004). As such, flight height during non-migratory periods is thought to remain low and to occur near the coastline.

There is a small possibility of ephemeral presence of piping plovers in the SWDA during migration. A movement study using nanotags estimated that three (out of 70) piping plovers passed through Lease Area OCS-A 0501 (which at the time of the study included Lease Area OCS-A 0534)[46] (Loring et al. 2019). Migratory flight height is not well studied (Burger et al. 2011), but evidence from the nanotag study suggests the potential for high altitude migratory flights in at least some individuals and that the mean fight height for birds flying though WEAs was 317 m (1,040 ft); the study estimated that the frequency of birds within an RSZ of 25 to 250 m (82 to 820 ft) in the WEAs was 15.2% (Loring et al. 2019). European studies indicate generally low mortality rates for shorebirds at coastal wind farms, even those located in proximity to stopover and wintering habitats (Burger et al. 2011). There are no known interactions of piping plovers with WTGs, including the limited number of WTGs built near nesting locations, and no mortalities observed to date (USFWS 2009; Burger et al. 2011). Piping plovers may be able to avoid collisions, though vulnerability to collision may increase in periods of poor visibility (Burger et al. 2011).

Red knots are not present in the SWDA during the breeding season and may only have ephemeral presence during migration. Two birds tracked with nanotags were estimated to pass through Lease Area OCS-A 0500 (adjacent to the SWDA) and Lease Area OCS-A 0501 (which at the time of the study included Lease Area OCS-A 0534)[47] (Loring et al. 2018). Red knot flight heights during

46 After the study, in June 2021, Lease Area OCS-A 0501 was segregated into Lease Area OCS-A 0534 and Lease Area OCS-A 0501.

47 After the study, in June 2021, Lease Area OCS-A 0501 was segregated into Lease Area OCS-A 0534 and Lease Area OCS-A 0501.

migration are thought to normally be 1,000 to 3,000 m (3,281 to 9,843 ft), except during takeoff and landing at terrestrial locations (Burger et al. 2011), but red knots likely adjust their altitude to take advantage of local weather conditions, including flying at lower altitudes in headwinds (Baker et al. 2013). Individuals could fly at lower altitudes during periods of poor weather and high winds or during shorter coastal migration flights (Burger et al. 2011). A movement study using nanotags indicated that red knots flew across WEAs generally at night when there were clear skies and little to no precipitation; the birds in the study were estimated to pass through a hypothetical RSZ of 20 to 200 m (66 to 656 ft), but the error around the estimated flight height was large (100–200 m [328–656 ft]) (Loring et al. 2018). Data on red knot interactions with WTGs are not available, but these birds are generally expected to be able to avoid collisions, though vulnerability to collision may increase in periods of poor visibility, high winds, and poor weather (Burger et al. 2011). Exposure to WTGs will depend, in part, on the degree of migratory movement through the SWDA, but is thought to be relatively low because, of the 388 birds tracked with nanotags, only 8% were detected passing through WEAs during migration (Loring et al. 2018).

In summary, the piping plover and red knot are expected to have **insignificant** to **unlikely** exposure to the operational activities occurring in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **insignificant** to **unlikely** behavioral vulnerability to collision. Because they have low exposure risk, and are not generally expected to fly through the RSZ during migration, anticipated loss of piping plover and red knot individuals is unlikely. These findings are consistent with BOEM's Biological Assessment for Vineyard Wind 1, which concluded that piping plover and red knot mortalities from collision would be zero and that the likelihood of collision fatalities would be "insignificant and discountable" (BOEM 2019). Risks will be further minimized through mitigation measures (see Section 6.2.2.2.3).

6.2.2.2.2 Potential Indirect Impacts of Operations and Maintenance (Phases 1 and 2)

Potential IPFs resulting in indirect impacts are related to habitat alteration. While direct collision mortality is the primary concern for terrestrial wind farms, behavioral avoidance responses to offshore wind farms, which can lead to displacement from habitat use areas, may have greater effects on birds in the offshore environment. Birds are displaced by wind developments through behavioral avoidance responses (Fox et al. 2006; Krijgsveld et al. 2011; Lindeboom et al. 2011), which has been documented for sea ducks, gannets, auks, geese, and loons (Desholm and Kahlert 2005; Larsen and Guillemette 2007; Percival 2010; Lindeboom et al. 2011; Plonczkier and Simms 2012; Langston 2013; Garthe et al. 2017). This avoidance may be a behavioral response to the visual stimulus (Fox et al. 2006). While macro-avoidance clearly reduces potential mortalities, birds that avoid a wind farm area completely experience effective habitat loss (Drewitt and Langston 2006; Masden et al. 2009; Petersen et al. 2011; Langston 2013). This avoidance, however, only results in a small increase in energy expenditure (Masden et al. 2009) and there is little evidence to suggest that avoidance and potential displacement from wind developments is reducing fitness, leading to critical habitat loss, or adversely affecting populations.

Habitat change caused by the addition of hard substrate (e.g. foundations, scour protection) during offshore wind development can lead to indirect effects. The construction of WTGs will have both a negative effect of direct loss of habitat (i.e. open ocean) and a positive effect with the gain of new habitat at WTG/ESP foundations and associated scour protection. However, these direct habitat changes represent far less than 5% of a wind farm area and are not considered to be significant (Fox et al. 2006); see Sections 3.3.1.13 and 4.3.1.13 of COP Volume I.

Coastal Birds

Little is known about how most coastal birds may avoid offshore wind farms because they are generally not present in the offshore environment. Since geese, ducks, and swans have been documented to avoid wind farms (see Section 6.2.1.3.3), coastal waterfowl may exhibit avoidance behavior if they pass through the wind farm during migration. Observations of raptors at the Anholt Offshore Wind Farm in the Baltic Sea (20 km [12.4 mi] from the coast) indicate macro-avoidance behavior (13 to 59% of birds observed depending on the species), which has the potential to cause a barrier for migrants in some locations, but also may reduce collision risk. The percentage of merlins and kestrels showing macro-/meso-avoidance behavior was 14/36% and 46/50%, respectively (Jacobsen et al. 2019). However, since most coastal birds are not using the SWDA as critical breeding, foraging, staging, or wintering areas, any avoidance behavior would not cause displacement from important habitat. If the birds did exhibit avoidance behavior, they would be reducing potential collisions as well as overall potential direct impacts.

Therefore, in summary, coastal birds are expected to have **insignificant** to **unlikely** exposure, primarily during migration, to the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **insignificant** behavioral vulnerability to displacement, except for raptors that are expected to have **insignificant** to **unlikely** vulnerability. Because coastal birds are unlikely to be exposed to the SWDA, there is little to no evidence that coastal birds will be displaced from offshore wind farms, and the SWDA does not provide important habitat for this species group, population level impacts are expected to be unlikely.

Marine Birds

<u>Loons and Grebes:</u> Loons and grebes are expected to have **unlikely** to **likely** behavioral vulnerability to displacement. Loons are identified as the birds most vulnerable to displacement (Garthe and Hüppop 2004; Furness et al. 2013) and received a **likely** displacement vulnerability score (see Section 3.2.1 of Appendix III-C). Red-throated loons are documented to consistently avoid offshore wind farms (Mendel et al. 2019). In addition to displacement caused by WTG arrays, red-throated loons have also been shown to be negatively affected by increased boat traffic associated with construction and O&M (Mendel et al. 2019). Common loons may have similar avoidance responses. There is little data on how grebes respond to offshore wind farms, but some grebe species rank higher in displacement vulnerability assessments because they can be disturbed by ship and helicopter traffic (Furness et al. 2013).

In summary, loons are expected to have, on an annual basis, **insignificant** exposure to operational activities in the SWDA. If this low likelihood event occurred where they would be exposed to operational IPFs, they are expected to have **likely** behavioral vulnerability to displacement. Because the SWDA probably does not have important foraging habitat for loons, population level impacts to this species are expected to be unlikely. Grebes are expected to have **insignificant** exposure to the SWDA. In the unlikely event that they would be exposed to operational IPFs, they are expected to have **unlikely** behavioral vulnerability to displacement. Because grebes have limited exposure to the SWDA, population level impacts to this species are expected to be unlikely.

<u>Sea Ducks:</u> Sea ducks are expected to have **potential** to **likely** behavioral vulnerability to displacement. After loons, sea ducks, particularly scoters, are considered to have greater displacement vulnerability than all other seabirds (Furness et al. 2013). Avoidance behavior has been documented for black scoter, common eider (Desholm and Kahlert 2005; Larsen and Guillemette 2007), tufted duck, common pochard, and greater scaup (Dirksen and van der Winden 1998 *in* Langston 2013). Avoidance behavior can lead to permanent or semi-permanent displacement, resulting in effective habitat loss (Petersen and Fox 2007; Percival 2010; Langston 2013). However, for some species, this displacement may cease several years after construction as food resources, behavioral responses, or other factors change (Petersen and Fox 2007; Leonhard et al. 2013). Avoidance occurs through macro-avoidance (Langston 2013) and has been demonstrated by a 4.5-fold reduction in waterfowl flocks entering an offshore development post-construction (Desholm and Kahlert 2005). Birds entering the wind farms at night increased their altitude to avoid the WTGs (Desholm 2006).

In summary, sea ducks are expected to have **insignificant** to **unlikely** exposure to the operational activities in the SWDA. They are expected to have **potential** to **likely** behavioral vulnerability to displacement. Because the SWDA probably does not have important foraging habitat for sea ducks and the birds concentrate closer to shore and towards Nantucket Shoals (see Section 6.2.1), population level impacts to this species group are expected to be unlikely.

<u>Shearwaters, Petrels, and Storm-Petrels:</u> Shearwaters, petrels, and storm-petrels are expected to have **unlikely** to **potential** behavioral vulnerability to displacement. Displacement has not been well studied for this taxonomic group, but Furness et al. (2013) ranked species in this group as having the lowest displacement rank. A study at Egmond aan Zee, the Netherlands, found that 50% (*n*=10) of tube-nosed species passed through the wind farm, which results in the birds receiving a displacement vulnerability score of 5 and thus "potential" vulnerability (see Section 3.2.3 of Appendix III-C). Wade et al. (2016) identified that there was "very high" uncertainty on displacement vulnerability for these species. Based upon the evidence in the literature and identified uncertainty, a lower range (**unlikely**) was added to the displacement vulnerability assessment of shearwaters, petrels, and storm-petrels.

In summary, the shearwater, petrel, and storm-petrel groups are expected to have **insignificant** to **potential** exposure to the operational activities in the SWDA. In the unlikely event that they would be exposed to operational IPFs, they are expected to have **unlikely** to **potential** behavioral vulnerability to displacement. Because exposure is expected to be **insignificant** to **potential** and vulnerability to displacement is **unlikely** to **potential**, population level impacts to these species are expected to be unlikely.

<u>Northern Gannet:</u> The northern gannet is expected to have a **potential** behavioral vulnerability to displacement. While northern gannets rank low for displacement in some vulnerability assessments (Furness et al. 2013), many studies indicate that they avoid wind developments (Krijgsveld et al. 2011; Cook et al. 2012; Hartman et al. 2012; Vanermen, Onkelinx, Courtens, et al. 2015; Dierschke et al. 2016; Garthe et al. 2017). In Belgium, northern gannets have been shown to avoid wind development areas and have decreased in abundance by 85% after a project was constructed (Vanermen, Onkelinx, Courtens, et al. 2015). However, there is little information on whether the avoidance behavior leads to permanent displacement. Since northern gannets feed on highly mobile surface-fish and follow their prey throughout the OCS (Mowbray 2002), avoidance of the SWDA is unlikely to lead to habitat loss.

In summary, northern gannets are expected to have **unlikely** exposure to operational activities in the SWDA. In the unlikely event that they would be exposed to operational IPFs, they are expected to have **potential** behavioral vulnerability to displacement. Because the species has **unlikely** exposure, due to a lack of important foraging habitat, population level impacts to this species are expected to be unlikely.

<u>Double-Crested Cormorants:</u> The double-crested cormorant is expected to have an **unlikely** behavior vulnerability to displacement because they have been documented to be attracted to wind developments (Krijgsveld et al. 2011; Lindeboom et al. 2011), it is not a species known to exhibit avoidance behavior, and they rank towards the middle of displacement vulnerability assessments (Furness et al. 2013).

In summary, double-crested cormorants are expected to have **insignificant** exposure to the operational activities in the SWDA. In the unlikely event that they would be exposed to operational IPFs, they are expected to have **unlikely** behavioral vulnerability to displacement. Because vulnerability and exposure are **unlikely** and **insignificant**, respectively, population level impacts to this species are expected to be unlikely.

<u>Gulls, Skuas, Jaegers, and Terns:</u> Gulls, skuas, and jaegers are expected to have **unlikely** to **potential** behavioral vulnerability to displacement. There is little information available on how jaegers (or skuas) will respond to offshore wind farms, but jaegers rank low in vulnerability to displacement assessments (Furness et al. 2013) and there is no evidence in the literature that they are displaced from projects. Gulls and terns rank low in displacement vulnerability assessments (Furness et al. 2013), and research suggests that distribution and abundance is either not affected by the presence of wind farms or, in the case of gulls, that the birds may be attracted to them (Krijgsveld et al. 2011; Lindeboom et al. 2011). At European offshore wind developments, gulls have been documented to be attracted to WTGs, which may be due to attraction to increased

boat traffic, new food resources, or new loafing habitat (i.e. perching areas) (Fox et al. 2006; Vanermen, Onkelinx, Courtens, et al. 2015), but interaction with offshore wind developments varies by season (Thaxter et al. 2015).

Terns are expected to have **potential** to **likely** vulnerability to displacement. Common terns fall into the high category for macro-avoidance because of a 69.5% avoidance rate determined at Horns Rev (Cook et al. 2012), which had 2 MW WTGs (Petersen et al. 2006), and because Willmott et al. (2013) categorized tern avoidance as greater than 40%. Here, a lower range was added to the displacement score (**potential**) (see Section 3.2.6 of Appendix III-C) because: (1) terns received a "low" disturbance score according to Wade et al. (2016); (2) terns were determined to have a 30% macro-avoidance of WTGs at Egmond aan Zee, the Netherlands (Cook et al. 2012); (3) terns have high uncertainty scores; and (4) displacement in terns has not been well studied. Common terns and roseate terns have been demonstrated to avoid the airspace around a single 660 kW WTG (rotor-tip height: 240 ft [73 m]) in Buzzard's Bay, MA when the WTG was rotating and usually avoided the RSZ (Vlietstra 2007).

In summary, the gull, skua, jaeger, and tern groups are expected to have **insignificant** to **potential** exposure to the operational activities in the SWDA. In the unlikely event that they would be exposed to operational IPFs, they are expected to have **unlikely** to **likely** behavioral vulnerability to displacement. While exposure is **insignificant** to **potential** and vulnerability to displacement is **unlikely** to **likely**, population level impacts to these species are expected to be unlikely since any habitat loss due to displacement is unlikely to affect population trends because of the relatively small area of the SWDA in relation to available foraging habitat.

<u>Auks:</u> Auks are expected to have **potential** to **likely** behavioral vulnerability to displacement. Due to their sensitivity to disturbance from boat traffic and a high habitat specialization, many auks rank high in displacement vulnerability assessments (Furness et al. 2013; Dierschke et al. 2016; Wade et al. 2016). Studies in Europe have documented varying levels of displacement with rates ranging from no apparent displacement to 70% (Ørsted 2018). Auks have a total avoidance rate of 99.2% (Cook et al. 2012). Common murres and razorbills decrease in abundance in the area of wind farms by 71% and 64%, respectively (Vanermen, Onkelinx, Courtens, et al. 2015). Auk populations are generally stable (Ainley et al. 2002; Lowther et al. 2002; Lavers et al. 2009).

In summary, auks are expected to have **insignificant** to **potential** exposure to the SWDA. In the unlikely event that they would be exposed to operational IPFs, they are expected to have **potential** to **likely** behavioral vulnerability to displacement. Because the SWDA exposure is **insignificant** to **potential** and the SWDA is not known to support important foraging habitat for auks, population level impacts to this species group are expected to be unlikely.

Federally-Listed Species

During O&M, listed species are not expected to be displaced from important habitat because the SWDA does not appear to be a primary foraging location or a primary travel corridor for breeding or staging roseate terns, piping plovers, or red knots.

Roseate Tern: Given what is known for common terns, roseate terns are expected to have **potential** to **likely** behavioral vulnerability to displacement based upon the displacement vulnerability ranking (see discussion above and Section 3.2.6 of Appendix III-C). However, terns in general are not considered vulnerable to disturbance (Furness et al. 2013). Research also suggests that tern distribution and abundance is not affected by the presence of wind developments (Krijgsveld et al. 2011; Lindeboom et al. 2011). Even if terns avoid the SWDA, there is no indication that roseate terns would lose important breeding season foraging habitat at the SWDA because they prefer shallow waters, such as shoals (Burger et al. 2011). If roseate terns forage during migration, they could avoid the SWDA, but it is unclear how much roseate terns forage during migration (Burger et al. 2011).

In summary, roseate terns are expected to have **potential** to **likely** behavioral vulnerability to avoidance of offshore wind farms and **unlikely** exposure to the SWDA. Because exposure will be limited and due to the relatively small area of the SWDA in relation to available foraging habitat, anticipated disturbance of roseate tern individuals is unlikely. These findings are consistent with BOEM's Biological Assessment for Vineyard Wind 1, which found for the roseate tern, piping plover, and red knot that "[it] is reasonable to assume that any extra energy expenditure, if any, resulting from making a relatively minor course correction to avoid of the offshore portions of the Action Area would be inconsequential and would not result in a measurable negative affect." The Biological Opinion subsequently issued for Vineyard Wind 1 concluded that impacts to these species from barrier effects (displacement) would be insignificant and discountable (BOEM 2019).

Piping Plover and Red Knot: The piping plover and red knot are expected to have **insignificant** behavioral vulnerability to displacement. There is little evidence and research on shorebird avoidance at offshore wind developments. Piping plovers and red knots are not considered to be vulnerable to displacement because their feeding habitat is strictly coastal (Burger et al. 2011). Therefore, while there is little data on displacement for these species, avoidance behavior is not likely to lead to habitat loss offshore. Piping plovers and red knots would not be displaced during breeding or migratory staging because the SWDA provides no habitat for the species during these life history stages. These species could potentially be exposed to SWDA ephemerally during migration (see Section 6.2.1), but shorebirds generally fly at high altitudes well above RSZs during migration (Nisbet 1963; Richardson 1979) and the SWDA is not located near red knot (Burger et al. 2011) or piping plover stopover locations.

In summary, the piping plover and red knot are expected to have **insignificant** to **unlikely** exposure to the operational activities occurring in the SWDA. In the unlikely event that they would be exposed to operational IPFs, they are expected to have **insignificant** behavioral vulnerability to disturbance and anticipated disturbance of individuals is unlikely. As discussed above for roseate terns, this finding is consistent with the Vineyard Wind 1 Biological Opinion (BOEM 2019).

6.2.2.2.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The SWDA is located within the MA WEA, which was established by BOEM through a multi-step process that involved significant agency and public input over a period of approximately six years. As described in Section 2.1 of COP Volume I, areas identified as important fishing areas and having high value sea duck habitat were excluded from the northeastern portion of the MA WEA (BOEM 2014). Effectively, the location of the SWDA minimizes and avoids exposure of birds to New England Wind's offshore wind energy generation facilities.

To further minimize potential bird mortality from collision, lighting will be reduced as much as is practicable during O&M. The Proponent will follow BOEM and FAA recommendations to use red flashing aviation obstruction lights on WTGs (unless current guidance is modified by the FAA and BOEM by the time Phase 2 proceeds). For Phase 1, the Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent would expect to use the same or similar approaches to reduce lighting used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS. Use of ADLS would lessen the potential impacts of nighttime light on birds.

Table 6.2-9 Summary of Potential Impacts to Birds in the SWDA During Construction and Operations

Species Group	Subgroup	Impact Type	Hazard Construction1	Hazard Operation	Hazard Intensifier	Annual Exposure	Behavioral Vulnerability
Coastal Birds	Shorebirds	Collision	V & C	WTG	Lighting	Insignificant – Unlikely	Insignificant – Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Insignificant
	Waterfowl & waterbirds	Collision	V & C	WTG	Lighting	Insignificant	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Insignificant
	Wading birds	Collision	V & C	WTG	Lighting	Insignificant	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Insignificant
	Raptors	Collision	V & C	WTG	Perching sites	Insignificant – Unlikely	Unlikely – Potential
		Displacement	V & C	SWDA footprint	Number of WTGs		Insignificant – Unlikely
	Songbirds	Collision	V & C	WTG	Lighting	Insignificant – Unlikely	Unlikely – Potential
		Displacement	V & C	SWDA footprint	Number of WTGs		Insignificant
Marine Birds	Loons and grebes	Collision	V & C	WTG	Lighting	Insignificant	Insignificant – Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Unlikely – Likely
	Sea ducks[2]	Collision	V & C	WTG	Lighting	Insignificant – Unlikely	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Potential – Likely
	Shearwaters, petrels, and storm-petrels	Collision	V & C	WTG	Lighting	Insignificant – Potential	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Unlikely – Potential
	Northern gannets	Collision	V & C	WTG	Lighting and perching sites	Unlikely	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Potential
	Cormorants	Collision	V & C	WTG	Lighting and perching sites	Insignificant	Potential
		Displacement	V & C	SWDA footprint	Number of WTGs		Unlikely

Table 6.2-10 Summary of Potential Impacts to Birds in the SWDA during Construction and Operations (Continued)

Species Group	Subgroup	Impact Type	Hazard Construction[1]	Hazard Operation	Hazard Intensifier	Annual Exposure	Behavioral Vulnerability
Marine Birds (Continued)	Gulls, skuas, and jaegers	Collision	V & C	WTG	Lighting and perching sites	Insignificant – Potential	Unlikely – Potential
		Displacement	V & C	SWDA footprint	Number of WTGs		Unlikely – Potential
	Terns	Collision	V & C	WTG	Lighting	Insignificant – Unlikely	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Potential – Likely
	Auks	Collision	V & C	WTG	Lighting	Insignificant – Potential	Insignificant – Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Potential – Likely
Federally-Listed	Piping plover	Collision	V & C	WTG	Lighting	Insignificant – Unlikely	Insignificant – Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Insignificant
	Red knot	Collision	V & C	WTG	Lighting	Insignificant – Unlikely	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Insignificant
	Roseate tern	Collision	V & C	WTG	Lighting and perching sites	Unlikely	Unlikely
		Displacement	V & C	SWDA footprint	Number of WTGs		Potential – Likely
	Black-capped petrel	Collision	V & C	WTG	Perching sites	Insignificant	-
		Displacement	V & C	SWDA footprint	Number of WTGs		-
	Eagles	Collision	V & C	WTG	Perching sites	Insignificant	-
		Displacement	V & C	SWDA footprint	Number of WTGs		-

Notes:

1. V & C = Vessel and Construction Equipment.
2. Excluding red-breasted merganser, which have not been detected within the SWDA.

In addition, when practicable, the Proponent will down-shield lighting or use down-lighting to limit bird attraction and disorientation (Poot et al. 2008) as well as limit outside light to necessary or required lighting (Wiese et al. 2001). Lighting will also be only used when necessary for work crews. As described in Section 6.2.2.1.2, anti-perching is incorporated in the design of the WTGs using tubular WTG support towers. In accordance with safety and engineering requirements, the Proponent will consider anti-perching devices on WTGs and ESP(s) for New England Wind, where and if appropriate, to reduce potential bird perching locations.

The Proponent is developing a framework for a post-construction monitoring program for birds and bats. The Proponent expects to model the framework based on the one developed for Vineyard Wind 1, allowing for the flexibility to include new technology and lessons learned. Using a standardized protocol for New England Wind, the Proponent will document any dead or injured birds found on vessels and structures during O&M.

6.2.2.3 Decommissioning

In general, potential impacts during decommissioning of each Phase are expected to be similar to the construction period. However, there is no equivalent of pile driving during decommissioning, which reduces any noise-related impacts. Using a standardized protocol, any dead or injured birds found on vessels and structures during decommissioning of both Phases of New England Wind will be documented. Best management practices available at the time of decommissioning to minimize any potential impacts to birds will be considered.

6.2.2.4 Summary of Findings

Overall, New England Wind activities occurring in the SWDA for both Phases are unlikely to cause population level impacts to any species or species group.

6.2.2.4.1 Coastal and Marine Birds

During construction, operations, and decommissioning of either Phase, coastal birds are expected to be ephemerally exposed during migration and marine birds are expected to be exposed during all seasons. Overall, coastal birds are expected to have **insignificant** to **potential** behavioral vulnerability. Of the coastal birds, shorebirds, peregrine falcons, and songbirds are the only species groups that may have **unlikely** exposure to the SWDA, and this will be limited to fall migration. Depending on the species, marine birds are expected to have a range of behavioral vulnerability and range of exposure to the SWDA. Of the marine birds, shearwaters and petrels, gulls, and auks were the species groups with **potential** exposure to the SWDA. Impacts will be minimized though mitigation measures that include reducing lighting. During all phases of New England Wind, the Proponent will consider the best management practices available at the time to reduce any potential adverse effects to birds.

6.2.2.4.2 Federally-Listed Species

During construction, operations, and decommissioning of either Phase, exposure of federally-listed species is expected to be **insignificant** to **unlikely** and would largely be restricted to migration. Roseate terns are expected to have **unlikely** exposure to the SWDA, **unlikely** vulnerability to collision, and **potential** to **likely** vulnerability to displacement. Piping plovers are expected to have **insignificant** to **unlikely** exposure and **insignificant** to **unlikely** vulnerability. Like roseate terns, piping plovers may be exposed during migration periods, though flight heights during migration are thought to be generally well above RSZs. Red knots are expected to have **insignificant** to **unlikely** exposure and **insignificant** to **unlikely** behavioral vulnerability. Impacts will be minimized though mitigation measures that include reducing lighting. During all phases of New England Wind, the Proponent will consider the best management practices available at the time to reduce any potential adverse effects to birds to the negligible level.

6.3 Bats

This section describes bat resources in the Onshore Development Areas and Offshore Development Area.

6.3.1 Description of the Affected Environment

The Onshore Development Areas and Offshore Development Area refer to the physical location of New England Wind's onshore and offshore facilities, respectively. Each Phase has a separate Onshore Development Area. The Onshore Development Areas for Phases 1 and 2 consist of: (1) the landfall sites; (2) the Onshore Export Cable Routes, which are the onshore routes within which the onshore export cables will be installed; (3) the onshore substation sites; (4) the Grid Interconnection Routes, which are the onshore transmission routes that connect the onshore substations to the grid interconnection point; and (5) the grid interconnection point at the West Barnstable Substation.

The potential landfall sites, Onshore Export Cable Routes, onshore substation site, and Grid Interconnection Routes for Phase 1 are illustrated in Figure 3.1-2. The potential Phase 2 landfall sites, onshore substation site options, Onshore Export Cable Routes, and Grid Interconnection Routes are also illustrated on Figure 3.1-2.

The Offshore Development Area is the offshore area where New England Wind's offshore facilities are physically located, which includes the Southern Wind Development Area (SWDA) as well as the Offshore Export Cable Corridor (OECC). The Southern Wind Development Area (SWDA) is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501. The OECC is the corridor identified for routing both the Phase 1 and Phase 2 offshore export cables between the SWDA and the landfall sites.

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[48] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

6.3.1.1 Bat Species of Massachusetts

Historically, there are nine species of bats in Massachusetts, five of which are listed as endangered under the Massachusetts Endangered Species Act (MA NHESP 2020). The Indiana bat (*Myotis sodalis*) is listed as federally endangered, the northern long-eared bat (*Myotis septentrionalis*) is listed as federally endangered, and the tricolored bat (*Perimyotis subflavus*) was proposed for being listed as federally endangered in September 2022 under the Endangered Species Act (ESA). The Indiana bat is thought to be extirpated from Massachusetts and its presence has not been recorded since 1939 (Luensmann 2005; MA NHESP 2020). Table 6.3-1 summarizes bat species present in Massachusetts along with their conservation status.

Bat species can be categorized into two major groups based on their wintering strategy: cave-hibernating bats and migratory tree bats. Both groups of bats are nocturnal insectivores that use a variety of forested and open habitats for foraging during the summer. Cave-hibernating bats generally exhibit lower activity in the offshore environment than migratory tree bats (Sjollema et al. 2014). These species hibernate regionally in caves, mines, and other structures, and feed primarily on insects in terrestrial and freshwater habitats. Their movements occur primarily during the fall. The presence of the fungal disease white-nose syndrome (WNS) in the hibernacula has caused high mortality of cave-hibernating bats and led to the northern long-eared bat being listed as threatened under the ESA. Migratory tree bats, rather than hibernating in the winter months, fly to southern parts of the United States (US). Eastern red bats (*Lasiurus borealis*) may exhibit shoreline migration (Cryan 2003). Targeted surveys, for example, have observed this species 16.9–44 kilometers (km) (10.5–27 miles [mi]) off the coast of New Jersey, Delaware, and Virginia (Hatch et al. 2013).

Every bat species in Massachusetts has the potential to utilize the New England Wind Development Area actively or inadvertently. Exposure of cave-hibernating and migratory tree bats to the specific activities and facilities within the SWDA is assessed below. The northern long-eared bat is discussed separately in this section because it is a federally-listed species.

48 The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 Construction and Operations Plan (COP) and has already been thoroughly reviewed and approved by the Bureau of Ocean Energy Management (BOEM) as part of that COP.

Table 6.3-1 Bat Species Present in Massachusetts, Type, and Conservation Status

Common Name	Scientific Name	Type[1]	State Status[3]	Federal Status[4]
Eastern small-footed bat	*Myotis leibii*	Cave-hibernating bat	E	-
Little brown bat	*Myotis lucifugus*	Cave-hibernating bat	E	-
Northern long-eared bat	*Myotis septentrionalis*	Cave-hibernating bat	E	E
Indiana bat[2]	*Myotis sodalis*	Cave-hibernating bat	E	E
Tricolored bat	*Perimyotis subflavus*	Cave-hibernating bat	E	Proposed[5]
Big brown bat	*Eptesicus fuscus*	Cave-hibernating bat	-	-
Eastern red bat	*Lasiurus borealis*	Migratory Tree Bat	-	-
Hoary bat	*Lasiurus cinereus*	Migratory Tree Bat	-	-
Silver-haired bat	*Lasionycteris noctivagans*	Migratory Tree Bat	-	-

Notes:

1. "Type" refers to two major life history strategies among bats in eastern North America; cave-hibernating bats roost in large numbers in caves during the winter, while migratory tree bats do not aggregate in caves and are known to migrate considerable distances.
2. Winter and summer records are not located east of the Connecticut River Valley in Massachusetts, Vermont, and New Hampshire border and Connecticut (USFWS 2007).
3. E=endangered; T=threatened.
4. E=endangered; T=threatened.
5. The tricolored bat was proposed by USFWS for listing as an endangered species in September 2022.

6.3.1.2 Cave-Hibernating and Migratory Tree Bats

6.3.1.2.1 Onshore Development Areas

As a general matter, forested areas can serve as important foraging habitat for bats. Preferred foraging habitat, however, varies among species. The type of foraging habitat a bat species selects may be linked to the flight capabilities, preferred diet, and echolocation capabilities of each species (Norberg and Rayner 1987). Small, maneuverable species like the northern long-eared bat and the little brown bat (*Myotis lucifugus*) can forage in cluttered conditions, such as the forest understory or small forest gaps. Larger, faster-flying bats, such as the hoary bat (*Lasiurus cinereus*), often forage above the forest canopy or in forest gaps (Taylor 2006). Some species, such as the little brown bat and the tri-colored bats (*Perimyotis subflavus)*, regularly forage over water sources. The big brown bat, eastern red bat (*Lasiurus borealis)*, and hoary bat are also known to use waterways as foraging areas as well as travel corridors.

Forested habitats also provide roosting areas for both migratory and non-migratory species. Some species roost solely in the foliage of trees, while others select dead or dying trees where they roost in peeling bark or inside crevices. Some species may select forest interior sites, while others prefer edge habitats. All bat species present in Massachusetts are known to utilize various types of forested areas during summer for foraging and roosting.

Caves and mines are a key habitat for bats. These locations serve as winter hibernacula, fall swarm locations (i.e. areas where mating takes place in the fall months), and summer roosting locations for some individuals. Four main factors are understood to determine whether a cave, mine, or anthropogenic structure (e.g. cellar) is suitable for use as a hibernaculum: (1) low levels of disturbance, (2) suitable temperature, (3) suitable humidity, and (4) suitable airflow (Tuttle and Taylor 1998).

Potential disturbance of bat habitat by the construction and installation of New England Wind's onshore facilities is primarily limited to the onshore substation sites. As described in Section 3.2.2.3 of COP Volume I, the Phase 1 onshore substation will be located at 8 Shootflying Hill Road in the Town of Barnstable, Massachusetts. The 0.027 square kilometer (km^2) (6.7 acre) commercial property at 8 Shootflying Hill Road is southwest of the Route 6-Route 132 highway interchange, located approximately 1.3 km (0.8 mi) east of the grid interconnection point at Eversource's existing 345 kilovolt West Barnstable Substation. The northern part of the site currently contains a motel building, while the southern part consists of wooded land. The Proponent anticipates the entire approximately 0.027 km^2 (6.7 acre) onshore substation site will need to be cleared to accommodate grading and access during construction; approximately 0.012 km^2 (3.0 acres) of the site are currently undeveloped and contain Pitch Pine-Oak forest. The Proponent plans to plant vegetated screening at the 8 Shootflying Hill Road onshore substation site following construction, pursuant to final design plans.

The Proponent has also secured an option to purchase a 0.004 km^2 (1 acre) parcel at 6 Shootflying Hill Road, which is located immediately northeast of the proposed Phase 1 onshore substation site at 8 Shootflying Hill Road. Assuming that the Proponent is able to acquire the property, the Proponent will use 6 Shootflying Hill Road for an improved access road to the onshore substation site in lieu of an access road from the northeast corner of 8 Shootflying Hill Road. 6 Shootflying Hill Road also contains Pitch Pine-Oak forest and the Proponent anticipates that the entire parcel will need to be cleared and graded to accommodate access.

As described in Section 3.2.2.3 of COP Volume I, the Proponent will likely use assessor map parcel #214-001 ("Parcel #214-001"), which is an approximately 0.011 km^2 (2.8 acre) parcel of land located immediately southeast of the West Barnstable Substation, as the northern terminus of a trenchless crossing across Route 6. Under a maximum build-out scenario, all of the approximately 0.011 km^2 (2.8 acre) Parcel #214-001, which is entirely forested, would be cleared.

The two sites considered for the Phase 2 onshore substation are located within the Town of Barnstable generally along the onshore routes identified in Figure 3.1-2. The largest parcel, or combination of parcels, currently under consideration for each substation is 0.12 km^2 (29 acres) in size. The maximum area of ground disturbance during construction of each onshore substation is 0.08 km^2 (19 acres). The maximum area of tree clearing that may be required to accommodate grading and access during Phase 2 onshore substation construction is approximately 0.03 km^2 (14 acres) for each site.

The Phase 1 and Phase 2 onshore substation sites and associated parcels (6 Shootflying Hill Road and Parcel #214-001) may serve as roosting or foraging habitat for bats, including northern long-eared bats. However, the onshore substation sites do not provide cave habitat and do not possess the necessary features for a hibernaculum. This assessment is confirmed by the Natural Heritage Species Report and online database (MA NHESP 2020), which does not show any known roosting or hibernaculum sites for northern long-eared bats in the Town of Barnstable, as of June 12th, 2019.

As described in Sections 3.2.2 and 4.2.2 of COP Volume I, the Onshore Export Cable Routes and Grid Interconnection Routes for Phases 1 and 2 are expected to be located primarily within public roadway layouts, which will avoid most impacts to bat habitat. Minimal tree trimming and/or tree clearing may be required where the onshore routes follow existing roadway layouts, depending on the final duct bank alignment. For both Phases, certain Onshore Export Cable Routes (including variants) and Grid Interconnection Routes (including variants) also utilize existing utility rights-of-way (ROWs). Some stretches of existing utility ROWs may require tree clearing where the ROWs have not been maintained to their full widths. Accordingly, the Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are generally not expected to affect bats because they primarily follow previously disturbed corridors, thereby minimizing any potential impacts to bat habitat.

Adjacent freshwater bodies along certain onshore route variants may support bat habitat. For Phase 1, these water bodies will not be disturbed by the Onshore Export Cable Routes or Grid Interconnection Routes (other than at the Centerville River crossing – see Section 3.3.1.10.2 of COP Volume I). Specialty trenchless crossing methods are expected to be used where the Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes traverse unique features such as busy roadways, wetlands, and waterbodies in order to avoid impacts to those features.

6.3.1.2.2 Offshore Development Area

This section assesses the potential exposure of cave-hibernating and migratory tree bats to the Offshore Development Area, which consists of the SWDA and the OECC (including the Western Muskeget Variant) for Phases 1 and 2. The assessment of potential exposure to bats during construction includes activities within the SWDA and OECC (including the Western Muskeget

Variant). For operations and maintenance (O&M), however, the assessment only includes the wind turbine generators (WTGs) within the SWDA since O&M activities within the OECC are not expected to affect bats and stationary objects (such as electrical service platforms [ESPs]) are not generally considered a collision risk for bats (BOEM 2014) because they are able to detect objects with echolocation (Johnson et al. 2004; Horn et al. 2008). See Table 6.3-2 for definitions of exposure.

Table 6.3-2 Definitions of Exposure Levels

Exposure Level	Definition
Insignificant	Based upon the literature, little to no evidence of use of the offshore environment for breeding, wintering, or staging and minimal predicted use during migration.
Unlikely	Based upon the literature, little evidence of use of the offshore environment during any season and a low proportion of the population is exposed.
Potential	Based upon the literature, moderate evidence of use of the offshore environment during any season and a moderate proportion of the population is exposed.
Likely	Based upon the literature, strong evidence of use of the offshore environment and the offshore environment is primary habitat during any season and a high proportion of the population is exposed.

While there is uncertainty regarding the specific offshore movements of bats, the presence of bats in the marine environment has been documented in the US (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; BOEM 2013; Hatch et al. 2013; Dowling et al. 2017). For example, bats have been observed temporarily roosting on structures, such as lighthouses, on nearshore islands (Dowling et al. 2017) and there is historical evidence of bats, particularly the eastern red bat, migrating offshore in the Atlantic Ocean (Hatch et al. 2013). In a mid-Atlantic bat acoustic study conducted during the spring and fall of 2009 and 2010 (86 nights), the maximum distance that bats were detected from shore was 21.9 km (13.6 mi) and the mean distance was 8.4 km (5.2 mi) (Sjollema et al. 2014). In Maine, bats have been detected on islands up to 41.6 km (25.8 miles) from the mainland (Peterson et al. 2014).

Cave-hibernating bats generally exhibit lower activity in the offshore environment than migratory tree bats (Sjollema et al. 2014). These species hibernate regionally in caves, mines, and other structures and feed primarily on insects in terrestrial and freshwater habitats. Their movements occur primarily during the fall. In the mid-Atlantic, the maximum distance *Myotis* bats have been detected offshore is 11.5 km (7.2 mi) (Sjollema et al. 2014). A nano-tracking study on Martha's Vineyard recorded little brown bat (*n* = 3) movements off the island in late August and early September, with one individual flying from Martha's Vineyard to Cape Cod (Dowling et al. 2017). Big brown bats (*n* = 2) were also detected migrating from Martha's Vineyard later in the year (October to November) (Dowling et al. 2017). These findings are supported by an acoustic study conducted on islands and buoys of the Gulf of Maine that indicate the greatest percentage of migration activity for cave-hibernating bats takes place between July and October (Peterson et al.

2014). As shown by these studies, the use of coastline as a migratory pathway by cave-hibernating bats is likely limited to their fall migration period. Furthermore, acoustic studies indicate lower use of the offshore environment by cave-hibernating bats as compared to tree-roosting species (Lagerveld et al. 2017).

Migratory tree bats, on the other hand, leave New England in the winter months and journey to milder climates to overwinter. These bats have been documented in the offshore environment during migration (BOEM 2014) and historically have been observed and detected offshore in acoustic and aerial surveys (Hatch et al. 2013; Peterson et al. 2014; Sjollema et al. 2014). In the mid-Atlantic acoustic study, eastern red bat comprised 78% (166 bat detections during 898 monitoring hours) of all bat detections offshore (Sjollema et al. 2014). Eastern red bats have been detected migrating from Martha's Vineyard in the late fall (October to November) with one bat tracked as far south as Maryland before records ceased (Dowling et al. 2017). In addition, eastern red bats were detected in the mid-Atlantic up to 44 km (27.3 mi) offshore by high resolution video aerial surveys (Hatch et al. 2013).

Several studies have also highlighted the relationship between bat activity and weather conditions. In general, bat activity has been found to occur primarily during nights with warmer temperatures and low wind speeds (Fiedler 2004; Reynolds 2006); bat activity is also documented to decrease as wind speed increases (Sjollema et al. 2014). Smith and McWilliams (2016) developed predictive models of regional nightly bat activity using continuous acoustic monitoring at several locations in coastal Rhode Island. Bat activity was found to steadily decrease with decreasing temperatures, and departures from seasonally normal temperatures increasingly inhibited bat activity later in the season (September through October). Although Smith and McWilliams (2016) found no association with wind speed and activity of migratory bats (primarily red and silver-haired bats), they demonstrated a strong relationship with "wind profit," a variable indicating combinations of wind speeds and directions that would likely induce coastal flight paths.

For both cave-hibernating and migrating tree bats, overall exposure to the SWDA is expected to be insignificant to unlikely. As detailed above, acoustic and radio-tracking studies indicate low use of the offshore environment by cave-hibernating bats and such use is likely limited to the fall migration period (Peterson et al. 2014; Dowling et al. 2017). In addition, these species do not regularly feed on insects over the ocean. While migratory tree bats are detected more often in the offshore environment, exposure is likely to be limited to the migration period.

6.3.1.3 Federally-Listed Species

As shown in Table 6.3-2 above, two federally-listed bat species are present in Massachusetts—the northern long-eared bat and the Indiana bat[49]. The northern long-eared bat is found in eastern Massachusetts while the range of the Indiana bat does not appear to include the eastern part of the state. Historical records only demonstrate its presence in western Massachusetts (Barbour and Davis 1969). Thus, this assessment will focus solely on the potential exposure of northern long-eared bat to New England Wind activities.

The northern long-eared bat is an insectivorous bat that hibernates in caves, mines, and other locations (e.g. possibly talus slopes) in winter and spends the remainder of the year in forested habitats. During the summer, northern long-eared bats roost under tree bark and in cavities and crevices of live and dead trees (Sasse and Perkins 1996; Foster and Kurta 1999; Owen et al. 2001; Perry and Thill 2007). Anthropogenic structures will also occasionally be used for roosting (Amelon and Burhans 2006; Timpone et al. 2010). Most foraging activity takes place between the understory and forest canopy, typically up to 3 m (10 ft) off the ground (Brack and Whitaker 2001). Foraging occurs within a few kilometers of roost sites (Broders et al. 2006; Henderson and Broders 2008; Lacki et al. 2009; Timpone et al. 2010), and roost locations are frequently relocated every two to three days (Foster and Kurta 1999; Owen et al. 2001; Carter and Feldhamer 2005; Timpone et al. 2010). The species' range includes most of the eastern and mid-western US and southern Canada. Due to impacts from WNS, the species has declined by 90–100% in most locations where the disease has occurred, and declines are expected to continue as the disease spreads throughout the remainder of the species' range (USFWS 2016). MassWildlife detected WNS in Massachusetts in 2007 (MassWildlife 2020). The impact of WNS on the northern long-eared bat resulted in the species being listed as threatened under the ESA in 2015.

The northern long-eared bat is active from March to November (Menzel et al. 2002; Brooks and Ford 2005). At summer roosting locations, the northern long-eared bat forms maternity colonies (aggregations of females and juveniles) where females give birth to young in mid-June. Roosting tree-selection varies and the size of tree and canopy cover changes with reproductive stage (USFWS 2016). The bats are born flightless and remain so until mid-July (Carter and Feldhamer 2005). Adult females and volant juveniles remain in maternity colonies until mid-August, at which time the colonies begin to break up and bats begin migrating to their hibernation sites (Menzel et al. 2002). Bats forage around the hibernation site and mating occurs prior to entering hibernation in a period known as fall swarm (Broders and Forbes 2004; Brooks and Ford 2005). Throughout

[49] The tricolored bat was proposed to be listed as endangered in September 2022; however, a final listing decision by USFWS is not anticipated until Fall 2023. According to Massachusetts Division of Fisheries and Wildlife's Tricolored Bat Fact Sheet, winter hibernacula (hibernation sites) have been reported in Berkshire, Franklin, and Hampden counties, which are all in Western Massachusetts (MA NHESP 2015).

the summer months and during breeding, northern long-eared bats have small home ranges of less than 0.1 km^2 (25 acres) (Silvis et al. 2016 *in* Dowling et al. 2017). Migratory movements, however, can be up to 275 km (170 mi) (Griffin 1945 *in* Dowling et al. 2017).

Despite severe population declines, northern long-eared bats are documented in 11 of 14 counties in Massachusetts (MA NHESP 2020), including Dukes and Nantucket Counties (Dowling et al. 2017).

The Proponent requested a report from the USFWS Information for Planning and Consultation (IPaC) tool in April 2023, which includes the new northern long-eared bat Determination Key. The Determination Key reported a No Effect finding for northern long-eared bats. The IPAC and Determination Key reports were provided by the Proponent to BOEM and USFWS for consideration during the development of the Biological Assessment. BOEM's consultation with USFWS is ongoing.

6.3.1.3.1 Onshore Development Areas

As discussed above, the assessment of the Onshore Development Areas is primarily limited to the onshore substation sites for Phases 1 and 2. The Phase 1 and Phase 2 onshore substation sites and associated parcels (6 Shootflying Hill Road and Parcel #214-001) may serve as roosting or foraging habitat for bats, including northern long-eared bats. However, no known northern long-eared bat maternity roost trees or hibernaculum are located near the onshore substation sites or the Town of Barnstable (MA NHESP 2020). Known roost trees continue to be mapped on Cape Cod and the Islands. The latest map update was June 12, 2019 (MA NHESP 2020). The closest known roost trees are at or near Cape Cod Joint Base (approximately 13 km [8 mi] from the Phase 2 onshore substation site) and Cape Cod National Seashore (approximately 34 km [21 mi] from the Phase 1 onshore substation site). The proximity of the Phase 1 and Phase 2 onshore substations to a major roadway (Route 6) may make the sites less suitable for bats given the likelihood of increased traffic noise, particularly during the summer months (Siemers and Schaub 2010).

6.3.1.3.2 Offshore Development Area

Northern long-eared bats are not expected to be exposed to the SWDA. While there is little information on the movements of northern long-eared bat with respect to ocean travel, a tracking study on Martha's Vineyard (n = 8; July to October 2016) did not record any offshore movements by northern long-eared bat (Dowling et al. 2017). If northern long-eared bats were to migrate over water, movements would likely be from Martha's Vineyard to the mainland. The related little brown bat has been found to migrate from Martha's Vineyard to Cape Cod. As such, northern long-eared bats may likewise migrate to mainland hibernacula between August and September. Tracking data suggest that at least some northern-long eared bats overwinter on the island (Dowling et al. 2017). Nevertheless, given that the SWDA is located far from shore, the exposure of northern long-eared bats is expected to be insignificant and will not be discussed further. These conclusions are consistent with those determined by comprehensive risk assessments conducted for Vineyard Wind 1, which will be located immediately northeast of New England Wind in Lease Area OCS-A 0501 (BOEM 2018; BOEM 2019).

6.3.2 Potential Impacts of New England Wind

The potential impacts of New England Wind to bats were evaluated by considering the exposure of bats (see Section 6.3.1) to impact producing factors (IPFs). IPFs are defined as the changes to the environment caused by project activities during each offshore wind development phase (BOEM 2012; Goodale and Milman 2016). Except for vessel activity during construction, activities in the OECC (including the Western Muskeget Variant) are not considered an IPF for bats and no impact analysis was conducted. Bats may otherwise be exposed to the following IPFs: construction and maintenance vessels, the WTGs, and associated lighting (see Table 6.3-3). Potential impacts to bats are most closely related to New England Wind offshore and onshore development as whole; therefore, the analysis below considers a total buildout of the SWDA of 130 WTG/ESP positions, the installation of five offshore export cables for Phases 1 and 2 within the OECC, and onshore development within the Onshore Development Areas for Phases 1 and 2. Additionally, the analysis below considers the full range of WTGs that may be used by either Phase of New England Wind.

Table 6.3-3 Impact Producing Factors for Bats

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Habitat alteration			•	•		•
Land disturbance			•	•		•
Vessel lights	•	•		•	•	•
Structure strikes hazard	•	•		•	•	•
Structure lights	•	•		•	•	•

The primary potential impact of New England Wind to bats is mortality or injury from collision with WTGs. Stationary objects are not generally considered a collision risk for bats (BOEM 2014) because they are able to detect objects with echolocation (Johnson et al. 2004; Horn et al. 2008). Bat mortality has been documented at terrestrial wind farms in the US (Cryan and Barclay 2009; Hayes 2013; Smallwood 2013; Martin et al. 2017; Pettit and O'Keefe 2017). Although bat mortality has not been documented at offshore wind farms, the collision mortalities detected at terrestrial wind farms suggest that bats, if exposed, may be vulnerable to collisions with rotating offshore WTGs.

6.3.2.1 Construction and Installation

6.3.2.1.1 Potential Mortality and Habitat Loss from Tree Clearing in the Onshore Development Areas (Phases 1 and 2)

IPFs for bats during onshore construction and installation include habitat alteration and land disturbance. As discussed above, the assessment of the Onshore Development Areas is primarily limited to the onshore substation sites for Phases 1 and 2. As noted previously, the onshore substation sites may serve as roosting or foraging habitat for bats, including northern long-eared bats. However, no known northern long-eared bat maternity roost trees or hibernaculum are located in the Town of Barnstable or surrounding towns (MA NHESP 2020). As described above, tree clearing will be minimal, affecting up to approximately 0.012 km^2 (3.0 acres) of forested habitat at the Phase 1 onshore substation site, up to 0.004 km^2 (1 acre) for a potential access road to the onshore substation site, and up to 0.011 km^2 (2.8 acres) at Parcel #214-001. For Phase 2 the total area of tree clearing associated with the Clay Hill Site will be approximately 0.05 km^2 (13.3 acres), while the tree clearing associated with the grid interconnection routes will range from 0.0008 km^2 (0.2 acres) to 0.008 km^2 (1.9 acres) depending on the route option selected.

As previously described, the Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are expected to be located primarily within public roadway layouts, which will avoid most impacts to bat habitat. Certain Onshore Export Cable Routes (including variants) and Grid Interconnection Routes (including variants) also utilize existing utility ROWs. Depending on the final duct bank alignment, minimal tree trimming and/or tree clearing may be required where the onshore routes follow existing roadway layouts and some stretches of existing utility ROWs may require tree clearing where the ROWs have not been maintained to their full widths. Overall, the Onshore Export Cable Routes and Grid Interconnection Routes primarily follow previously disturbed corridors, thereby minimizing any potential impacts to bat habitat.

Tree clearing at the Phase 1 onshore substation site and associated parcels (6 Shootflying Hill Road and Parcel #214-001), at the Phase 2 onshore substation site, and along the onshore routes (if needed) could result in permanent loss of potentially suitable summer roosting habitat. However, given the small area being cleared in relation to locally available habitat, habitat loss is unlikely to affect bat populations, including the northern long-eared bat. This finding is consistent with BOEM's assessment in the Vineyard Wind 1 Draft Environmental Impact Statement (DEIS) (BOEM 2018) and the Biological Assessment (BA) (BOEM 2019).

Displacement from potentially suitable summer habitats could also occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Siemers and Schaub 2010). However, BOEM determined for Vineyard Wind 1 that these impacts are expected to be insignificant because construction activities will be temporary and highly localized (BOEM 2018).

6.3.2.1.2 Potential Attraction of Bats to Construction Activities in the Offshore Development Area (Phases 1 and 2)

IPFs for bats during offshore construction include vessel lights, structure strikes hazard, and structure lights. Bats may be attracted to construction vessels (particularly if insects are drawn to the lights of the vessels) as well as WTGs and ESP(s) under construction (BOEM 2014). Bats at onshore wind facilities have been documented as showing higher attraction and more frequent approaches to stationary WTGs (Cryan et al. 2014), but stationary objects are not generally considered a collision risk for bats because of their use of echolocation (Johnson et al. 2004; Horn et al. 2008; BOEM 2012). Overall, since there is little evidence to suggest that stationary objects pose significant risk to bats, behavioral vulnerability to collision is expected to be insignificant. As such, population level impacts are unlikely. This finding is consistent with BOEM's assessment in the DEIS for Vineyard Wind 1, which concluded that the impact of offshore construction and installation would be "negligible" (BOEM 2018).

6.3.2.1.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes are sited primarily within public roadway layouts or existing utility ROWs, thereby minimizing any potential impacts to bat habitat. Agency consultation is ongoing for northern long-eared bats. This consultation will identify any necessary avoidance, minimization, and mitigation measures to protect bat species.

The location of the New England Wind WTGs far offshore avoids exposure of bats. During construction, lighting will be minimized to reduce potential attraction of bats to vessels and construction activities where practicable and safe to do so.

6.3.2.2 Operations and Maintenance

6.3.2.2.1 Potential Collision of Bats with WTGs (Phases 1 and 2)

IPFs for bats during offshore O&M include vessel lights, structure strikes hazard, and structure lights. As discussed in Section 6.3.1, the exposure of cave-hibernating bats to the SWDA is expected to be insignificant to unlikely and would only occur rarely during migration when a small number of bats may occur in the Massachusetts Wind Energy Area (MA WEA) given its distance from shore (BOEM 2014). Migratory tree bats could pass through the SWDA, but overall, small numbers of migratory bats are expected in the MA WEA given its distance from shore (BOEM 2014).

If bats pass through the SWDA, injury or mortality from collision with WTGs is a potential risk. Bats are not expected to regularly forage in the SWDA but may be present during fall migration (BOEM 2012, 2019). As discussed above, the exposure of cave-hibernating bats to the Offshore Development Area is expected to be insignificant to unlikely and would only occur on rare occasion during migration. Therefore, population level impacts to cave-hibernating bats are unlikely. This finding is consistent with BOEM's assessment in the DEIS for Vineyard Wind 1, which determined that cave-hibernating bats "would not be exposed" to the WTGs (BOEM 2018).

Migratory tree bats have a higher potential to pass through the SWDA, but overall, a small number of bats are expected in the SWDA given its distance from shore (BOEM 2014). While there is evidence of bats visiting WTGs close to shore (4 to 7 km [2.5 to 4.3 mi]) in the Baltic Sea (enclosed by land) (Ahlén et al. 2009; Rydell and Wickman 2015), the SWDA is far offshore (see Section 2.2 of COP Volume I) and there are no nearby landing areas (e.g. islands), which might otherwise increase the presence of bats in the SWDA. Therefore, population level impacts are expected to be unlikely. This finding is consistent with BOEM's assessment in the DEIS for Vineyard Wind 1, in which BOEM anticipated "that the expected rarity of bats encountering WTGs would lead to only negligible impacts, if any, on migratory tree bat populations" (BOEM 2018).

The need for lighting during O&M of New England Wind is expected to be minimal and best practices will be considered, when necessary, to mitigate any risks. Several studies have investigated the impacts of different lighting methods on attraction and avoidance behaviors in bats. Red aviation lights on top of WTG towers have been considered to be a potential source of interest to bats; however, studies have shown that mortality at land-based towers with aviation lights is similar to or even less than mortality at towers without aviation lights (Arnett et al. 2008; Bennett and Hale 2014). Bennett and Hale (2014) reported higher red bat fatalities at unlit WTGs in comparison with those lit with red aviation lights. Bats may also be attracted to maintenance vessels servicing WTGs, ESP(s), or offshore export cables, particularly if insects are drawn to the lights of the vessels.

In summary, bats have an insignificant to unlikely exposure to the SWDA because the SWDA is located far offshore, and bat exposure is likely limited to a few individuals of migrating tree bats in the fall. Risks will be further minimized through mitigation measures. For these reasons, population level impacts are unlikely.

6.3.2.2.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The location of the New England Wind WTGs far offshore avoids exposure of bats. The Proponent will reduce lighting to the extent practical. For Phase 1, the Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent expects to use the same or similar approaches to reduce lighting used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS. Use of ADLS would lessen the potential impacts of nighttime light on bats. Aviation obstruction lighting for the WTGs and ESPs is described in Sections 3.2.1.1, 3.2.1.3, 4.2.1.1, and 4.2.1.3 of COP Volume I.

The Proponent is developing a framework for a post-construction monitoring program for birds and bats. The Proponent expects the framework to be modeled off of the framework developed for Vineyard Wind 1, but it will allow for the flexibility to include new technology and lessons learned.

6.3.2.3 Decommissioning

The decommissioning period IPFs that bats will be exposed to (e.g. boat activity) are expected to be similar to the construction period (see Section 6.3.2.1). Best practices available at the time of decommissioning will be discussed with BOEM and the USFWS to avoid and minimize potential impacts to bats.

6.4 Coastal Habitats

This section describes the habitats within the Commonwealth of Massachusetts' coastal zone that are located around the New England Wind landfall sites and within a portion of the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]).

The Massachusetts Office of Coastal Zone Management (CZM) manages coastal habitat within portions of the Offshore Development Area. The Offshore Development Area is the offshore area where New England Wind's offshore facilities are physically located, which includes all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]) and the OECC. CZM defines the coastal zone as the area that "includes the lands and waters within the seaward limit of the state's territorial sea [3 nautical miles from land] to generally 100 feet [ft] beyond (landward of) the first major land transportation route encountered (a road, highway, rail line, etc.)" (CZM 2011). For New England Wind, coastal habitat is defined as the affected area out to the three nautical mile limit (5.5. kilometer [km]), which includes the landfall sites and a portion of the OECC (see Figure 6.4-1). The Offshore Development Area does not include any coastal habitats of Rhode Island.

This section also includes measures to avoid, minimize, or mitigate potential impacts to coastal habitats. Benthic resources are discussed in greater detail in Section 6.5, finfish and invertebrates are discussed in Section 6.6, and terrestrial habitat and wetlands are discussed in Section 6.1.

6.4.1 Description of the Affected Environment

New England Wind will be developed in two Phases. Five offshore export cables—two cables for Phase 1 and three cables for Phase 2—will transmit electricity generated by wind turbine generators and electrical service platforms to shore. The offshore export cables for both Phases will be installed within a shared OECC.

The New England Wind OECC will travel from the northwestern corner of the SWDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then head northward along the eastern side of Muskeget Channel toward landfall sites in the Town of

Barnstable (see Figure 6.4-1). At approximately 2–3 km (1–2 mi) from shore, the OECC for each Phase will diverge to reach separate landfall sites in Barnstable. The OECC specific to each Phase is further described in Sections 3.1.3 and 4.1.3 of COP Volume I.

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables[50] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[51] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

6.4.1.1 Landfall Sites (Phases 1 and 2)

6.4.1.1.1 Landfall Sites (Phase 1)

Phase 1 has two potential landfall sites: the Craigville Public Beach Landfall Site and the Covell's Beach Landfall Site, with the Craigville Public Beach site the preferred site. The Craigville Public Beach Landfall Site is located within a 0.014 square kilometer (3.5 acre) paved parking area associated with a public beach that is owned and managed by the Town of Barnstable. The landfall site is situated in the central part of the Centerville Harbor bight in an area where the shoreline is relatively stable. The Craigville Public Beach Landfall Site has adequate space for an HDD staging area and favorable route options to the onshore substation site.

The second landfall under consideration is at Covell's Beach, approximately 0.6 km (0.4 miles) east of the Craigville Public Beach Landfall Site. As described in Section 3.2.2.1 of COP Volume I, the Covell's Beach Landfall Site is similarly situated in a large, paved parking area associated with Covell's Beach, a residents-only public beach that is owned and managed by the Town of Barnstable. This landfall site is advantageously located within the Centerville Harbor bight, has adequate space for a construction staging area, and provides favorable egress to the Onshore Export Cable Routes. However, the Covell's Beach Landfall Site is being used for Vineyard Wind 1, which may create engineering constraints and construction feasibility challenges. For this reason, the Proponent would only expect to use the Covell's Beach Landfall Site for Phase 1 if unforeseen challenges arise that make it infeasible to use the Craigville Public Beach Landfall Site.

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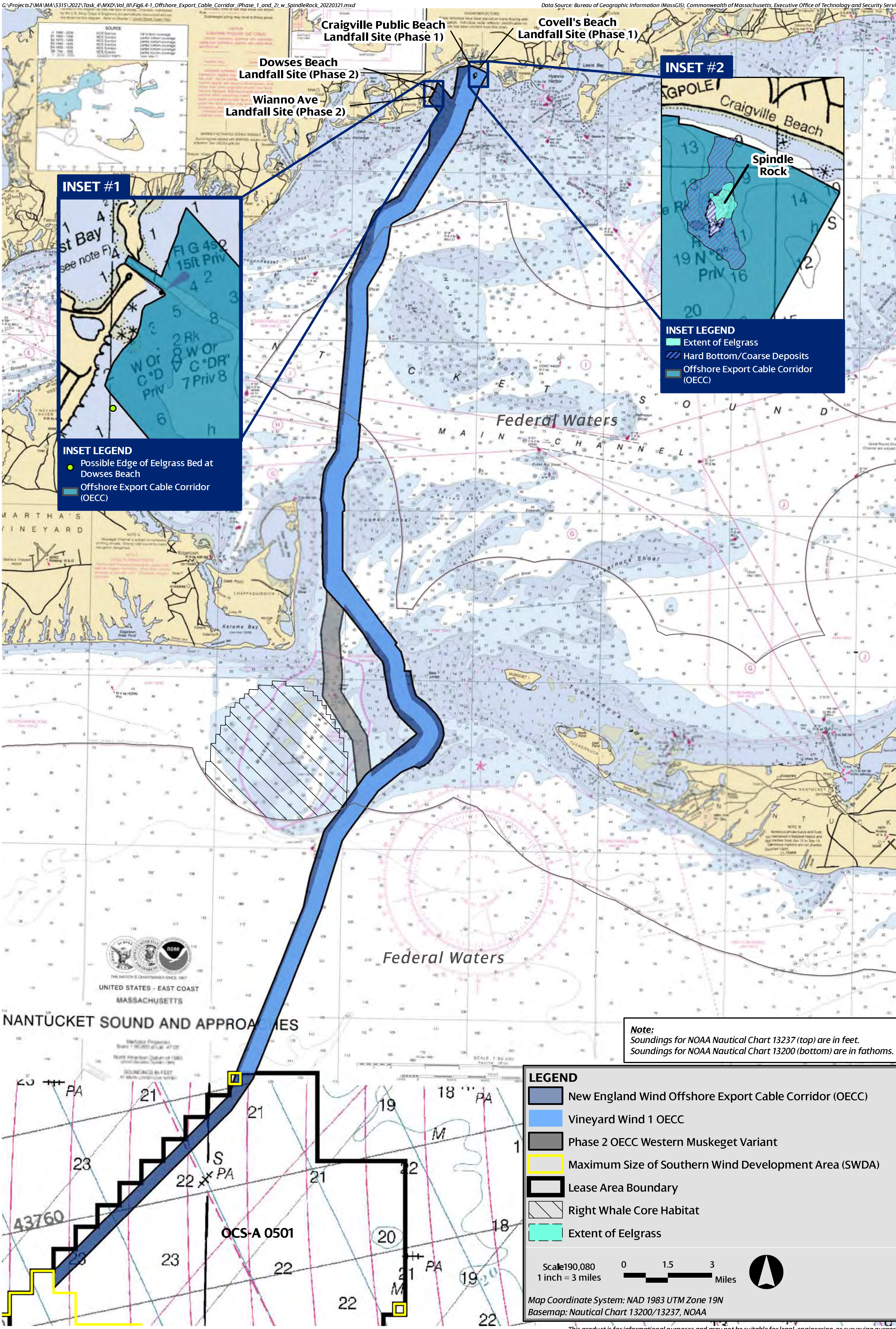
50 It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

51 The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP

G:\Projects2\MA\MA\5315\2022\Task_4\MXD\Vol_III\Fig6.4-1_Offshore_Export_Cable_Corridor_(Phase_1_and_2)_w_SpindleRock_20220321.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



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

New England Wind
AVANGRID RENEWABLES

Figure 6.4-1
Offshore Export Cable Corridor (Phases 1 and 2)

Both Phase 1 landfall sites have been surveyed to identify any sensitive nearshore habitats. Marine surveys in 2018 identified a relatively small eelgrass bed, co-located within an area of hard bottom, offshore from the landfall sites in the vicinity of Spindle Rock (see Figure 6.4-1). Otherwise, the Phase 1 landfall sites are free of offshore eelgrass beds and other sensitive habitats in the nearshore area.

6.4.1.1.2 Landfall Sites (Phase 2)

The Phase 2 offshore export cables will come to shore at one or two landfall sites in the Town of Barnstable, unless technical, logistical, grid interconnection, or other unforeseen issues arise. These two landfall sites include Dowses Beach and Wianno Avenue, with Dowses Beach as the preferred landfall site.

As described in Section 4.2.2.1 of COP Volume I, the Dowses Beach Landfall Site is located within a 0.01 km^2 (2.5 acre) paved parking area at Dowses Beach, which is a residents-only beach that is owned and managed by the Town of Barnstable. Dowses Beach is situated on a peninsula between East Bay and the Centerville Harbor. Existing uses in and around the landfall site include recreational use of the beach area, seasonal residential use, and recreational boating in the East Bay Area to the northwest of the Dowses Beach. At Dowses Beach, the offshore export cables' ocean-to-land transition will be made using HDD. From Dowses Beach, the onshore export cables would either continue beneath public roadway layouts or, using a trenchless crossing, travel beneath East Bay to one of two potential locations on East Bay Road (see Figure 3.1-2). The Dowses Beach Landfall Site has adequate space for an HDD/trenchless crossing staging area and favorable route options to the onshore substation sites.

The Phase 2 offshore export cables may make landfall at a 462 m^2 (4,970 ft^2) paved parking area where Wianno Avenue intersects with Sea View Avenue. The landfall site may extend into the adjacent roadway layouts. As described further in Section 4.3.1.8.2, the Wianno Avenue Landfall Site is less suited for HDD than open-trenching due to the elevated onshore topography and slope of the parking lot. This landfall site is suitable for open-trenching because the shoreline has already been altered by the installation of a riprap seawall, a portion of which would be temporarily removed and replaced following cable installation. The Proponent only expects to use the Wianno Avenue Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all or some of the Phase 2 offshore export cables.

Both potential landfall sites described above are considered good candidates for cable landing given their favorable egress and inland routing to Eversource's existing 345 kV West Barnstable Substation via public roads and existing utility rights-of-way (ROWs). The Phase 2 landfall sites have similarly been surveyed to identify any sensitive nearshore habitats. As described in Section 5.2.3 of COP Volume II, a patch of eelgrass was found outside the OECC to the southwest of the Phase 2 landfall sites at the very end of a video transect. This may indicate the edge of a bed that extends to the southwest or inshore but does not occur within the OECC. Additionally, as described further below, an area of Complex Habitat was found near the Phase 2 landfall sites.

6.4.1.2 Offshore Export Cable Corridor (Phases 1 and 2)

The offshore export cables for both Phases of New England Wind will be installed within an OECC with a width of approximately 950–1,700 m (3,100–5,500 ft). The OECC for New England Wind is substantially similar to the OECC proposed for Vineyard Wind 1, but it has been widened by approximately 300 m (984 ft) to the west along the entire corridor and by approximately 300 m (984 ft) to the east in portions of Muskeget Channel. Figure 6.4-1 illustrates the expansion of the OECC for New England Wind as compared to the OECC for Vineyard Wind 1.

The preliminary engineering studies for New England Wind indicate that it is technically feasible to install New England Wind's five offshore export cables within the OECC. However, if detailed engineering or other technical issues arise demonstrating that installation of all Phase 2 cables within a portion of the OECC in the Muskeget Channel area is not feasible, the Proponent would exercise the option to install one or two Phase 2 offshore export cables within the Phase 2 OECC Western Muskeget Variant (Western Muskeget Variant) that was included as part of the Vineyard Wind 1 OECC (see Section 2.3.1 of COP Volume I and Appendix I-G)[52]. The Western Muskeget Variant, which is shown on Figure 6.4-1, is the same corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

Much of the OECC was surveyed as part of the Vineyard Wind 1 project (i.e. all areas identified as part of the Vineyard Wind 1 OECC on Figure 6.4-1 were surveyed; the western Muskeget Variant was also surveyed as part of the Vineyard Wind 1 OECC). The portions of the OECC that were expanded for New England Wind were surveyed in 2020.

Based on survey data collected through 2020, the OECC (including the Western Muskeget Variant) has been divided into five geological zones grouped by physical characteristics and benthic substrate (see Section 2.1.3 in COP Volume II). Four of the five geological zones are present within coastal habitats. The fifth geological zone, referred to as Zone 1, is only present in federal waters. Typically, water depths within the four coastal geological zones range from 0 to greater than 25 m (82 ft). Much of the OECC in these four coastal geological zones consists of flat sand with areas of coarse bottom and bedforms (i.e. sand waves). Overall, the surficial sediment from the grab samples changes systematically across the entire OECC into the SWDA, with generally coarser material present along the shallower sections of the OECC (Zones 2-5) and finer material present in the deeper OECC (Zone 1) and SWDA. Average bedform relief is 1–1.5 m (3.3–4.9 ft), though increased sand wave heights of up to 5–9 m (16.4–29.5 ft) exist locally in high current areas. Biogenic structures are present in certain locations. Benthic grab samples and underwater video transects collected during biological surveys performed from 2016 through 2020 helped

[52] It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

determine habitat type (see Section 6.5 for a discussion of benthic organisms associated with these types of habitats). Further information on each zone is presented in Section 2.1.3 of COP Volume II.

6.4.1.2.1 Massachusetts Ocean Management Plan Sensitive Habitats

The Massachusetts Ocean Management Plan (OMP) establishes a framework intended to manage uses and activities within the state's ocean waters (i.e. within coastal habitats). The OMP defines "special, sensitive, and unique" habitats for cable projects, which are a priority to avoid, as core habitat for the North Atlantic Right Whale, eelgrass beds, and hard/complex bottom.

Core Habitat for North Atlantic Right Whale

Core habitat for the North Atlantic right whale (*Eubalaena glacialis*) is mapped in the OMP in a location directly south of Martha's Vineyard. The OECC avoids this core habitat, which is located just to the west of the OECC (see Figure 6.4-1).

Eelgrass

Eelgrass (*Zostera marina*) is a marine flowering plant that lives below the ocean surface in less than 5 m (16.4 ft) of water. Eelgrass beds form an important coastal habitat that provides refuge and sustenance for a large variety of organisms including shellfish, finfish, and waterfowl, and serves as a critical component of sediment and shoreline stabilization. During the Proponent's marine surveys, underwater video was the primary tool used for identifying and mapping of eelgrass beds (see Section 5.2.3 of COP Volume II).

A single eelgrass bed has been identified within the OECC, and New England Wind will avoid impacts to that area. Video transects and a diver survey delineated a patch of eelgrass offshore that is co-located within the OECC and associated with an area of hard bottom (a rock pile) known as Spindle Rock (see Figure 6.4-1). Patches of grass intertwined with macroalgae inhabit the discontinuous sandy bottom in and around the rock pile.

Additionally, several isolated rooted plants were observed on multiple transects in 2019 at the Craigville Public Beach and Dowses Beach Landfall Sites, but none were considered part of an eelgrass bed. As described in Section 5.2.3 of COP Volume II a patch of eelgrass was found outside the OECC to the southwest of the Phase 2 landfall sites at the very end of a video transect. This may indicate the edge of a bed that extends to the southwest or inshore, but does not occur within the OECC (see Figure 6.4-1).

Hard Bottom Habitat

Hard bottom areas within the OECC include high concentrations of coarse material (>50% gravel, cobbles, boulders in a sand matrix), which, even though considered an unconsolidated sediment surface, form a relatively hard substrate to which sessile benthic organisms can attach. Most of these are associated with glacial moraine deposits and consist of rock piles and scattered individual rocks (i.e. boulders) of varying abundance on the seafloor. Some areas are predominantly gravel and cobbles with the sand matrix and a sparse distribution of boulder-sized material. No bedrock outcrops exist offshore within the OECC.

As described in Section 5.2.1.1 and shown on Figure 5.2-2 in COP Volume II, areas of the OECC that exhibit coarse deposits and associated rugged seafloor topography are present in the Muskeget Channel area and the Western Muskeget Variant, where hard bottom covers the full width of the installation corridor. Additional isolated hard bottom areas are present in the northern portion of Nantucket Sound within the OECC. These include scattered and piled boulders around charted features such as Collier Ledge, Gannet Rocks, and Spindle Rock toward/in Centerville Harbor.

Complex Seafloor

As described further in Section 5.2 of COP Volume II, complex seafloor is defined under the Massachusetts Ocean Management Plan (OMP) and refers to seafloor areas with bedforms. As described further in Section 3 of COP Volume II, bedform fields (i.e. ripples, megaripples, and sand waves) are present in many locations within the OECC. Size and wavelength vary considerably throughout, ranging from less than 0.3 to over 9 m (1 to over 30 ft) in relief, with wavelengths of less than 2 to over 125 m (6.5 to over 410 ft). Large sand waves are found in many areas along the OECC, typically in areas where tidal currents force large volumes of water to enter and exit constricted pathways. The areal extent of these bedforms is constantly changing with subtle environmental shifts in water depths, sediment grain size, and current flow. This is a laterally extensive habitat due to the predominantly sandy seafloor and tidal currents flowing over the bottom and constantly reworking sediment.

6.4.1.2.2 National Marine Fisheries Service Sensitive Habitats

In addition to the sensitive habitats identified by the Massachusetts Ocean Management Plan, the National Marine Fisheries Service (NMFS) has developed Recommendations for Mapping Fish Habitat (2021) that defines the following sensitive habitats: Complex habitat, Heterogeneous Complex habitat, Large Grained Complex habitat, Soft Bottom habitat, and Benthic Features. These habitats are described in Section 5.2.2 and are shown on Figures 5.2-5b and 5.2-5c in COP Volume II.

As described in Section 5.2.2 of COP Volume II, the definition of Complex in the NMFS (2021) mapping recommendations has a smaller grain size threshold (>2 mm) and lower composition threshold (>5% gravel) than what is required in the MA OMP and what was classified in previously used classification systems such as Auster (1998) and Barnhardt et al. (1998), making it a much more conservative classification system. Therefore, more ground truthing samples are now classified as Complex, resulting in increased areas of Complex or Heterogeneous Complex Habitats than had been previously mapped. Many of these samples that are now considered Complex, such as those in the Gravelly Group, have low percentages of gravel (5 to 30%) and a small grain size of Pebbles/Granules (2 to 64 mm). Areas with this low percentage of gravel and small grain size such as those outside Muskeget Channel, though classified as Complex or Heterogeneous Complex Habitats, do not have the same habitat values as areas with more and larger gravel such as those within Muskeget Channel. Because the NMFS habitat classifications are broad enough to include these varying levels of habitat values within the Complex and Heterogeneous Complex Habitat categories, habitat areas that have lower habitat value are now classified as Complex or Heterogeneous Complex Habitat.

Complex Habitat

Complex habitat is defined in NMFS's Recommendations for Mapping Fish Habitat (2021) as hard bottom substrates, hard bottom with epifauna or macroalgae cover, and vegetated habitats. As described in Section 5.2.2.1 and shown on Figures 5.2-5b and 5.2-5c of COP Volume II, complex habitat includes delineated areas where all ground truthing showed hard bottom, as defined in CMECS as the Substrate Groups Gravels, Gravel Mixes, Gravelly, and Shell. Areas of this habitat type were found mainly in the Muskeget Channel area for the OECC and Western Muskeget Variant, where coarse material is known to occur. Most of the ground truthing revealed the Complex habitat in the Muskeget Channel area for the OECC and Western Muskeget Variant to be mainly Sandy Gravel, Gravelly Sand, or Shell Hash/Rubble, with very rare Pebble/Granule Gravel and Gravel Pavement and isolated boulders locally. Ground truthing showed low amounts of gravel at the Dowses Beach Landfall Site, with samples classified as Gravelly Sand and Gravelly Muddy Sand, therefore requiring classification as a Complex habitat.

Heterogeneous Complex Habitat

Heterogeneous Complex habitat is defined as delineated areas where ground truthing showed both Complex habitat and Soft Bottom habitat. This type of habitat was found scattered throughout the middle and northern portion of the OECC and within the southern portion of the Western Muskeget Variant as shown on Figures 5.2-5b and 5.2-5c of COP Volume II. Several areas in the OECC were mainly shell areas, whereas others showed mostly small grained coarse material and/or low percentages of gravel. One area of Heterogeneous Complex habitat was mapped in the southern portion of the OECC, which was due to grab samples categorized as Gravelly Sand, though the percentage of gravel was very low, and the grain size was small within these samples. This Heterogeneous Complex area corresponds to southern portion of the Western Muskeget Variant that also had grab samples categorized as Gravelly Sand with lower percentages of gravel and small grain size. Bedforms were common in Heterogeneous Complex Habitat.

Large Grained Complex Habitat

Large Grained Complex habitat is defined as delineated areas where ground truthing or sonar data showed rock outcrops or abundant large boulders. Large Grained Complex habitat was mapped at Spindle Rock and near Collier Ledge, similar to the Hard Bottom areas mapped under the Massachusetts Ocean Management Plan. Boulders are present within Muskeget Channel in the

OECC and the Western Muskeget Variant, but not in high enough density to warrant the designation of Large Grained Complex habitat and therefore are designated under Complex or Heterogeneous Complex habitat.

Soft Bottom Habitat

Soft Bottom habitat was the most common habitat type throughout the OECC. Large stretches of Soft Bottom habitat were found in the northern and southern portions of the OECC. These areas were mainly sand. Bedforms were common in Soft Bottom Habitat. There was no Soft Bottom habitat within the Western Muskeget Variant.

Benthic Features

Benthic features were present throughout the entire OECC and within the Western Muskeget Variant and SWDA. The benthic features ranged from ripples to sand waves within the OECC and Western Muskeget Variant. The bedforms were usually a range of sizes within a given geographical area and therefore, delineating the various size categories of benthic features (bedforms) defined in NMFS (2021) (ripples, megaripples, and sand waves) was not deemed feasible. Instead, all were mapped under the single category of Benthic Features. No bedforms moving over gravel pavement were found within the OECC, while some gravel pavement is suspected underlying the large sand waves in the Western Muskeget Variant.

6.4.2 Potential Impacts of New England Wind

Potential impacts to coastal habitat are described below for New England Wind construction and installation, operations and maintenance (O&M), and decommissioning stages.

Table 6.4-1 Impact Producing Factors for Coastal Habitat

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Temporary habitat alteration		•	•	•		•
Cable installation/maintenance		•		•	•	
Permanent habitat alteration		•			•	

6.4.2.1 Construction and Installation

As New England Wind involves the installation of offshore export cables below the sea bottom, some disturbances to coastal habitat are unavoidable.

6.4.2.1.1 Temporary Alteration of Coastal Habitat (Phases 1 and 2)

Landfall Site—Phase 1

As described in Section 3.3.1.8 of COP Volume I, at either landfall site, the ocean-to-land transition is expected to be completed by two horizontal directional drilling (HDD) paths that are 300–365 m (1,000–1,200 ft) in length, though the final length will be refined through the ongoing engineering processes. This will avoid or minimize direct impacts to the beach, intertidal zone, and nearshore areas. To facilitate cable pull-in and expose the conduit end, a shallow “pit” would be excavated at the HDD exit point. At the HDD exit point, the contractor may lower a gravity cell to the seafloor that would capture any incidental drilling fluid released from the end of the HDD drill. After the cables are pulled in through the conduit, the seaward end of the conduit would then be reburied beneath the seafloor. All HDD construction activities and staging will be performed within a paved parking lot. The HDD route trajectory will entirely avoid impacts to the relatively small area of eelgrass located offshore from the landfall site in the vicinity of Spindle Rock.

Landfall Site—Phase 2

As described in Section 4.3.1.8 of COP Volume I, HDD is also expected to be used for the ocean-to-land transition at the Dowses Beach Landfall Site to avoid or minimize direct impacts to the beach, intertidal zone, and nearshore areas. The HDD staging area would be setup in the Dowses Beach parking lot. To facilitate cable pull-in and expose the conduit end, a shallow “pit” would be excavated at the HDD exit point. At the HDD exit point, the contractor may lower a gravity cell or cofferdam to the seafloor that would capture any incidental drilling fluid released from the end of the HDD drill.

The Wianno Avenue Landfall Site would use HDD or open trenching. However, the Proponent only expects to use the Wianno Avenue Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all of some of the Phase 2 offshore export cables. Wianno Avenue is less suited for HDD due to the elevated onshore topography and slope of the parking lot. This landfall site is suitable for open-trenching because the shoreline has already been altered by the installation of a riprap seawall, a portion of which would be temporarily removed and replaced following cable installation. As described in Section 4.3.1.8.2 COP Volume I, open-trenching activities involve the installation of a temporary cofferdam, riprap removal and restoration at the existing seawall, dewatering of the cofferdam and excess trench spoils, installation of the conduit(s) and backfilling with sand and gravel fill within the cofferdam, removal of the cofferdam, and burial of the seaward end of the conduits.

Regardless of the landfall site construction method used, no impacts to eelgrass beds are expected.[53]

OECC—Phases 1 and 2

As described in Sections 3.3.1.3 and 4.3.1.3 of COP Volume I, two offshore export cables will be installed for Phase 1 and three offshore export cables will be installed for Phase 2. The offshore export cables can either be installed from the shore towards the electrical service platforms in the SWDA or in the opposite direction.

Prior to cable laying, a pre-lay grapnel run and pre-lay survey will be performed to clear obstructions, such as abandoned fishing gear and other marine debris, and inspect the route. Large boulders along the route may need to be relocated prior to cable installation. Additionally, some dredging of the upper portions of sand waves may be required prior to cable laying to achieve sufficient burial depth below the stable sea bottom. Following the route clearance activities and any required dredging, offshore export cable laying is expected to be performed primarily via simultaneous lay and bury using jetting techniques (e.g. jet plow or jet trenching) or mechanical plow. However, depending on sea bottom conditions, water depth, and contractor preferences, other specialty techniques may be used in certain areas to ensure sufficient burial depth (see Section 3.3.1.3.6 of COP Volume I). No blasting is proposed for cable installation.

Boulder Relocation: Any large boulders along the final offshore export cable alignments may need to be relocated prior to cable installation, facilitating installation without any obstructions to the burial tool and better ensuring sufficient burial. Boulder relocation is accomplished either by means of a grab tool suspended from a vessel's crane that lifts individual boulders clear of the route or using a plow-like tool that is towed along the route to push boulders aside. Boulders will be shifted perpendicular to the cable route; no boulders will be removed from the site.

Pre-Lay Grapnel Run: The pre-lay grapnel run will consist of a vessel towing equipment (i.e. a grapnel train) that will hook and recover obstructions such as fishing gear, ropes, and wires from the seafloor. The grapnel train will consist of a series of different sized and shaped hooks that are dragged across the seafloor.

Pre-Lay Surveys: Shortly before offshore export cable installation, the Proponent will conduct pre-lay surveys along the planned cable alignments. These surveys, which are expected to include high resolution multi-beam echosounder, side scan sonar, and magnetometer, would be used to confirm that the cable route is free of obstructions and verify seabed conditions.

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53 Several isolated rooted plants were observed on multiple transects in 2019 at the Craigville Public Beach and Dowses Beach Landfall Sites, but none were considered part of an eelgrass bed.

Dredging: Multiple seasons of marine surveys have confirmed that segments of the OECC contain sand waves, parts of which may be mobile over time. Therefore, the upper portions of the sand waves may need to be removed so that the cable laying equipment can achieve sufficient burial depth below the sand waves and into the stable sea bottom. As described in Section 3.3.1.3.5 and 4.3.1.3.5 of COP Volume I, where dredging is necessary, it is conservatively assumed that the dredge corridor will typically be 15 m (50 ft) wide at the bottom (to allow for equipment maneuverability) with approximately 1:3 side slopes for each cable.

Sand wave dredging could be accomplished by several techniques:

- A trailing suction hopper dredge, which contains one or more drag arms that extend from the vessel, rest on the seafloor, and suction up sediments. Once filled to capacity, the dredge would sail several hundred meters away and deposit the dredged material within other surveyed areas of sand waves within the OECC.

- Jetting by controlled flow excavation, which uses a pressurized stream of water to push sediments aside.

Dredge volumes are presented in Section 3.3.1.3.5 of COP Volume I for the Phase 1 offshore export cables and in Section 4.3.1.3.5 of COP Volume I for the Phase 2 offshore export cables. The dredge volumes are dependent on the final route and cable installation method; a cable installation method that can achieve a deeper burial depth will require less dredging.

Cable Installation: The offshore export cables will have a target burial depth of 1.5 to 2.5 m (5 to 8 ft) below the seafloor, which New England Wind engineers have determined is more than twice the burial depth that is required to protect the cables from potential fishing activities and also provides a maximum of 1 in 100,000 year probability of anchor strike, which is considered a negligible risk (see Appendix III-P).

Several possible techniques may be used during cable installation to achieve the target burial depth (see description below). Generally, jetting methods are better suited to sands or soft clays whereas a mechanical plow or mechanical trenching tool is better suited to stiffer soil conditions (but is also effective in a wide range of soil conditions). While the final offshore export cable installation method(s) will be determined by the cable installer based on site-specific environmental conditions and the goal of selecting the most appropriate tool for achieving adequate burial depth, the Proponent will prioritize the least environmentally impactful cable installation alternative(s) that is/are practicable for each segment of cable installation.

The majority of the offshore export cables are expected to be installed using simultaneous lay and bury via jetting techniques (e.g. jet plow or jet trenching) or mechanical plow. However, additional specialty techniques are retained as options 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 possible cable protection measures and accommodating varying weather conditions. These techniques are described further in Sections 3.3.1.3 and 4.3.1.3 of COP Volume I.

Impacts from cable installation include an up to 1 m (3.3 ft) wide cable installation trench and an up to 3 m (10 ft) wide temporary disturbance zone from the skids/tracks of the cable installation equipment that will slide over the surface of the seafloor (each skid/track is assumed to be approximately 1.5 m [5 ft] wide). The skids or tracks have the potential to disturb benthic habitat, however, they are not expected to dig into the seabed. The impact is therefore expected to be minor relative to the impacts from the trench. It is expected that the trench will naturally backfill as sediments settle out of suspension, and no separate provisions to facilitate restoration of a coarse substrate are required.

Anchored or Jack-Up Vessel Use: As described in Sections 3.3.1.3.6 and Section 4.3.1.3.6 of COP Volume I, although dynamic positioning cable laying vessels may be used for offshore export cable installation, the expectation is that anchored cable laying vessels will be used along the entire length of the offshore export cables. Anchoring during installation of the offshore export cables is expected to require the use of a nine-point anchoring system, with repositioning needed approximately every 400 m (1,312 ft) on average; however, anchor resetting is highly dependent on final contractor selection and the contractor's specific vessel(s). Each anchor is estimated to disturb approximately 30 m^2 (323 ft^2), such that a vessel equipped with nine anchors would disturb approximately 270 m^2 (2,906 ft^2) of the seafloor each time the vessel repositions its anchors.[54]

Anchored vessels may be equipped with spud legs that are deployed to secure the cable laying vessels while its anchors are being repositioned. The spud legs would disturb up to approximately 10 m^2 (108 ft^2) each time they are deployed. To install the cable close to shore using tools that are best optimized to achieve sufficient cable burial, the cable laying vessel may temporarily ground nearshore, impacting an area of up to 9,750 m^2 (2.4 acres) per cable. A jack-up vessel may be used to facilitate pulling the offshore export cables through horizontal directional drilling (HDD) conduits installed at the landfall site (see Section 3.3.1.8 for a description of HDD).[55] Any anchoring, jacking-up, spud leg deployment, or grounding will occur within areas of the OECC and SWDA that will have been surveyed.

Cable Splicing: Due to the length of the offshore export cables and other considerations, the offshore export cables will likely require two or three joints (splices). Upon reaching the splicing location, a cable will be retrieved from the seabed and brought inside the cable laying vessel or

[54] The impacts from anchor sweep are not quantified at this time due to the difficulty of estimating potential anchoring practices at the early planning stages of New England Wind.

[55] Any seafloor disturbance resulting from a jack-up vessel used for cable pulling operations would be within the total seafloor disturbance from offshore export cable installation provided in Appendix III-T.

other specialized vessel (e.g. jack-up vessel). If a jack-up vessel is used for cable splicing operations, the vessel would impact approximately 600 m^2 (0.15 acres) of seafloor each time the vessel jacks-up.

<u>Summary:</u> The total seafloor impacts from offshore export cable installation are quantified for Phases 1 and 2 in Appendix III-T. These impacts are provided for the entire OECC within state and federal waters, but it is noted that only those portions of the OECC within state waters are considered to be within "coastal habitat."

6.4.2.1.2 Permanent Alteration of Coastal Habitat (Phases 1 and 2)

The Proponent's priority is to achieve sufficient burial depth of the offshore export cables and reduce or avoid the need for any cable protection. A risk remains, however, that cable burial may be unsuccessful in areas where the seafloor is composed of consolidated materials, submerged boulders, or stiff clays that would hamper cable burial, thereby making cable protection necessary. In the event sufficient burial depths cannot be achieved or the cables need to cross other infrastructure (e.g. existing cables), alternative cable protection methods will be used. If needed, the methods for cable protection are listed below, and are described in greater detail in Sections 3.2.1.5.4 and 4.2.1.5.4 of COP Volume I:

- Rock placement
- Gabion rock bags
- Concrete mattresses (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 (only for cable crossings or where the cable is laid on the seafloor)

Cable crossings are described in Sections 3.3.1.3.11 and 4.3.1.3.11 in COP Volume I.

Where used, cable protection will be up to 9 m (30 ft) wide. A conservative estimate is that approximately 6% of the cable alignments within the OECC for both Phases may require cable protection (or up to 7% of the cable alignments within the OECC for both Phases if the Western Muskeget Variant is used for one or two Phase 2 export cables). Areas requiring cable protection, if any, will be the only locations where post-installation conditions at the seafloor will permanently differ from existing conditions along the OECC.

6.4.2.1.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Proponent is implementing multiple measures to avoid, minimize, or mitigate impacts in coastal habitats. For the Phase 1 and Phase 2 landfall sites, the Proponent has minimized or avoided impacts by selecting locations that are primarily situated in previously-disturbed areas and have sufficient workspace to allow construction and installation activities to be effectively segregated from any nearby sensitive coastal habitats (i.e. work at the landfall sites will primarily occur within paved or otherwise disturbed areas). Similarly, use of HDD at the Phase 1 and Phase 2 landfall site will avoid impacts to the beach, intertidal area, and nearshore areas, though open trenching may also be used during Phase 2 if it is not feasible to use the Dowses Beach Landfall Site and open trenching is needed at the Wianno Avenue Landfall Site. Additionally, best management practices will be used in both Phases during refueling and lubrication of equipment to protect coastal habitats from accidental spills. The Proponent has also developed a draft Oil Spill Response Plan for New England Wind, which is included in Appendix I-F.

Although not anticipated, a small amount of bentonite clay could be released at the exit point of the HDD operation, and the contractor may install silt curtains at the exit point. Bentonite clay is an inert, naturally-occurring substance and is appropriate for use in sensitive environments because it poses minimal environmental risks; for this reason, bentonite is commonly used for the HDD process. Nevertheless, the contractor will minimize the amount of bentonite near the exit hole and will have controls near the exit hole to minimize and contain any bentonite. The temporary receiving pit will be filled back in with the same material once the offshore export cable has been brought to land, thereby restoring the ocean bottom to pre-installation conditions.

Routing for the OECC has been undertaken in a manner that avoids and minimizes impacts to sensitive habitats where feasible (see Section 2.4 of COP Volume I). More specifically, the OECC avoids mapped core habitat for the North Atlantic right whale. The preliminary routing of the Phase 1 and Phase 2 cables has avoided sensitive habitats including eelgrass, hard bottom, and complex bottom (i.e. sand waves) where feasible, but avoidance of all sensitive habitats is not always possible. Route engineers must develop routes for cables within the OECC that are technically viable and provide workable slopes, suitable water depths for available cable installation vessels, feasible turning radii for the cables, avoid high concentrations of boulders or very stiff sediments where cable burial would be challenging, maintain a sufficient distance between the planned Vineyard Wind 1 cables and Phase 2 cables, and avoid crossing the planned Vineyard Wind 1 cables.

The identified eelgrass resources near Spindle Rock in proximity to the landfall sites will be avoided (see Figure 6.4-1). Additionally, the eelgrass resources in proximity to the potential Phase 2 landfall sites, located outside the OECC boundary, will be avoided (see Figure 6.4-1). It is also expected that isolated areas of hard bottom may be avoided, such as at Spindle Rock; however, in areas such as Muskeget Channel where hard bottom extends across the entire corridor, it will not be possible to avoid hard bottom.

Prior to the start of offshore export cable laying preparatory activities for either Phase, The Proponent will communicate with commercial fishermen following the protocols outlined in the Fisheries Communication Plan provided in Appendix III-E to help avoid potential fishing gear interactions. Any fishing gear discovered during the pre-lay grapnel run will be handled in accordance with the gear interaction protocols outlined in the Fisheries Communication Plan, the requirements of the Massachusetts Division of Marine Fisheries, and other relevant regulations.

For each Phase, prior to the start of construction, contractors will be provided with a map of sensitive habitats to allow them to plan their mooring positions accordingly. Vessel anchors and legs will be required to avoid known eelgrass beds and will also be required to avoid other sensitive seafloor habitats (hard/complex bottom) as long as such avoidance does not compromise the vessel's safety or the cable's installation. Where it is considered impossible or impracticable to avoid a sensitive seafloor habitat when anchoring, use of mid-line anchor buoys will be considered, where feasible and considered safe, as a potential measure to reduce and minimize potential impacts from anchor line sweep.

The Proponent will also continue to prioritize achieving sufficient cable burial. While the actual offshore export cable installation method(s) will be determined by the cable installer based on site-specific environmental conditions and the goal of selecting the most appropriate tool for achieving adequate burial depth, the Proponent will prioritize the least environmentally impactful cable installation alternative(s) that is/are practicable for each segment of cable installation. The Proponent intends to avoid or minimize the need for cable protection to the greatest extent feasible through careful site assessment and thoughtful selection of the most appropriate cable installation tool to achieve sufficient burial.

6.4.2.2 Operations and Maintenance

6.4.2.2.1 Alteration of Coastal Habitat (Phases 1 and 2)

Normal O&M activities for either Phase will not result in further coastal habitat alteration. Some maintenance or repairs may be required at the landfall site transition vaults over the up to 30-year life of each Phase. Such work would typically occur within the vaults, which will be located beneath existing public roadway layouts and accessed through manholes. This will allow such work to be completed within previously installed onshore infrastructure and without additional impacts to coastal habitat.

It is expected that cable protection installed in areas where sufficient burial depth cannot be achieved would be in place during O&M. The presence of cable protection may introduce a source of new hard substrate that may attract structure-oriented species, as discussed further in Section 6.5.

In case of a cable fault along the OECC for either Phase, repair operations would be undertaken. Impacts associated with cable maintenance and/or repair could include a temporary increase in turbidity and some localized deposition of sediment during the repair process. The increase in turbidity would be caused by the removal of sediments to uncover the damaged portion of the cable, hoisting of the cable after it is cut, laying the cable back down, and then jetting or otherwise removing sediments for reburial of the repaired cable. Temporary impacts would also occur where anchors are deployed or where anchor cable sweeps the bottom. Such impacts would be confined to the specific area of the repair(s) and, given the limited area(s) where repair(s) may occur, would be considerably less than the impacts during construction.

6.4.2.2.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The majority of the repairs that could be needed at the landfall sites for either Phase are expected to be conducted within previously installed onshore infrastructure, which will minimize or avoid impacts to coastal habitat.

The offshore export cables for each Phase will be regularly monitored. As described in Sections 3.2.1.5.1 and 4.2.1.5.1 of COP Volume I, the cable design may include a Distributed Temperature System that monitors the temperature of the cable at all times. Significant changes in temperature recorded by this system may also be used to indirectly indicate cable exposure. Further, bathymetric and other surveys will be used to monitor cable exposure and/or depth of burial.

6.4.2.3 Decommissioning

A general decommission plan is being developed for Phases 1 and 2 and is described in Sections 3.3.3 and 4.3.3 of COP Volume I. Upon receipt of the necessary Bureau of Ocean Energy Management approval and any other required permits, The Proponent would implement the decommissioning plan to remove and recycle equipment and associated materials. As currently envisioned, the decommissioning process is essentially the reverse of the installation process. Decommissioning of the offshore facilities within coastal habitats is expected to include:

- ♦ Retirement in place or removal of the offshore cables and any associated cable protection.
- ♦ Possible removal of onshore cables.

The extent of the decommissioning of onshore components, such as the onshore export cables, is subject to discussions with the Town of Barnstable on the decommissioning approach that best meets the Town's needs and has the fewest environmental impacts. The onshore cables, transition vaults, and concrete duct bank could be retired in place or retained for future use.

If the offshore export cables are removed from the seafloor, the environmental impacts would be generally similar to the impacts experienced during construction. If they are retired in place, no additional impacts to coastal habitats are anticipated. It is expected that similar avoidance, minimization, and mitigation measures as used for construction would be used to limit impacts during decommissioning activities.

6.5 Benthic Resources

This section describes benthic resources present in the Offshore Development Region and Offshore Development Area of New England Wind.

6.5.1 Description of the Affected Environment

The Offshore Development Area is the offshore area where the Proponent's offshore facilities are physically located, which includes all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]), as well as the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]). New England Wind will be developed in two Phases with a maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions and five offshore export cables in the OECC.

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the option to install one or two Phase 2 cables[56] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[57] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

With respect to benthic resources, the Offshore Development Region is the broader offshore geographic region surrounding the SWDA and OECC that could be affected by New England Wind-related activities, which includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, and the Massachusetts Wind Energy Area (MA WEA) where Lease Areas OCS-A 0501 and OCS-A 0534 are located.

This section presents a summary of benthic habitat and shellfish within the broader Offshore Development Region and also, more specifically, within the Offshore Development Area. Data used to describe benthic resources in these areas come from a robust dataset and previous studies conducted within the Offshore Development Region and Offshore Development Area, primarily between 2012–2020. Primary data sources include the Bureau of Ocean Energy Management's (BOEM) Revised Environmental Assessment for the MA WEA (BOEM 2014), region-wide surveys in Massachusetts state waters, and site-specific data collected within Lease Areas OCS-A 0501 and OCS-A 0534, including within the SWDA (see COP Volume II for details of site-specific sampling). The datasets not specific to Lease Areas OCS-A 0501 and OCS-A 0534 (i.e. samples not collected by the Proponent) consist of a mix of grab sample and imagery data collected within the Offshore Development Region, covering both spring and fall seasons, which enabled characterization of seasonal and inter-annual variability. Combined, the above data

56 It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

57 The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

sources allowed for the characterization of abundance, diversity, and community composition of benthic macrofauna and macroflora, both within the Offshore Development Region and within the Offshore Development Area.

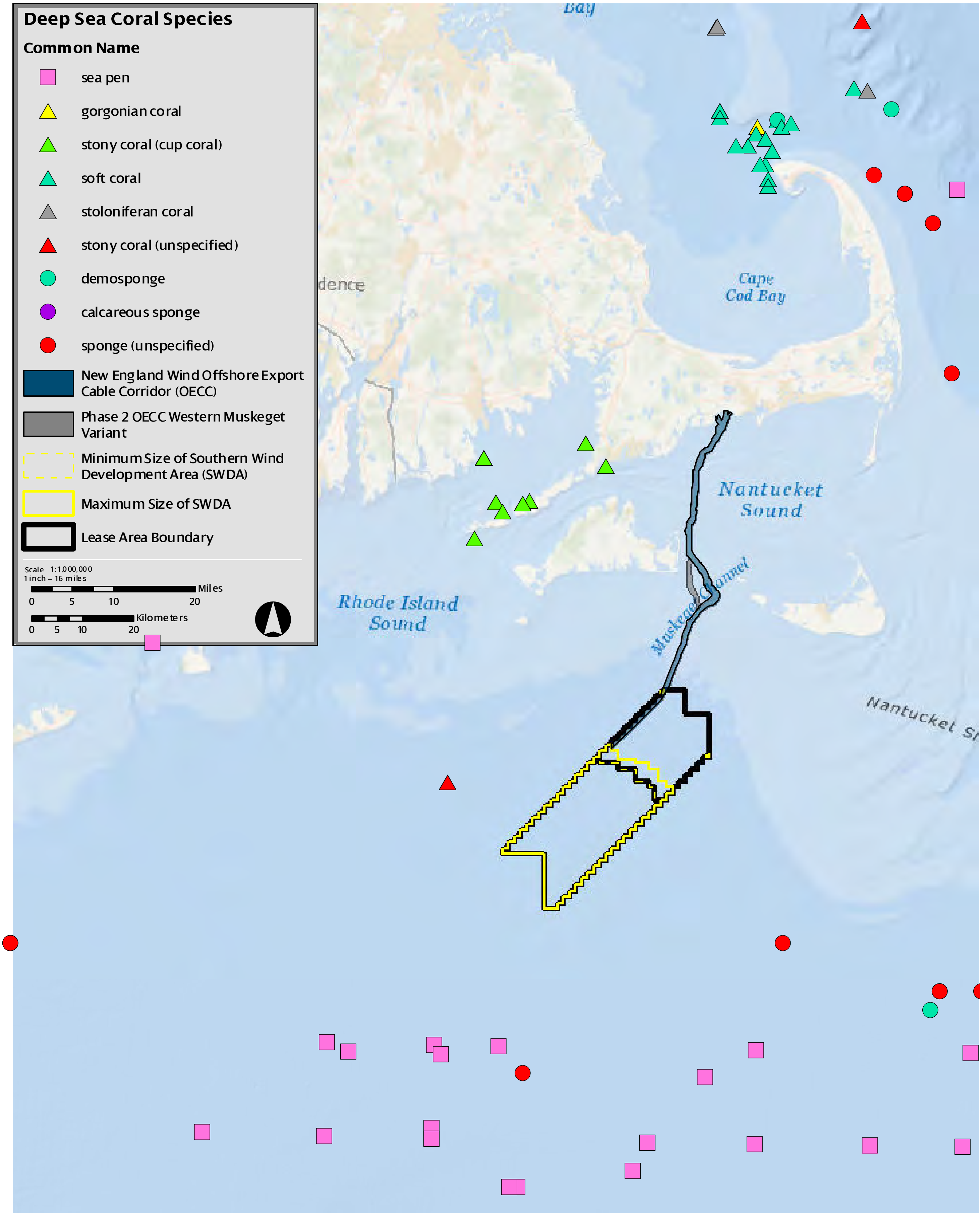
6.5.1.1 Offshore Areas Within and Around the SWDA

6.5.1.1.1 SWDA Habitats and Communities

As discussed in Section 2 of COP Volume II, seafloor conditions within the SWDA are entirely composed of fine unconsolidated substrate dominated by sand and silt-sized sediments. These homogenous conditions were identified by multi-beam echo sounding and side scan sonar imaging techniques that have been ground-truthed via benthic grab samples, underwater video, borings, and cone penetration tests, and further verified via historic grab sample and still photo data (Guida et al. 2017; Stokesbury 2013; 2014). Localized ripple scour depressions (RSDs) are located in the middle of the SWDA, oriented northeast-southwest in the southeastern portion of the SWDA. Within the RSDs, the sediment is coarser grained sand (medium and very coarse/coarse) as opposed to the typically muddy sand outside the RSD areas. The RSD features within the SWDA provide less than 0.8-1 meter (m) (2.6-3.3 feet [ft]) relief and are far smaller than sand waves in some other parts of the Atlantic that can stretch hundreds of meters.

As discussed in the Shallow Hazards Assessment in Section 3 of COP Volume II, side scan sonar coverage of the seafloor revealed two possible shipwrecks in the western portion of the SWDA in 54 and 55 m (167.3 and 108.4 ft) of water. One area had a scattered debris field with less than 1-m (3.3 ft) relief above the seafloor. The second potential shipwreck had 2 m (6.6 ft) relief above the seafloor, and a wider debris field with less than 0.5 m (1.6 ft) relief. Three shipwrecks have been charted within the SWDA limits but only one aligned with the second sonar contact.

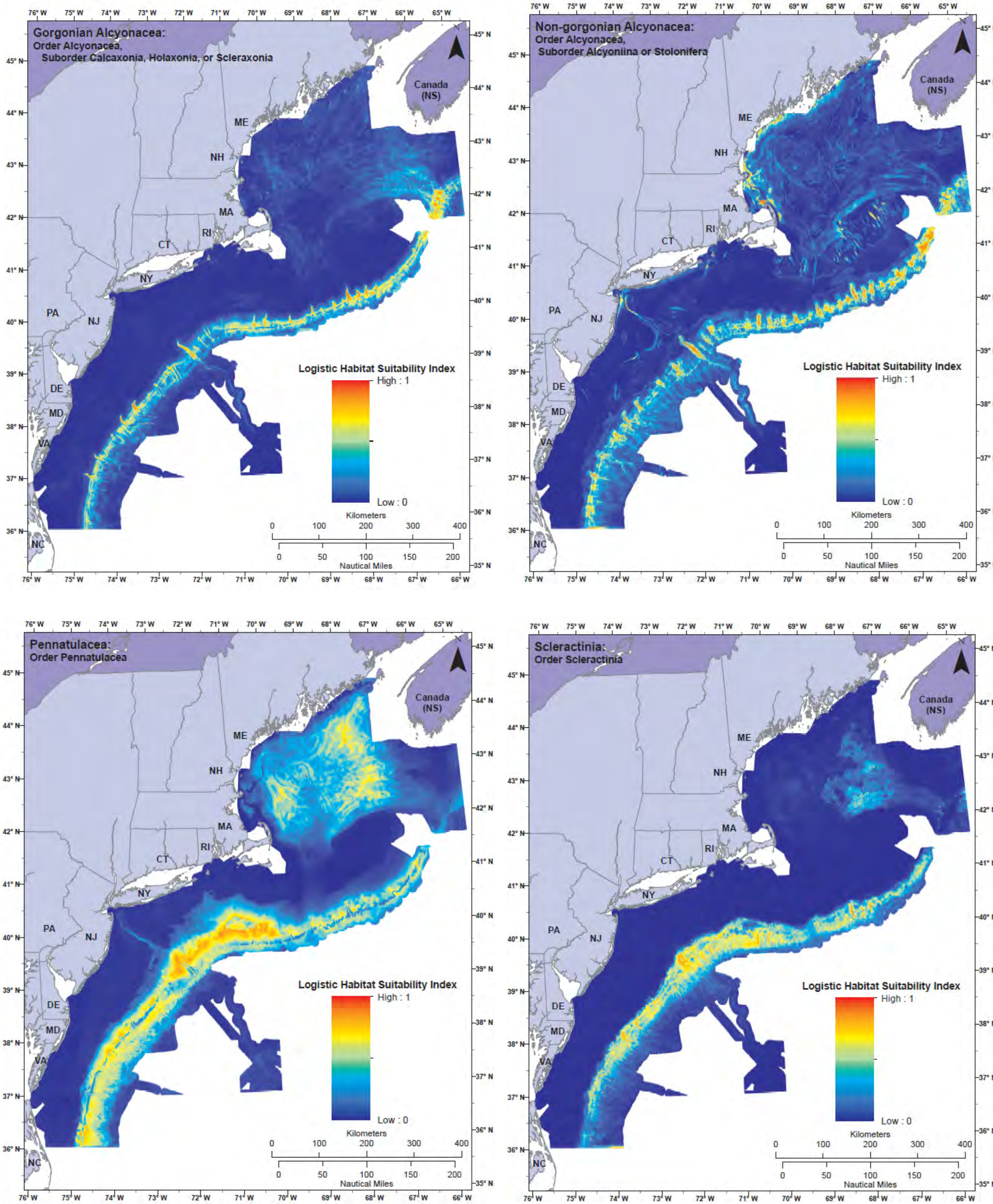
No state-managed artificial reefs have been documented within the SWDA. Other types of potentially sensitive or unique benthic habitat types, such as live bottom, are also not present based on the Shallow Hazards Assessment discussed in Section 3 of COP Volume II. Similarly, no observations of living bottom have been made within the SWDA based on data available on the National Oceanic and Atmospheric Administration (NOAA) Deep-Sea Coral Data Portal (NOAA 2020) (see Figure 6.5-1). However, it is important to note that this database does not include "observations of absence" for corals and sponges. As few areas have been surveyed for corals or sponges, the lack of observations in the database does not necessarily indicate no taxa are present (Hourigan et al. 2015). Due to the logistical difficulty and expense of surveying the deep ocean, NOAA National Centers for Coastal Ocean Science (NCCOS) uses statistical modeling techniques to help fill the gap between surveyed areas, which use known deep-sea coral locations, environmental data, and oceanographic data to predict areas that can support deep-sea corals. The NOAA NCCOS model results indicated that the area within the SWDA has a low habitat suitability index for all soft and hard coral species analyzed (Kinlan et al. 2016) (see Figure 6.5-2).



New England Wind

Figure 6.5-1

Locations of Observed Deep-sea Coral in the Offshore Development Area (NOAA 2020)



National Centers for Coastal Ocean Science,
Center for Coastal Monitoring and Assessment, Biogeography Branch
Map Projection: WGS84 UTM Zone 18N

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Figure 6-5.2

NOAA NCCOS Logistic Habitat Suitability Indices for Soft Coral (Alcyonacea), Hard Coral (Scleractinia) and Sea Pens (Pennatulacea)

6.5.1.1.2 SWDA Epifauna

According to known observations within the NOAA Deep Sea Coral Data Portal database (NOAA 2020), the closest unspecified stony coral (Scleractinia) is approximately 20 kilometers (km) (11 nautical miles [NM]) to the west-northwest of the SWDA. Farther offshore, outside the MA WEA, are patches of sea pens (*Stylatula elegans*), stony coral, sponges, soft coral, and gorgonian coral as shown in Figure 6.5-1. Star coral (*Astrangia poculata*) was observed in discrete areas in surveys along the OECC and in surrounding waters in 2017 and 2018 (CR Environmental 2017; 2018).

The benthic communities in the SWDA represent a subset of communities within New England waters in depths from approximately 43–62 m (141–203 ft), which includes amphipods and other crustaceans, American lobster (*Homarus americanus*), crabs, gastropods, polychaetes, bivalves, sand dollars, burrowing anemones, brittle stars, sea squirts, tunicates, and sea cucumbers (BOEM 2014; Provincetown Center for Coastal Studies 2005). These organisms are important food sources for many commercially important northern groundfish species. Benthic communities are present in the patches of sand ripples and small mega-ripples within the SWDA but within these variable mobile sand environments, fauna is often quite sparse (Jennings et al. 2013).

Benthic beam trawls and grab samples were collected throughout the MA WEA during a shipboard Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution (AMAPPS) conducted by the Northeast Fisheries Science Center (NEFSC), Integrated Statistics, Inc., and Woods Hole Oceanographic Institution from April to May 2014 (NEFSC 2014). The aim of this survey was to document the relationship between the abundance of sea birds, cetaceans, and sea turtles and the biological and physical environment, including the benthos. Within 23 beam trawls (2 m [6.5 ft] width, 7-minute tows at 3.7 km/hr [2 knot] vessel speed) conducted by NEFSC in the MA WEA, 59 invertebrate taxa were identified, with sand shrimp (*Crangon septemspinosa*), sand dollars, pandalid shrimp (*Pandalidae*), and monkey dung sponge (*Suberites ficus*) observed as the top four species by percent count, weight, and frequency (see Table 6.5-1).

Table 6.5-1 Beam Trawl Summary for Epibenthic and Demersal Invertebrate Fauna within the MA WEA (23 trawls and 59 taxa)[1]

Common Name	Taxonomic Name	% Total Count[2]	% Total Weight[2]	% Frequency[3]
Sand shrimp	*Crangon septemspinosa*	70.5	5.7	95.7
Sand dollar	*Echinarachnius parma*	17.4	47.6	39.1
Pandalid shrimp	Pandalidae	0.5	0.1	52.2
Monkey dung sponge	*Suberites ficus*	0.1	15.4	26.1

Notes:

1. Data from NEFSC (2014).
2. Does not add to 100% because only the top four species are shown.
3. Does not add to 100% because frequency is not additive.

Drop-down video surveys of benthic epifauna in the MA WEA conducted by the University of Massachusetts School of Marine Science and Technology (SMAST) from 2010–2013 indicated that the common sand dollar (*Echinarachnius parma*) was the most abundant within the MA WEA, with this species occurring in approximately 70% of a total of 216 samples collected (SMAST 2016).

Similar patterns of sand dollar abundance were observed during video surveys conducted by the Coonamessett Farm Foundation, Inc. as part of a southern New England juvenile fish study between December 2015 and early April 2016 in portions of the MA WEA and Rhode Island/Massachusetts Wind Energy Area (Siemann and Smolowitz 2017). In the juvenile fish study, comprising video surveys and scallop dredge tows, high abundances of sand dollars were found throughout portions of the MA WEA and SWDA, where sandy substrates predominate. The sampling locations for these surveys are provided in Figure 6.5-3.

As part of the 2010–2013 SMAST drop-down video survey, sampling occurred within the SWDA in May 2012 and September 2013 (SMAST 2016). The numbers of species collected during the two seasons is provided in Table 6.5-2. From this sampling program, more benthic organisms were collected in the spring (113 organisms) than in the fall (103 organisms). Hydrozoans and bryozoans were present in approximately 19% of the 191 samples, while hermit crabs, euphausiids, sea stars, and anemones, combined, were present in 13% of the samples (SMAST 2016). It is important to note, however, that none of these benthic epifauna, infauna, or macrofauna have a designated conservation status as they are typically found widespread on the Nantucket Shelf.

Table 6.5-2 Number of Organisms by Season from SMAST Video Survey Samples Collected in the SWDA in April/May 2012 and September 2013 (191 samples from 16 locations)[1]

Common Name	Number in Spring	Number in Fall
Hermit crab	9	1
Euphausiids	4	0
Sea stars	2	3
Sand dollars	58	21
Anemones	6	0
Hydra	34	73
Scallop	0	5

Notes:
1. Data from SMAST (2016).

The Proponent has also engaged SMAST to conduct video surveys within Lease Areas OCS-A 0501 and OCS-A 0534, including the SWDA. As part of the 2019 SMAST video surveys, drop-down video sampling occurred within the SWDA in July and October (Bethoney et al. 2019). Sampling occurred in a 5.6 km (3 NM) grid with 13 total stations in the SWDA. Bryozoans/hydrozoans followed by burrows were the most common benthic features observed (see Table 6.5-3). Except for skates, the presence of animal groups generally declined from July to October. As part of the 2020 SMAST video surveys, drop-down video sampling occurred again within the same grid in July and October (Stokesbury et al. 2020). Burrows crabs, sea stars, and anemones were the most common benthic features observed (see Table 6.5-3). The presence of animal groups generally declined again from July to October.

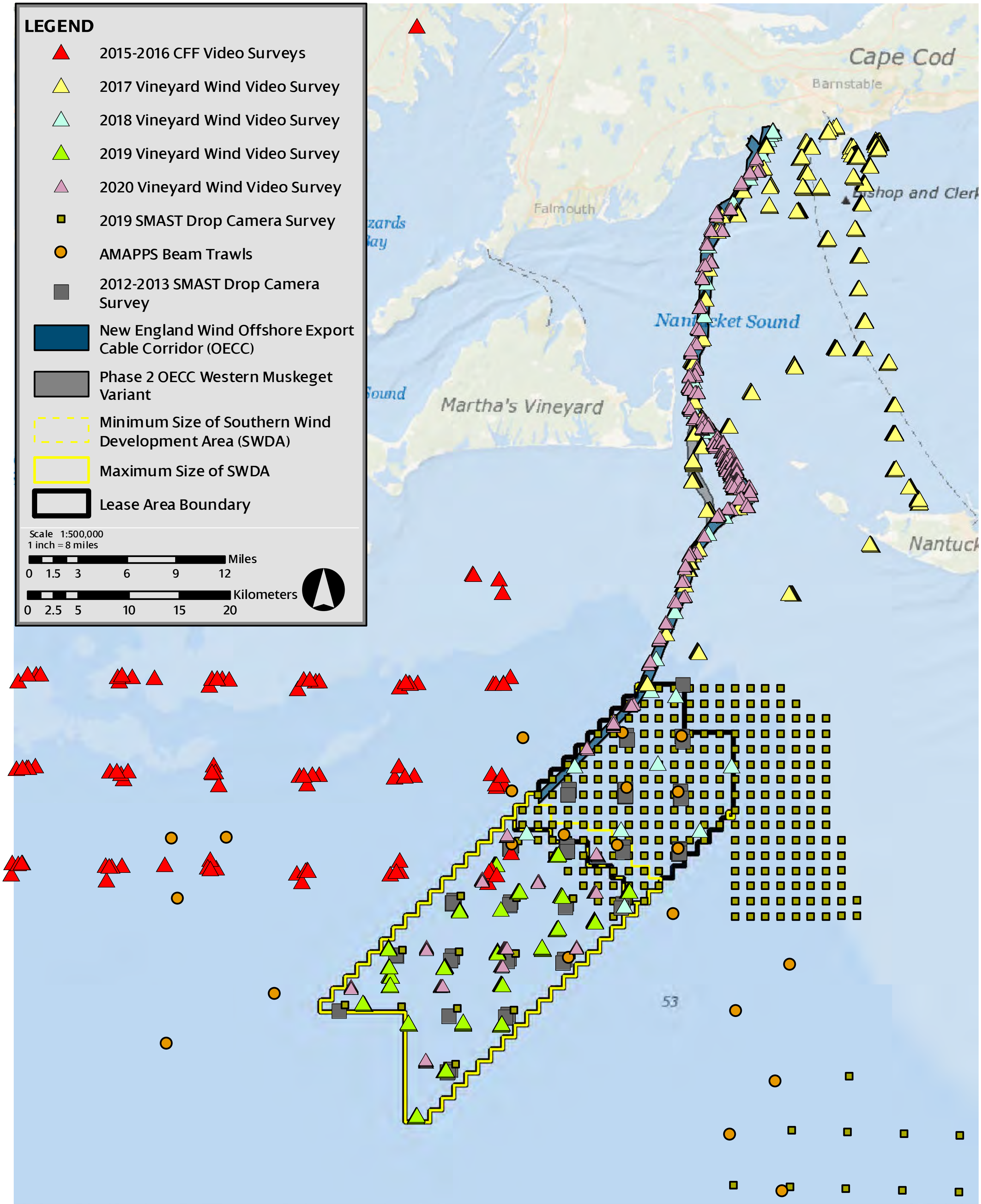

Figure 6.5-3

Epifauna Sampling Locations within and around the Offshore Development Area

Table 6.5-3 Benthic Animal Groups, in Order of Frequency of Appearance, During the July and October 2019 and 2020 SMAST Drop Camera Surveys in the SWDA[1]

Common Name	2019		2020	
	Quadrats Present	Count[2]	Quadrats Present	Count[2]
Bryozoans/Hydrozoans	52	-	0	
Anemones	10	-	6	-
Common whelk	10	12		
Crabs (cancer spp.)	4	4	10	11
Flat fishes	5	6		
Hagfish			1	1
Hermit crabs	12	14	5	5
Holes (burrowing animals)	50	-	43	-
Red hake	4	4	3	3
Sea stars	7	8	8	14
Skates	3	3		
Sliver hake	3	3	5	6
Sponges			3	-
Unidentified fish			2	5

Notes:
1. Data from SMAST (Bethoney 2019, Stokesbury 2021).
2. Groups with “-“ in the count column are only tracked as present or absent.

Video transects were completed in the SWDA from November to December 2019 as part of a Vineyard Wind 1 survey. It included 22 SWDA transects of about 200 m (656 ft) in length to characterize benthic resources. During the 22 transects, with varying degrees of visibility, seven fish taxa, 10 invertebrate taxa, and two kinds of egg cases (skate and moon snail) were identified within the SWDA to the Lowest Practical Taxonomic Level. A total of 1,632 individual macrofauna were counted in one transect, 80% of which (1,311 individuals) were sea stars. Other relatively numerous taxa across transects include moon snail (Naticidae), sea sponge (Porifera), skate (Rajidae), and hake (*Merluccius* spp.) (RPS 2020a) (see Table 6.5-4).

Table 6.5-4 2019 Video Transect Summary for Epibenthic and Demersal Fauna within the SWDA (22 video transects)[1]

Common Name	Lowest Taxonomic Grouping	Total Counted
Seastar	Asterias	1,311
Moon snail	Naticidae	66
Sea sponge	Porifera	45
Skate	Rajidae	41
Hake	Merluccius	39
Flounder	Pleuronectiformes	38
Sea urchin	Echinoidea	27
Hermit crab	Pagurus	15
Cancer crab	Cancer	14
Sea scallop	Plactopecten magellanicus	7
Skate egg case	Rajidae egg case	6

Table 6.5-4 2019 Video Transect Summary for Epibenthic and Demersal Fauna within the SWDA (22 video transects)[1] (Continued)

Common Name	Lowest Taxonomic Grouping	Total Counted
Squid	Cephalopoda	5
Unidentified fish	Actinopterygii	5
Moon snail egg case	Naticidae egg case	4
American lobster	*Homarus americanus*	2
Ray-finned Fish	Actinopterygii	2
Winter skate	*Leucoraja ocellata*	2
Fourspot flounder	*Hippoglossina oblonga*	1
Northern sea robin	Prionotus	1
Shrimp	Decapoda	1
Total	-	**1,632**

Notes:
1. Data from RPS (2020).

Video transects were completed in the SWDA from July to August 2020 as part of a Vineyard Wind 1 survey. It included 12 SWDA transects of about 150-300 m (492-984 ft) in length to further characterize benthic resources. During the 12 transects, with varying degrees of visibility, six fish taxa, 16 invertebrate taxa, and two kinds of egg cases (skate and moon snail) were identified within the SWDA to the Lowest Practical Taxonomic Level. A total of 782 individual macrofauna were counted in one transect, 94% of which (732 individuals) were burrowing anemones. Other relatively numerous taxa across transects include shrimp (Decapoda), hakes (Gadidae), and sea stars (*Asterias* spp.) (see Table 6.5-5 and RPS 2021; Appendix II-H).

Table 6.5-5 2020 Video Transect Summary for Epibenthic and Demersal Fauna within the SWDA (12 video transects)[1]

Common Name	Lowest Taxonomic Grouping	Total Counted
Burrowing Anemone	*Cerianthus borealis*	782
Shrimp	Decapoda	178
Hake, Unidentified	Gadidae	99
Sea Star	Asterias	93
Crab, Cancer	Cancer	85
Roundfish, Unidentified	Teleostei	17
Scallop, Sea	*Placopecten magellanicus*	14
Flounder	Pleuronectiformes	14
Skate	Rajidae	13
Crab, Hermit	Pagurus	12
Sea Star, Blood	*Henricia sanguinolenta*	6
Moon Snail	Naticidae	6
Solitary Hydroid	Hydrozoa	5
Fish, Unidentified (Bony)	Teleostei	5
Skate, Egg Case	Rajidae	4

Table 6.5-5 2020 Video Transect Summary for Epibenthic and Demersal Fauna within the SWDA (12 video transects)[1] (Continued)

Common Name	Lowest Taxonomic Grouping	Total Counted
Sea Urchin	Echinoidea	2
Hake, Silver	*Merluccius bilinearis*	2
Whelk (Knobbed, Channeled)	Melongenidae	1
Moon Snail, Egg Case	Naticidae	1
Worm, Polychaete	Polychaeta	1
Worm, Unidentified	Polychaeta	1
Worm, Scale	Polynoidae	1
Worm, Sabellid	Sabellida	1
Skate, Little or Winter	Leucoraja	1
Monkfish	*Lophius americanus*	1
Flatfish, Unidentified	Teleostei	1
Squid	Cephalopoda	1
Total	-	**1,348**

Notes:
1. Data from RPS 2021.

6.5.1.1.3 SWDA Infauna

Information on infauna within the SWDA is available from regional and site-specific surveys. In addition to beam trawls, the NEFSC AMAPPS survey (NEFSC 2014) also consisted of 32 grab stations with three replicate grabs for grain size and benthic infauna at each location. The grab samples were analyzed for sediment grain size and confirmed that homogenous sand is predominate in the MA WEA.

While the infaunal results have not been made available, BOEM provided the Proponent with preliminary data results to incorporate into the evaluation of benthic resources within Lease Areas OCS-A 0501 and OCS-A 0534. Within the 90 successful samples, amphipods from the family Ampeliscidae were most common and contributed to 41% of the total sample abundance. Nut clams (Nuculidae) and three families of polychaete worm (Paraonidae, Lumbrineridae, and Cirratulidae) accounted for 16% and 19% of the total sample abundance, respectively. For the SWDA specifically, 12 benthic grabs from the NEFSC AMAPPS survey were collected from four sampling locations in March 2014 (see Figure 6.5-4). The most abundant species within these samples were amphipods from the family Ampeliscidae (52% of all taxa) and marine polychaete worms from the families Paraonidae, Lumbrineridae, Maldanidae, and Cirratulidae (at 23% as a combined taxa) (see Figure 6.5-5).

Infaunal sampling occurred in Massachusetts state waters south of Martha's Vineyard and Nantucket in September 2011. This survey included benthic grabs at 214 stations, 95 of which were located south of Cape Cod and the Islands near, but not within, the SWDA. Oligochaetes, polychaetes, and nemertean ribbon worms were the most widely distributed taxa (AECOM 2012). One hundred twenty-eight families were identified from the samples collected with an average of 23 (standard deviation [SD] ± 7) taxa per location. Density ranged from 12 to greater than 1,000 individuals per sample, with an average density of 599.5 (SD ± 712.1) per 0.04 square meters (m^2) (4.3 square feet [ft^2]). Nut clams (family Nuculidae) were the most abundant, comprising over 24% of all organisms. Capitellid polychaetes and four-eyed amphipods (Ampeliscidae) were also abundant, comprising 16% and 9% of organisms, respectively.

The collection and analysis of benthic samples occurred in 2017 and 2018 within the Wind Development Area for Vineyard Wind 1 and along the OECC.[58] The benthic macrofaunal assemblages in the analyzed samples consisted of polychaete worms, crustaceans, mollusks, echinoderms, nematode roundworms, and nemertean ribbon worms (Epsilon Associates, Inc. 2018).

As part of site-specific surveys of the SWDA in 2019, forty 0.008 m^2 (0.086 ft^2) grab sample cores were collected in November and processed. These samples yielded a total of 2,641 organisms from five phyla for an average of 66 individuals per sample (8,250 individuals per m^2 [766 per ft^2]) (RPS 2020a). Arthropoda (1,735 organisms) were most abundant followed by Annelida (742 organisms), Nematoda (80 organisms), Mollusca (56 organisms), and Nemertea (28 organisms). Specifically, Ampeliscidae were the most abundant Arthropods (1,338 organisms) while Lumbrineridae and Paraonidae were the most abundant Annelids. Margalef's richness index applied to the samples ranged from 0.87 to 5.42 with a mean of 2.96 while the Shannon diversity ranged from 1.03 to 2.36 with an average of 1.70 indicating variability between samples.

As part of site-specific surveys of the SWDA in 2020, forty 0.008 m^2 (0.086 ft^2) grab sample cores were collected in July and processed. These samples yielded a total of 2,632 organisms from eight phyla for an average of 66 individuals per sample (8,225 individuals per m^2 [766 per ft^2]) (RPS 2021). Arthropoda (1,040 organisms) were most abundant followed by Annelida (1,019 organisms), Mollusca (335 organisms), Nematoda (206 organisms), Nemertea (28 organisms), and a few Echinodermata, Cnidaria, and hemichordata. Specifically, Ampeliscidae were the most abundant Arthropods (792 organisms) while Spionidae and Lumbrineridae were the most abundant Annelids. Margalef's richness index applied to the samples ranged from 1.44 to 5.29 with a mean of 3.53 while the Shannon diversity ranged from 1.1 to 2.63 with an average of 2.06 indicating variability between samples.

[58] The OECC for New England Wind is largely the same OECC proposed for Vineyard Wind 1.

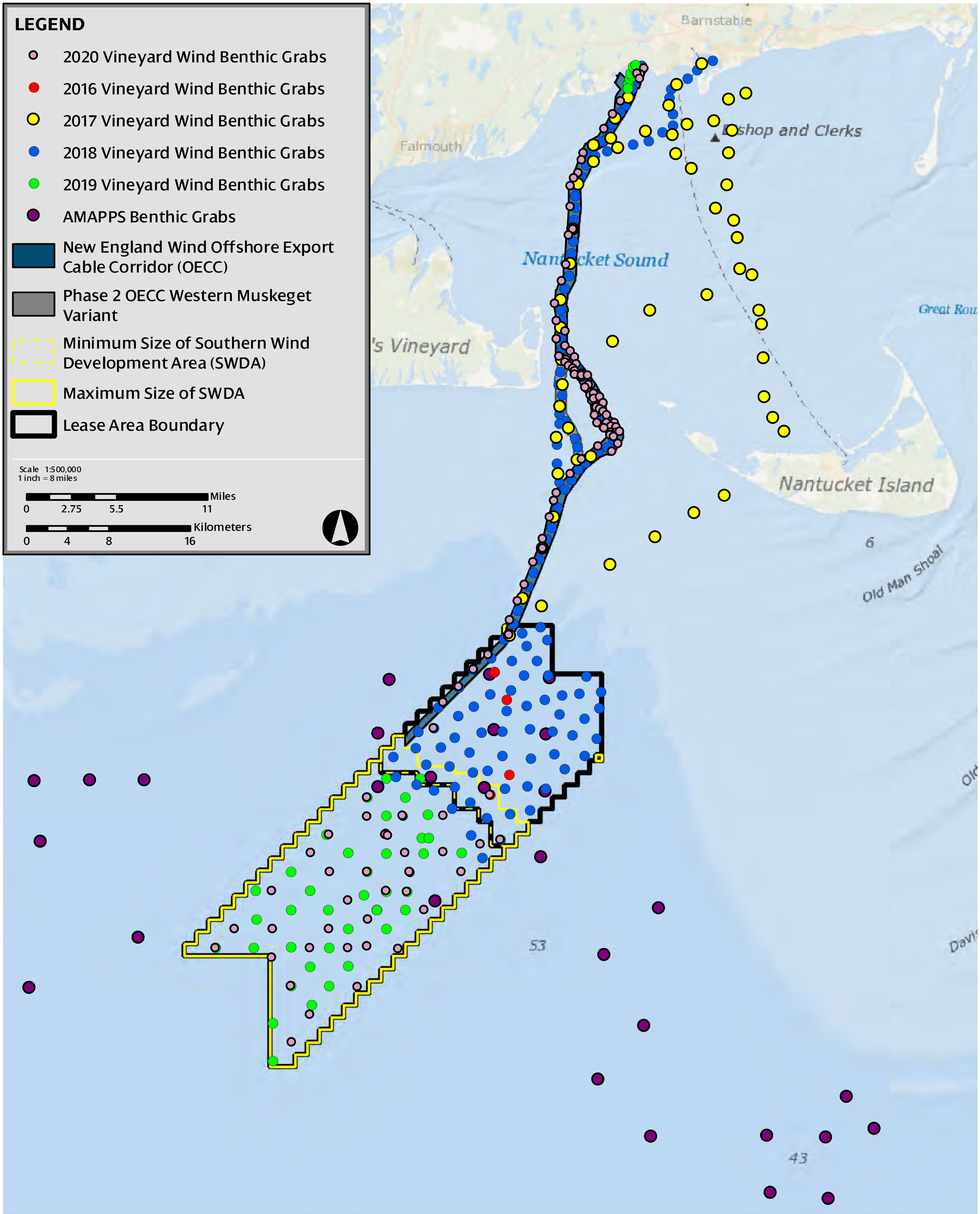

Figure 6.5-4

Infauna Sampling Locations within and around the Offshore Development Area

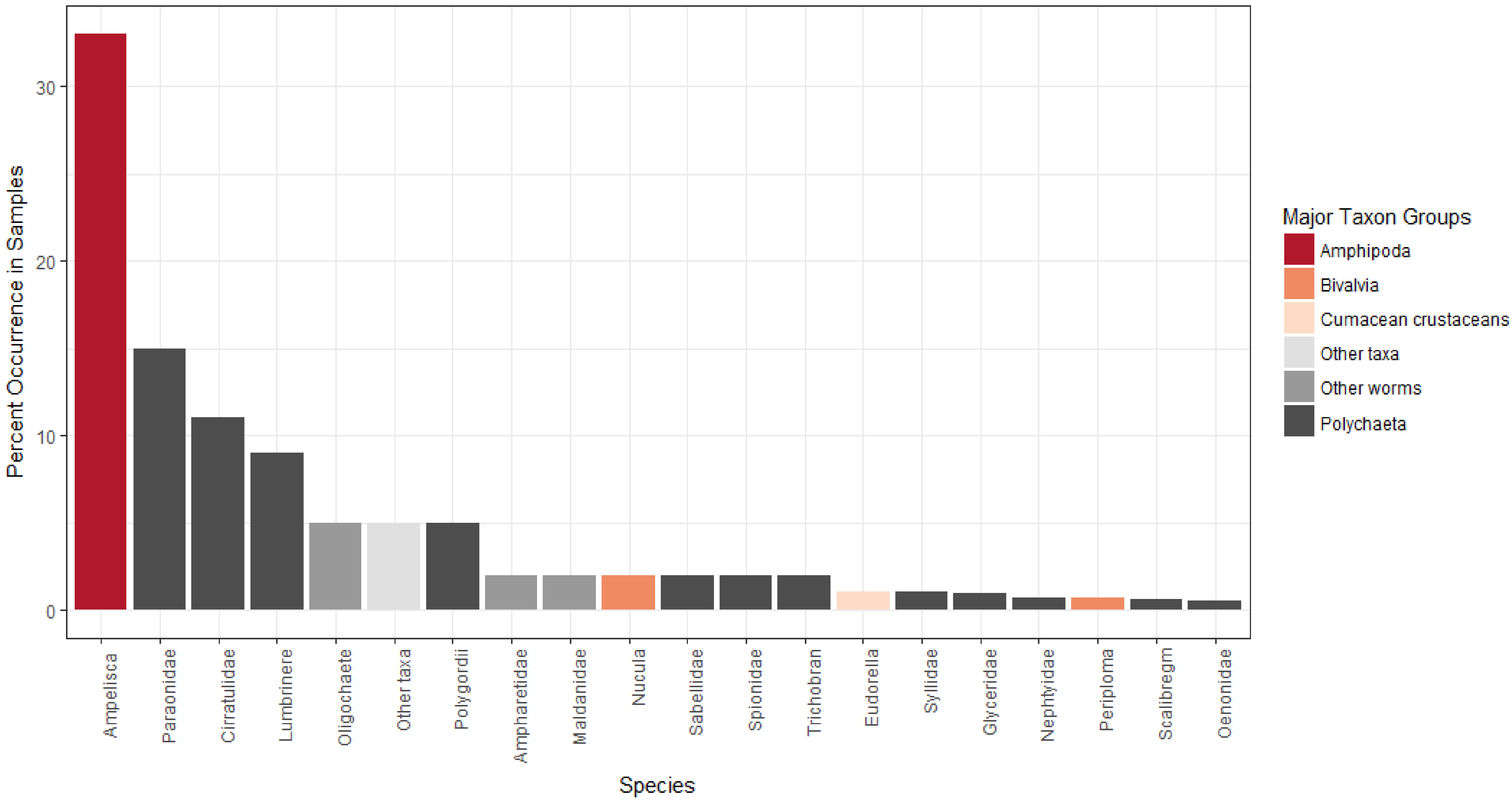

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Figure 6.5-5

2014 NEFSC AMAPPS Grab Sample Catch by Percentage of Total Catch Numbers in the SWDA

Overall, data collected from each of these surveys indicated similar dominate infaunal taxa throughout the SWDA and the surrounding waters of the Offshore Development Region (RPS 2020b; RPS 2021; Appendix II-H). Amphipods, polychaete worms, nematodes, and nut clams were consistently collected in high abundances in the various surveys, which spanned multiple sample years and seasons (see Figure 6.5-6). Within the SWDA, polychaete worms and amphipods were both most abundant and frequent in samples from the multiple surveys.

6.5.1.1.4 SWDA Species of Commercial or Recreational Importance

For benthic macrofauna, species of commercial or recreational importance within the SWDA include Atlantic sea scallop (*Placopecten magellanicus*), ocean quahog (*Artica islandica*), Atlantic surf clam (*Spisula solidissima*), American lobster, Jonah crab (*Cancer borealis*), and horseshoe crab (*Limulus polyphemus*). The longfin squid (*Doryteuthis pealeii*) is another species of commercial and recreational importance with a benthic life stage within the SWDA (immobile, attached egg masses/egg mops) and is discussed in more detail in Section 6.6.

The NEFSC has also conducted surveys for Atlantic surf clam and ocean quahog near the SWDA since 1999. This region-wide survey has involved five-minute tows at a speed of 1.5 knots (2.8 kmh^{-1}) with a hydraulic jet dredge at randomly-selected sites (NEFSC 2018). The survey has not always sampled within the SWDA; however, both Atlantic surf clam and ocean quahog have been collected near the SWDA as outlined in Table 6.5-6. The seasonal trawl data from 2003–2016 (NEODP 2021) indicated that the catch of sea scallops is typically higher in the fall than in spring, with the only catch of this species in the SWDA occurring in the fall (see Figure 6.5-7). Although juvenile and adult Atlantic surf clams are typically found in well-sorted, medium sand (Dames and Moore 1993), they also occur in fine sand (MacKenzie et al. 1985) and silty-fine sand (Cargnelli et al. 1999a; Meyer et al. 1981), which is in line with the predominant sediment types found in the SWDA (Coastal and Marine Ecological Classification Standard [CMECS] defined sandy mud to very coarse/coarse sand) (RPS 2020a). Ocean quahogs are usually found in dense beds over level bottoms, typically just below the surface in medium to fine grain sand sediments (Cargnelli et al. 1999b; MAFMC 1997). Ocean quahog have been qualitatively observed throughout the MA WEA, including multiple locations in the SWDA, based primarily on bottom grab samples (Guida et al. 2017).

Table 6.5-6 Catch Numbers of Atlantic Surf Clam and Ocean Quahog in NOAA NEFSC Surf Clam/Ocean Quahog Survey at Sampling Locations near the SWDA[1]

Year	Catch Number of Atlantic Surf Clam	Catch Number of Ocean Quahog
1999	59	12
2002	0	1,136
2005	0	36
2008	1	80
2011	0	46
2013	0	171

Notes:

1. Data from NEFSC (2018).

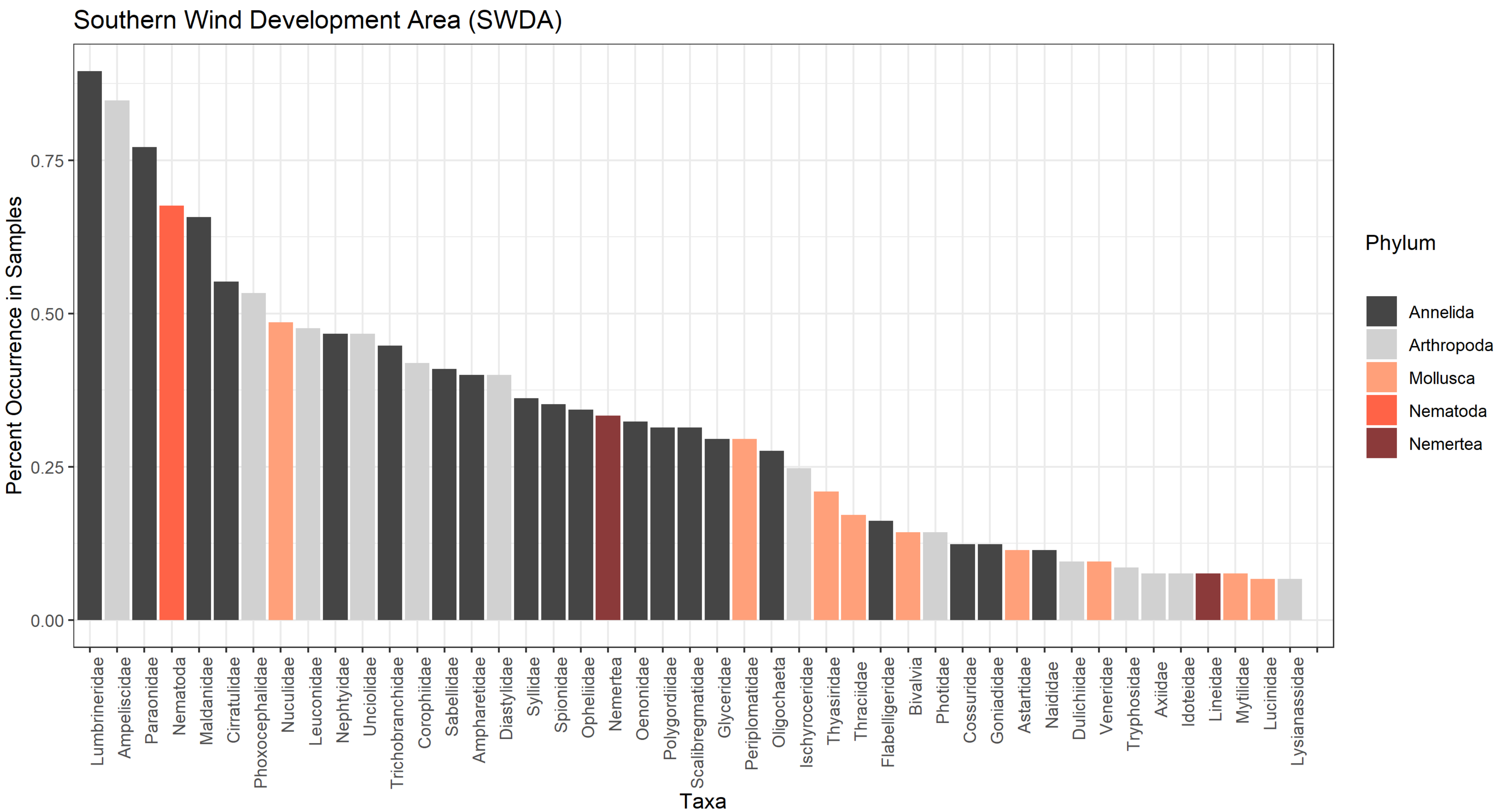

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Figure 6.5-6

Relative Frequency of Benthic Macroinfaunal Taxa Presence in Grab Samples Collected in 2016, 2018, 2019, and 2020 in the SWDA

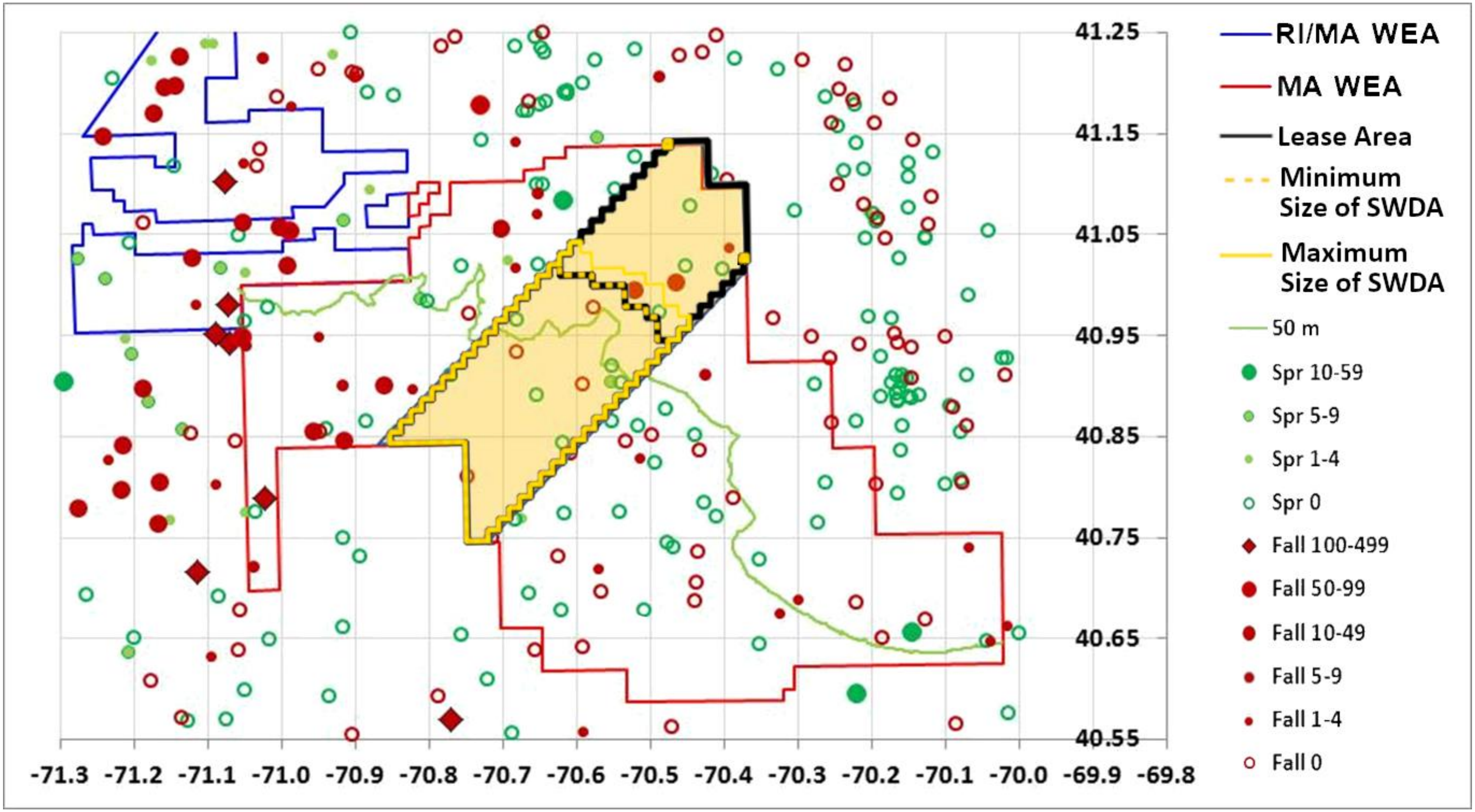

Figure 6.5-7

Sea Scallops Numbers Caught by NEFSC Seasonal Trawl: 2003-2016 (Guida et al. 2017)

The NEFSC fall and spring bottom trawls have also caught American lobster within the northern portion of the SWDA (see Figure 6.5-8). Spatial analyses by the NEFSC of their bottom trawl survey data between 2004 and 2014 indicated that the fall and spring distribution of American lobster in and around the SWDA is 0.8 or less individuals per tow (NEFSC 2017). Jonah crab have been infrequently encountered in the Massachusetts inshore state water trawl surveys, which overlap with the OECC but are focused primarily on finfish (ASMFC 2015). Spatial analyses by the NEFSC of their bottom trawl survey data indicated that the fall distribution of Jonah crab in and around the SWDA from 2004 to 2014 ranged from approximately 0.03 to 0.1 individuals per tow (NEFSC 2017). This same analysis indicated that the spring distribution of Jonah crab in and around the SWDA was lower (at less than 0.02 individuals per tow) than during the fall. Little data exists on the distribution of horseshoe crab near the SWDA; however, older juvenile and adult horseshoe crabs could occur in the area, though NEFSC bottom trawl data suggest they prefer depths less than 30 m (98 ft) (ASMFC 1998). Figure 6.5-9 provides an overview of the occurrence of Jonah crab, horseshoe crab, and American lobster within the Offshore Development Area during fall sampling by the Massachusetts Division of Marine Fisheries (MA DMF) between 2005–2014 and NEFSC between 2010–2016. In summary, though these species are present near the Offshore Development Area, they have been only observed in relatively low numbers. For a broader description of the primary mobile benthic invertebrates within the Offshore Development Area, refer to Section 6.6.1.2.

6.5.1.2 Offshore and Nearshore Areas Along the OECC

6.5.1.2.1 OECC Habitats and Communities

As described in Section 1 of COP Volume II, surveys of epifauna and infauna along the OECC were conducted using underwater video transects and sediment grab samples, respectively. The majority of the video transect samples recorded bottom habitats with low complexity, mostly comprised of fine unconsolidated substrate including flat sand/mud and migrating bedforms. Areas of shell aggregate, specifically common Atlantic slipper shells (*Crepidula fornicata*), were observed along the OECC in the northern Nantucket Sound. Several locations within Muskeget Channel contained coarse deposits and hard bottom habitats consisting of areas of shell hash and rubble and areas of gravel and gravel mixes, some with sulfur sponge (*Cliona celata*), blue mussel (*Mytilus edulis*), and/or various macroalgal communities.

There are no artificial reefs directly along the OECC; however, there are three artificial reef locations well outside the Offshore Development Area, as shown in Figure 6.5-10 (NEODP 2021). Surveys have revealed isolated man-made objects to be avoided in the OECC and one debris pile/possible shipwreck in the OECC, approximately 11 km (5.9 nm) southwest of Covell's Beach. Potential sensitive habitats, mainly in the Muskeget Channel area, were also identified in surveys as described in COP Volume II.

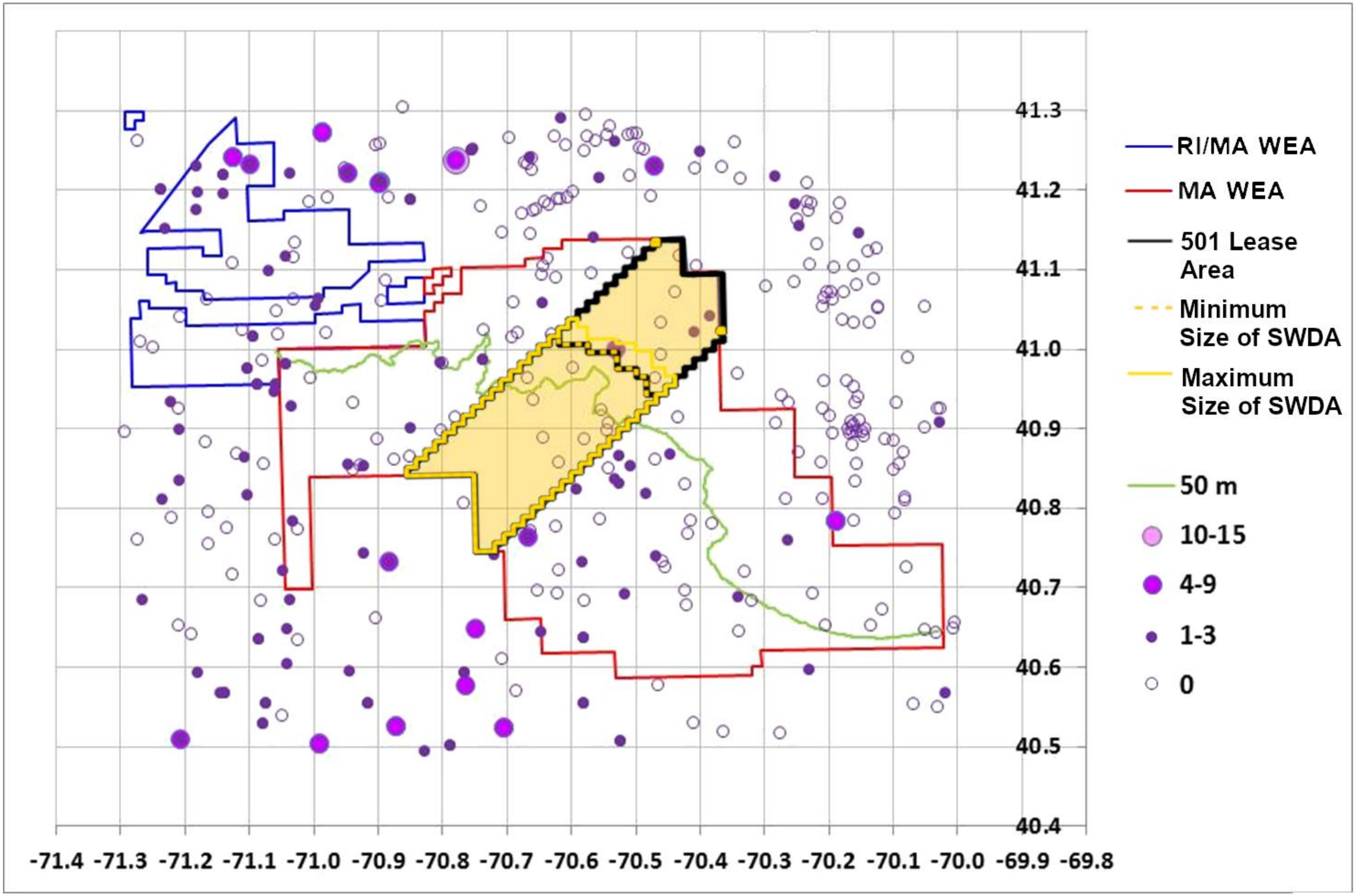

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Figure 6.5-8

American Lobster Numbers Caught by NEFSC Seasonal Trawl: 2003-2016 (Guida et al. 2017)

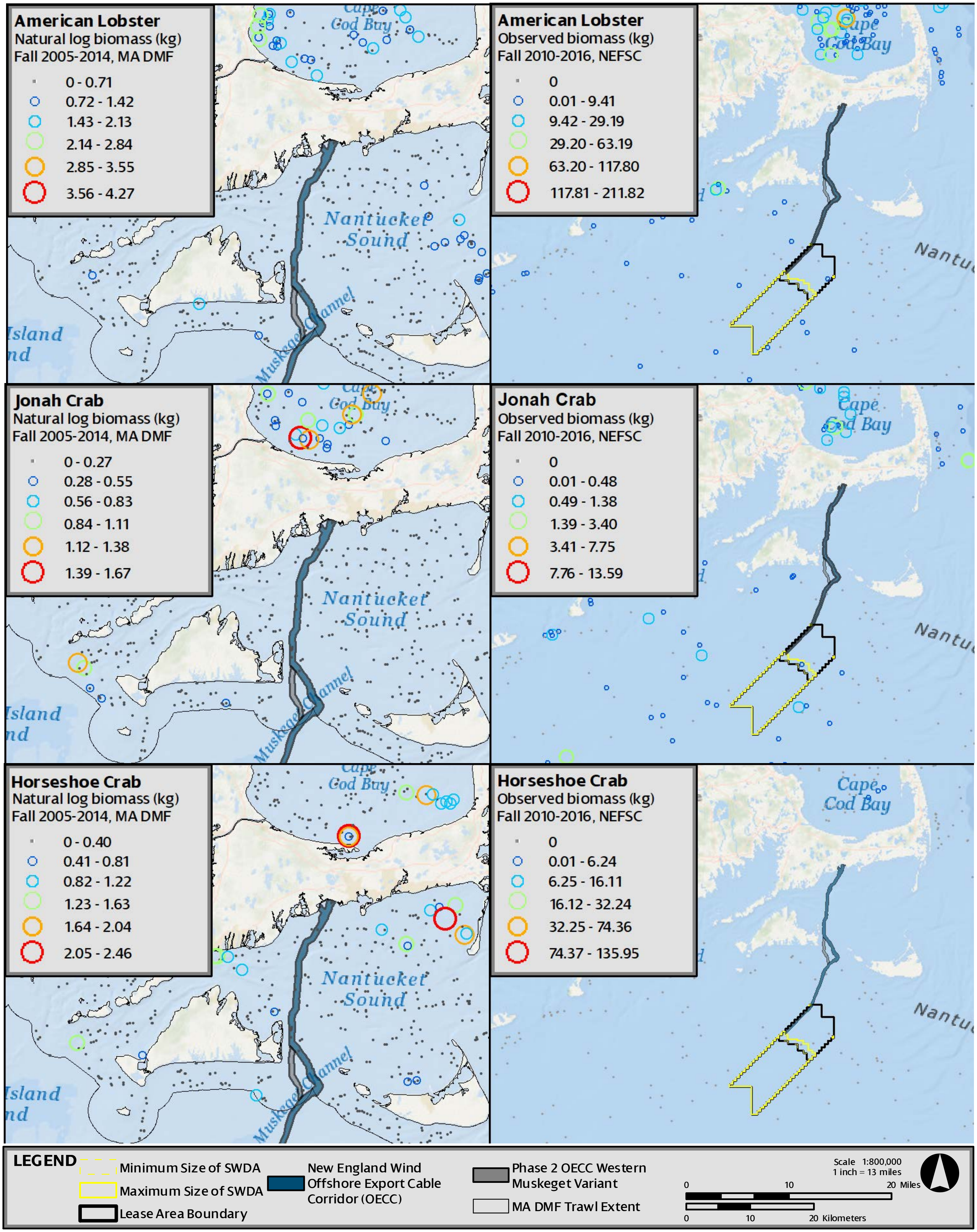

Figure 6.5-9

Biomass (natural log or observed) per Tow for MA DMF (2005-2014) and NEFSC (2010-2016) Fall Sampling of American Lobster, Jonah Crab, and Horseshoe Crab (NEODP 2021).

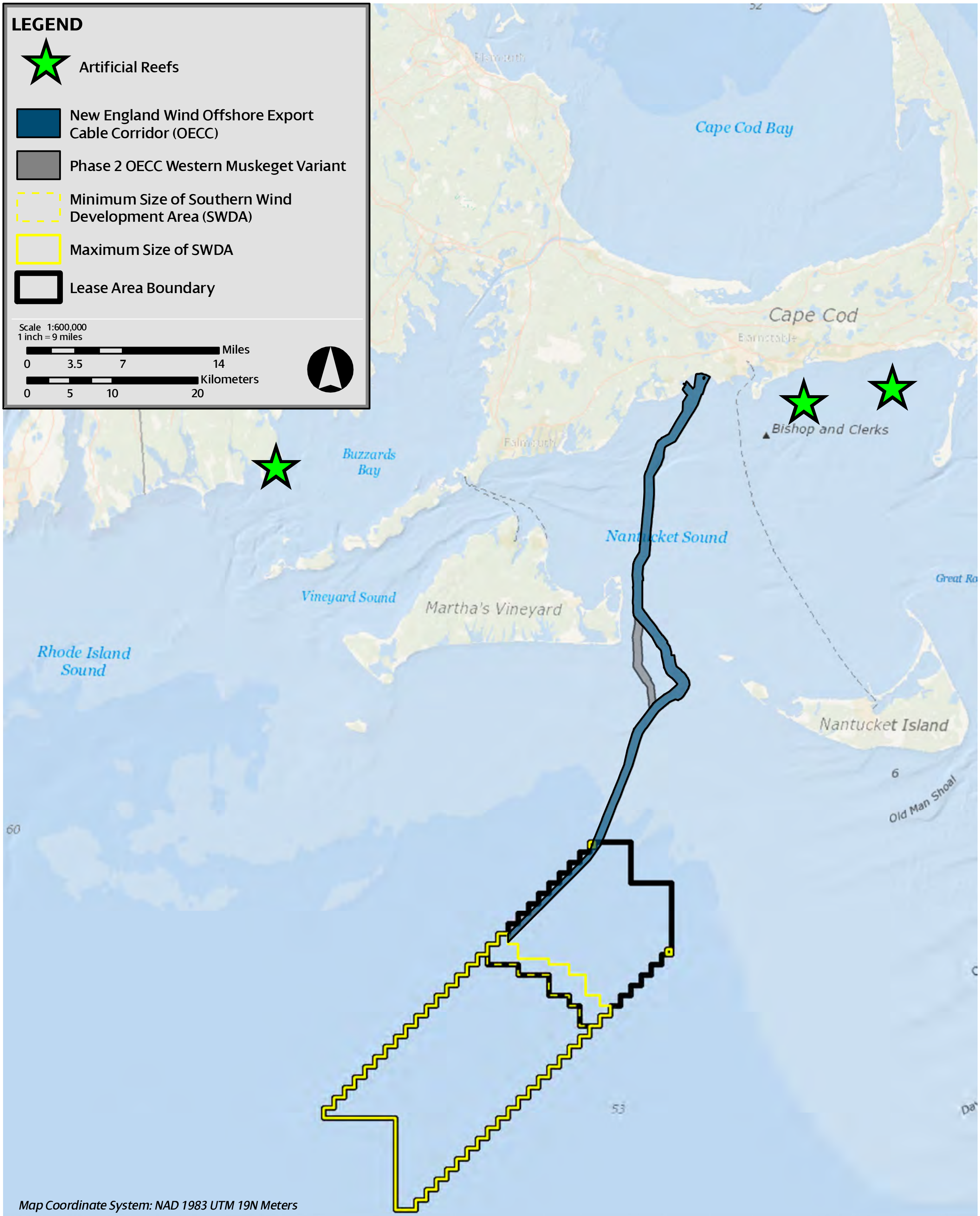

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Figure 6.5-10
Locations of Artificial Reefs in Relation to the New England Wind OECC (NEODP 2021)

In addition to site-specific surveys, five separate comprehensive benthic field surveys were conducted from 2001 through 2005 in Nantucket Sound as part of the Cape Wind project development process. Coverage from these surveys overlap the areas of the OECC. Between 2001 and 2005, 90 benthic samples were collected from Horseshoe Shoal to Lewis Bay and Popponesset Bay, over various seasons, and analyzed to provide insight into the nature and general characteristics of the benthic communities in the area and allow for characterization of potential effects (USDOE MMS 2009). Overall, the benthic community composition documented from these surveys is consistent with the results of earlier studies (Pratt 1973; Sanders 1956; Theroux and Wigley 1998; Wigley 1968). However, the earlier studies indicated that the Nantucket Sound benthic community had a lower than average invertebrate density when compared with the rest of the southern New England Shelf, whereas the more recent surveys (2001–2005) found biomass and density to be relatively high (USDOE MMS 2009). Additionally, there is a high sample-to-sample variability in total invertebrate abundance, which supports conclusions from previous research indicating that the Nantucket Sound benthic community is highly variable from one location to the next and from one season to another. This is likely due to the patchy nature of "microhabitats" created by variations in parameters such as depth, currents, sediment types, availability of food, etc. (USDOE MMS 2009; Wigley 1968). Data from these surveys show that the presence or absence of the sand wave microhabitat significantly affects macroinvertebrate abundance.

As described in COP Volume II, bedforms ranging in size from ripples up to sand waves have been identified locally along the OECC; larger bedforms are found in waters with fast-flowing tidal currents. The height of the largest bedforms exceeded 5-9 m (16.4–29.5 ft) with 80–125 m (262.4–410.1 ft) or greater wavelengths. Faunal abundance and composition generally vary based on where sampling occurs on the sand wave. Fauna tend to be most dense in the trough between sand waves where organic matter accumulates, while mobile species such as amphipods are prevalent on the slope of the sand wave (Jennings et al. 2013; Shepherd 1983). Previous studies of the species composition within sand waves have found that species present tend to be robust filter feeders (e.g. bivalves) as opposed to more delicate deposit feeders (e.g. feather dusters and sea cucumbers), which tend to be found within flatter sedimentary bedforms (Warwick and Uncles 1980).

6.5.1.2.2 OECC Epifauna

The results of the initial underwater video survey of the OECC, which are fully described in the CR Environmental, Inc. final report (2017) and summarized in COP Volume II, demonstrated that the epifauna communities vary throughout the OECC, as expected. The Nantucket Sound area was predominated by amphipods, slipper limpets, whelks, sponges, polychaetes, and spider crabs. Communities within Eastern Muskeget were more varied with sulphur sponge, red beard sponge, and blue mussels making up most of the observed epifauna. South of Muskeget, flat sand, mud, and biogenic structures were observed to be inhabited by mostly sand dollars and some burrowing anemones.

Additional New England Wind-specific epifauna sampling occurred in July-October 2020 in the potential Phase 2 landfall sites and for those portions of the New England Wind OECC that were expanded relative to the Vineyard Wind 1 OECC (see Section 1.2.5 of COP Volume II). A video transect survey in the OECC recorded 63 transects of about 150-300 m (492-984 ft) in length to further characterize benthic resources (RPS 2021), as part of Vineyard Wind 1. During the 63 transects, with varying degrees of visibility, 3,329 individuals including 20 fish taxa, 21 invertebrate taxa, and three kinds of egg cases were identified within the OECC to the Lowest Practical Taxonomic Level. A total of 465 individual macrofauna were counted in one transect, 96% of which (447 individuals) were burrowing anemones. Other relatively numerous taxa across transects include sea urchins (Echinoidea), sea stars (*Asterias* spp.), and various demersal fishes (see Table 6.5-7 and RPS 2021; Appendix II-H).

Table 6.5-7 2020 Video Transect Summary for Epibenthic and Demersal Fauna within the OECC (63 video transects)[1]

Common Name	Lowest Taxonomic Grouping	Total Counted
Sea Urchin	Echinoidea	1593
Cerianthid, Northern	*Cerianthus borealis*	969
Crab, Cancer	Cancer	114
Sea Star	Asterias	98
Roundfish, Unidentified	Teleostei	91
Large Whelk (Knobbed, Channeled)	Melongenidae	54
Hake, Unidentified	Gadidae	37
Scallop, Bay	*Argopecten irradians*	34
Scup	*Stenotomus chrysops*	29
Crab, Spider (Portly)	*Libinia emarginata*	28
Skate, Little or Winter	Leucoraja	27
Skate, Egg Case	Rajidae	25
Skate	Rajidae	24
Crab, Hermit	Pagurus	19
Black Sea Bass	*Centropristis striata*	17
Whelk, Unidentified	Melongenidae	16
Tautog	*Tautoga onitis*	15
Moon Snail	Naticidae	14
Whelk, Channeled	*Busycotypus canaliculatus*	12
Crab, Unidentified	Decapoda	11
Flounder	Pleuronectiformes	11
Other		91
Total	-	3,329

Notes:

1. Data from RPS (2021).

Phase 2 OECC Western Muskeget Variant

Four video transects occurred within the Western Muskeget Variant in 2017 as part of work for Vineyard Wind 1. Across these four transects there were 16 unique taxa present dominated by sponges, moss animals (i.e. bryozoans), and branching red algae.

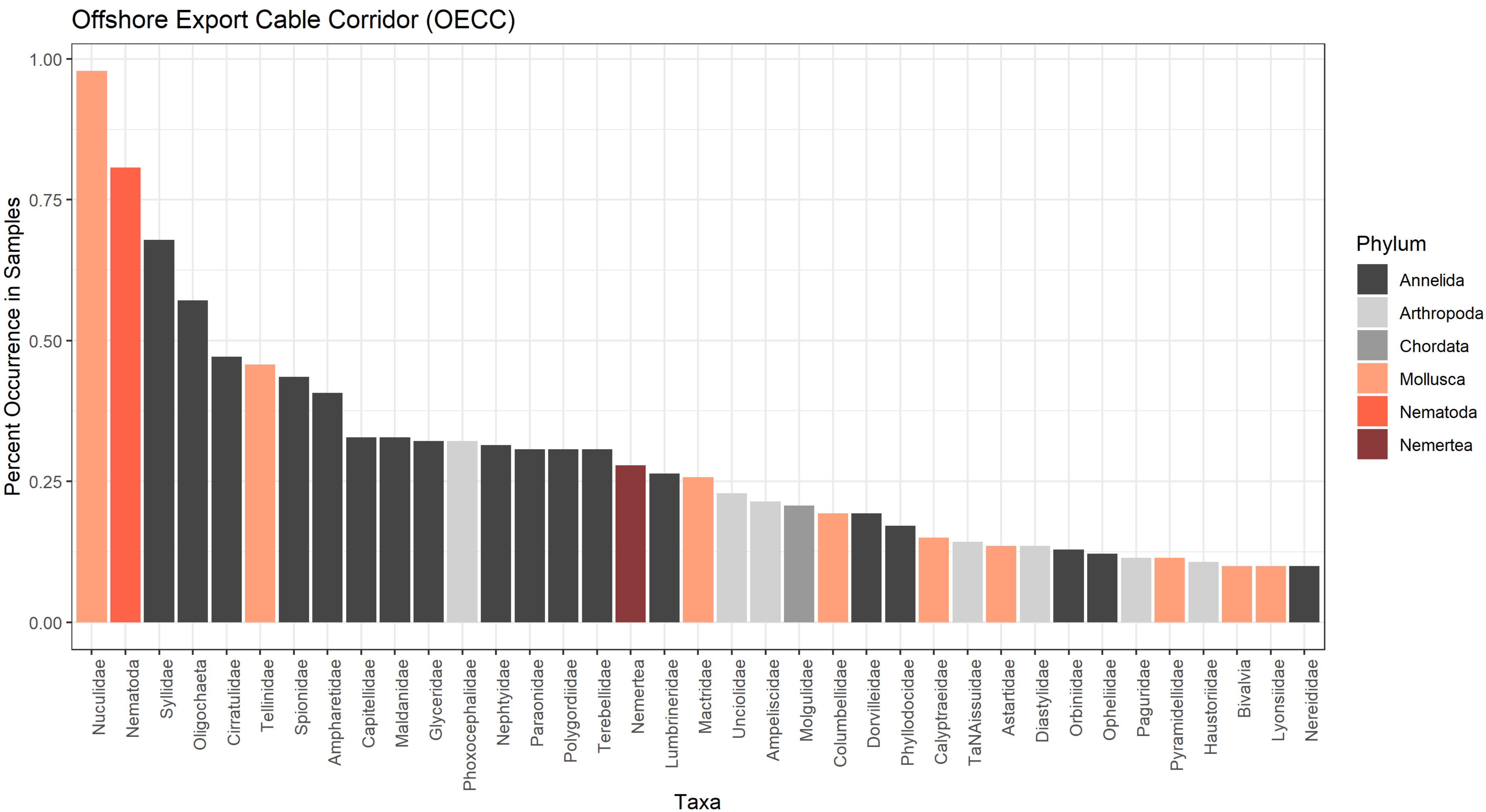
Two video transects occurred within the Western Muskeget Variant in 2018 as part of Vineyard Wind 1. These transects observed sparse to dense coverage of red and green algae, sea robins (*Prionotus* sp.), evidence of tubeworms, and fish that were potentially scup (*Stenotomus chrysops*).

6.5.1.2.3 OECC Infauna

As provided in Appendix II-H of COP Volume II, the results of 140 grab samples collected along the OECC in 2017 through 2020, as documented by Normandeau Associates (2017), RPS (2018), Seaforth Geosurveys Inc., Horizon Geosciences Ltd. (2019), and RPS (2021), indicated the predominate infaunal organisms along the OECC include nematodes, amphipods, polychaete worms, nut clams, and snails (e.g. slipper limpets, pyram shells, and dove snails) (see Figure 6.5-11). While samples from all years had consistently high occurrence rates and abundances of nematodes, they dominated the samples collected in 2019 and accounted for 68% of the total abundance of organisms. Other abundant taxa in 2019 included polychaete worms, barnacles (all observed at a single site), and multiple mollusk species including slippersnails, bubble-barrel snails, and tellins. In 2020, similar communities were observed with the phyla Annelida, Mollusca, and Nematoda dominating the abundance in samples, representing 84% of all organisms (RPS 2021). The most abundant organisms collected in 2017 and 2018 were polychaete worms, which accounted for roughly 40% and 53% of the total abundance and 35% and 30% of unique taxa, respectively. Nematodes, arthropods (amphipods and hooded shrimp), and mollusks (nut clams and tellins) were also abundant in samples from 2017 and 2018 (RPS 2020c). Multivariate analyses provided evidence that samples taken from within the same general location, year, marine zone, or habitat type, are more likely to be similar within categories than across categories, but variability (interannual, seasonal, and or spatial) was too high or other confounding influences prevented the establishment of strong relationships. However, results suggest that there is greater similarity between sample community assemblages in offshore deeper waters than in nearshore locations (RPS 2020c; Appendix II-H).

Phase 2 OECC Western Muskeget Variant

Four of the grab samples collected in September of 2017 were within the Western Muskeget Variant. There were 42 unique taxonomic classifications across these samples, predominated by a majority of caprellids composing 69% of individuals. Other dominant taxa included mollusks, annelid worms, nematodes, and arthropods.



New England Wind
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Figure 6.5-11

Relative Frequency of Benthic Macroinfaunal Taxa presence in Grab Samples Collected in 2017, 2018, 2019, and 2020 in the OECC

Four of the grab samples collected in June of 2018 were within the Western Muskeget Variant. Overall lower infaunal abundance and unique taxa was observed compared to 2017 samples. One grab had 19 unique taxa, while the other three samples each had six or less unique taxa. Nematodes were the dominant taxa composing 48% of individuals. The majority of the remaining individuals were predominately annelid worms.

6.5.1.2.4 OECC Species of Commercial and Recreational Importance

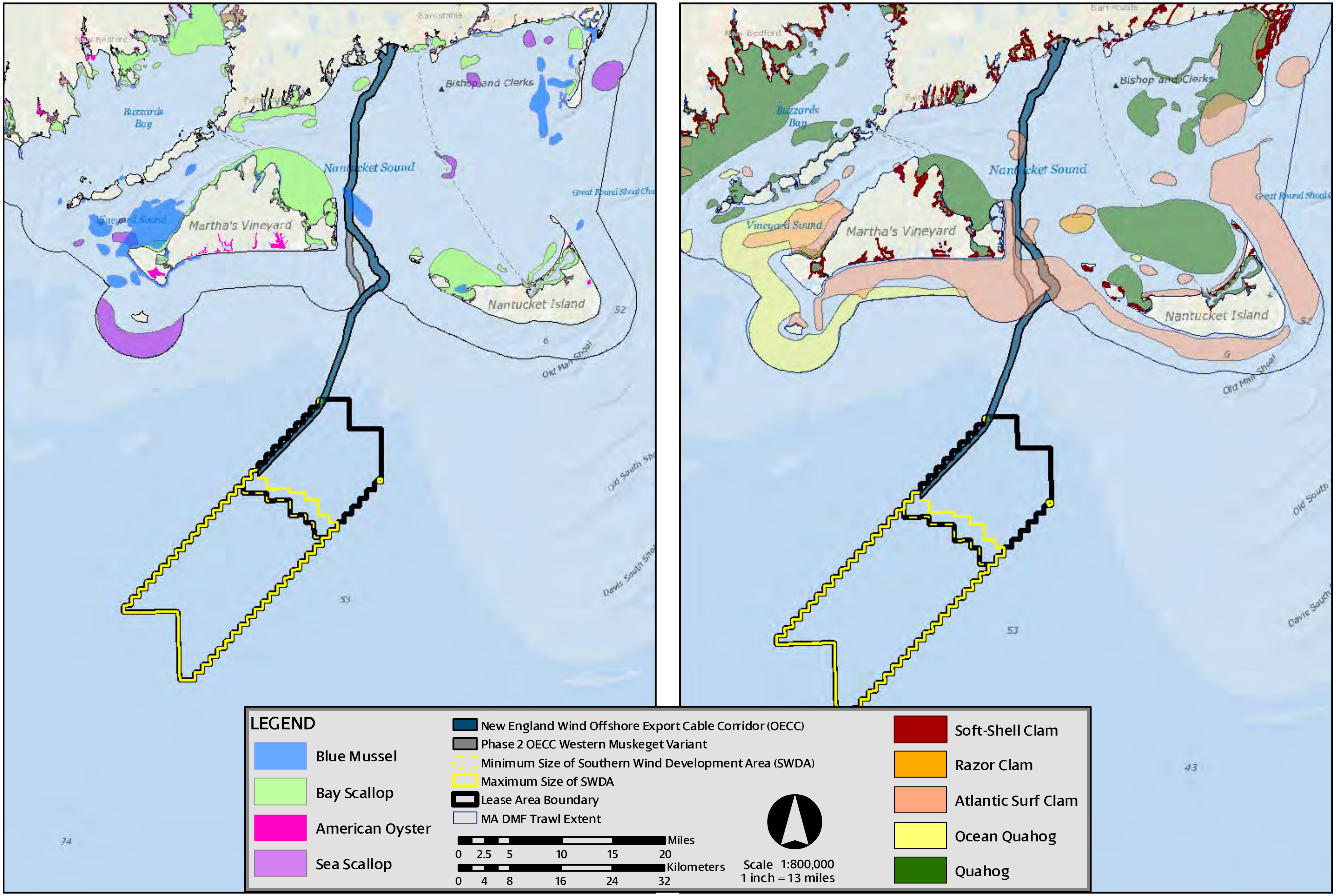
Since the mid-1970s, areas of suitable shellfish habitat have been observed along the coast of Massachusetts based on information provided by MA DMF, local shellfish constables, commercial fishermen, maps, and studies (NEODP 2021). According to these data (limited to Massachusetts state waters), the OECC will transverse over suitable shellfish habitat for Atlantic surf clam, blue mussel (*Mytilus edulis*), bay scallop (*Argopecten irradians*), and quahog (*Mercenaria mercenaria*) (see Figures 6.5-12 and 6.5-13) (NEODP 2021). It has also been reported that species of large gastropod whelks (*Busycon carica* and *Busycotypus canaliculatum*) are abundant in Nantucket Sound coastal waters (Davis and Sisson 1988; USDOE MMS 2009).

6.5.2 Potential Impacts of New England Wind

The potential impacts of New England Wind to benthic resources are related to the specific sizes of offshore components, including cables, WTGs, ESPs, associated foundations, and scour protection, and the portion of the seafloor occupied. This section therefore assesses the full 130 WTG/ESP buildout of the SWDA.

As described in Section 3 of COP Volume III, the seafloor impacts presented for the full buildout of the SWDA assume the smallest area for Phase 1 and the largest possible area for the greater potential seafloor disturbance associated with Phase 2 (e.g. larger areas of scour protection and larger areas of cable installation impacts). This section also presents the maximum amount of seafloor disturbance within the SWDA associated with the maximum footprint of each individual Phase. For seafloor impacts within the OECC, because New England Wind includes the installation of five offshore export cables—two for Phase 1 and three for Phase 2—seafloor impacts are presented for installation of five cables within the OECC.

The impact producing factors for benthic resources are provided in Table 6.5-8.



Service Layer Credits: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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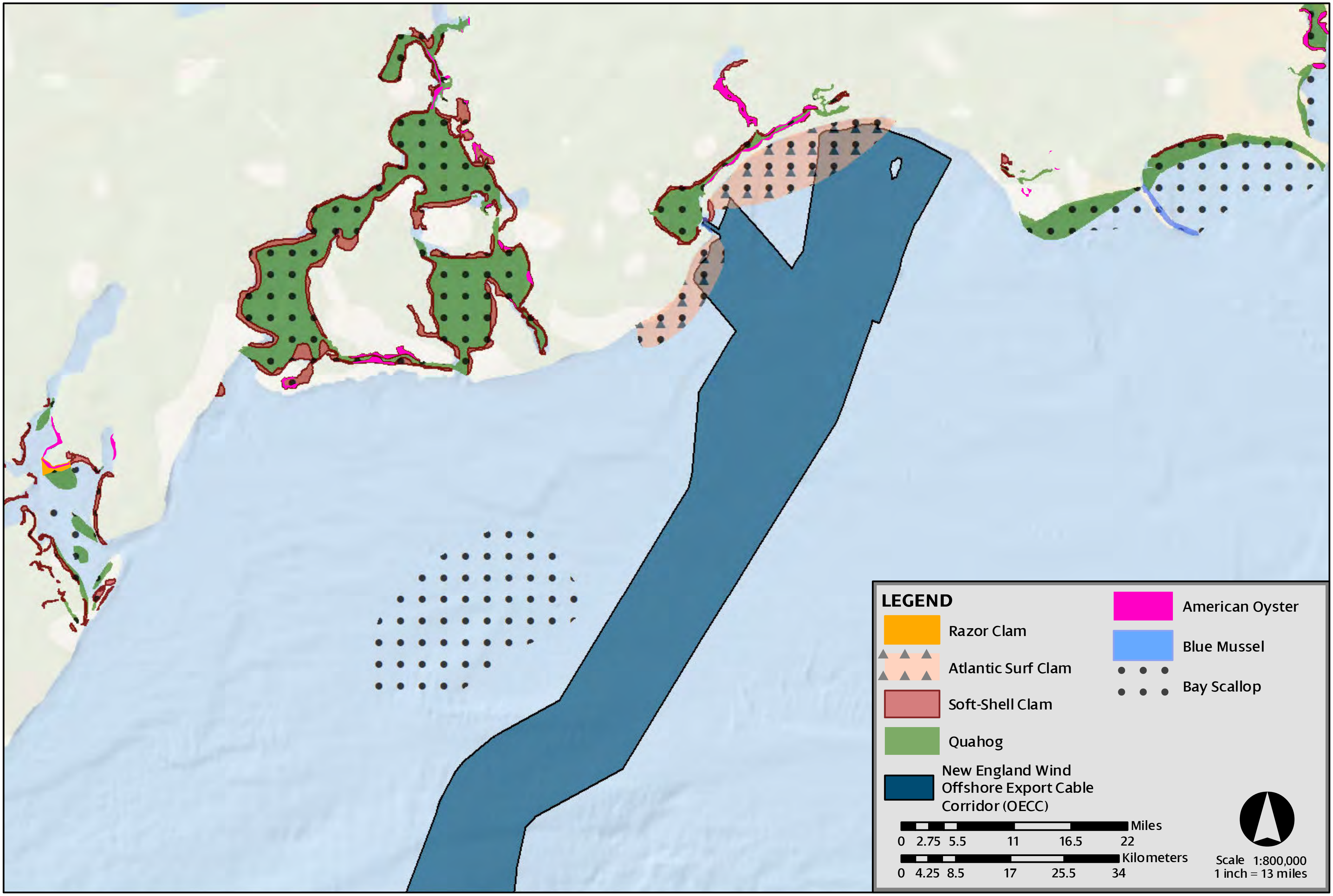
Figure 6.5-12

Suitable Shellfish Habitat Along Portions of the OECC in Massachusetts State Waters (NEODP 2021)



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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Figure 6.5-13

Suitable Shellfish Habitat in the Vicinity of the Potential Landfall Sites (NEODP 2021)

Table 6.5-8 Impact Producing Factors for Benthic Resources

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Habitat alteration	•	•		•	•	•
Suspended sediments	•	•		•	•	•
Sediment deposition	•	•		•	•	•
Water withdrawals	•	•		•	•	•
Electromagnetic fields	•	•			•	
Cable installation/ maintenance	•	•		•	•	
Noise	•	•		•	•	

6.5.2.1 Construction and Installation

Offshore construction activities will involve installation of WTGs and ESPs (with their associated foundations and scour protection), installation of offshore export, inter-array, and inter-link cables, and installation of cable protection (if required). These offshore construction activities will require an array of vessels, many of which are 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 dynamic positioning (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 ocean floor to elevate the hull to provide a safe, stable working platform.

6.5.2.1.1 Habitat Alteration (Phases 1 and 2)

SWDA—Overview (Phases 1 and 2)

During the construction of New England Wind, habitat alteration will occur through the installation of WTG and ESP foundations, scour protection, inter-array and inter-link cables, offshore export cables within the SWDA, and cable protection (if used). Use of jack-up vessels or anchored vessels may also cause temporary habitat alteration. Benthic invertebrates with limited or no motility located in the direct path of foundations, scour protection, inter-array and inter-link cables, offshore export cables within the SWDA, cable protection (if any), jack-up vessel legs, or anchors would be the most at risk of injury or mortality from construction and installation activities in the SWDA. Mobile benthic invertebrates would be temporarily displaced by increased suspended sediments and underwater construction but would likely be able to escape harm and move away from construction and installation areas. Construction activities conducted in the winter, if any, may further reduce the avoidance ability of some benthic organisms because low temperatures can influence metabolic rates and locomotion (Brockington and Clarke 2001).

Impacts to the seafloor would be expected along inter-array, inter-link, and offshore export cable routes and near the WTGs and ESPs as a result of foundation installation, scour protection installation, and the use of jack-up and/or anchored vessels for the installation of each WTG and ESP. All WTG/ESP foundations may have scour protection that consists of rock or stone placed around the base of the foundation. This design could promote deposition of a sand/silt matrix in the interstices of the boulder framework with the eventual burial of the scour protection (USDOE MMS 2009). Tidal currents may expose portions of the scour protection at the surface for short periods of time. However, the bi-directional nature of these currents should lead to establishment of a dynamic equilibrium, allowing the average condition of the scour-protected zone to be buried by sand. Bottom habitat may also be permanently altered to hard bottom substrate through the installation of cable protection (as described in Section 3.2.1.5.4 of COP Volume I) in areas where the inter-array, inter-link, or offshore export cables in the SWDA cannot reach sufficient burial depths. Soft bottom habitat and benthic fauna, such as polychaetes and Oligochaeta worms, amphipods, sand dollars, and sea scallops, in the direct path of the foundations, scour protection, jack-up vessel legs, or anchors will be crushed. However, the presence of these structured habitats can also lead to colonization of other organisms.

Since most of the SWDA is comprised of homogeneous fine sand and silt-sized sediments, the addition of the stone/rock scour protection (and any required cable protection) will alter the nature of the seabed thereby contributing to higher complexity in a three-dimensional (3-D) scale. Scour and/or cable protection has the potential to turn exposed, biodiversity-poor soft bottoms into species-rich ecosystems (Langhamer 2012). Under ideal conditions (i.e. sufficient number of larvae and suitable environmental conditions), scour and/or cable protection would be colonized by organisms abundant in the water mass or nearby hard bottom habitat. Several examples of this exist, such as the Danish Horns Rev development, in which scour protection has been colonized by species inhabiting rocky substrata (e.g. anemones, crabs, lobsters, barnacles, and sponges) (Langhamer 2012). BOEM's Draft Environmental Impact Statement (DEIS) (2018) for Vineyard Wind 1 determined that effects from added scour and cable protection would possibly have long-term moderate benefit.

As described in Sections 3.3.1.3 and 4.3.1.3 of COP Volume I, cable installation for inter-array, inter-link, or offshore export cables in the SWDA will likely be accomplished using one or more of the following: jetting techniques, a mechanical plow, or other techniques. Anchoring may be used for installation of offshore export cables within the SWDA. Anchored vessels may be equipped with spud legs that are deployed to secure the cable laying vessels while its anchors are being repositioned. Additionally, to monitor weather and sea state conditions during construction, the Proponent may deploy meteorological oceanographic ("metocean") buoys within the SWDA; if so, anchors for the metocean buoys will also temporarily disturb bottom habitat.

Within the SWDA, deployment of anchors (if/where used) would disturb the substrate and leave a temporary irregularity in the seafloor resulting in localized mortality of infauna. In addition, portions of the seafloor would be swept by an anchor cable/chain as the installation equipment moves along the cable route. If used, anchored vessels or metocean buoys will avoid sensitive seafloor habitats to the greatest extent practicable.

Organisms that may be subject to impacts from anchor line sweep include mollusks (e.g. soft shell clams [*Mya arenaria*], sea scallops, surf clams, and whelks), echinoderms (e.g. sea stars and sand dollars), and sessile species (e.g. tube-dwelling polychaetes and mat-forming amphipods), which make up a relatively large portion of the taxa occurring in the Offshore Development Area. The level of impact for these organisms could vary seasonally and by species group. For example, according to the SMAST drop-down video survey (see Table 6.5-2), sand dollars and sea stars may be more prevalent in the spring. Organisms that are mobile, such as certain polychaete species, amphiods, lobsters, and crabs may be able to avoid impacts from the anchor line sweep because sediment vibrations would cause avoidance behaviors as the cable laying equipment moves across the seafloor (USDOE MMS 2009). However, Jonah crab and ocean pout (*Zoarces americanus*) may be susceptible to impacts if they use the anchor lines as refuge during cable laying disturbance occurring in nearby benthic habitat. Such use will depend upon the length of time the anchoring lines are deployed. The BOEM DEIS (2018) for Vineyard Wind 1 determined that direct mortality and habitat loss would occur during construction, but impacts would be minor and short-term.

The following sections present impacts (1) within the maximum footprint of New England Wind associated with a total buildout of 130 WTG/ESP positions (453 square kilometers [km^2] [111,939 acres]), (2) within the maximum footprint of Phase 1 associated with a total buildout of 62 WTGs and two ESPs (231 km^2 [57,081 acres]), and (3) within the maximum footprint of Phase 2 associated with a total buildout of 88 WTG/ESP positions (303 km^2 [74,873 acres]). As described in Section 3 of COP Volume III, due to the range of buildout scenarios for Phases 1 and 2 where certain parts of the SWDA could be included in either Phase 1 or 2, the sum of the maximum design scenarios for Phase 1 and Phase 2 does not equal the total maximum design scenario of New England Wind. In other words, it is not possible to have both the maximum size of Phase 1 (231 km^2 [57,081 acres]) and the maximum size of Phase 2 (303 km^2 [74,873 acres]) as the total size of the SWDA is a maximum of 453 km^2 (111,939 acres). Nonetheless, impacts are provided for the maximum size of each Phase to provide the maximum potential impact associated with each Phase.

SWDA—Maximum Impact (Phases 1 and 2)

As detailed in Appendix III-T, within the maximum size of the SWDA and encompassing both Phases 1 and 2, the amount of permanent habitat alteration from the installation of WTG/ESP foundations, associated scour protection, and potential cable protection (if required) would be approximately 1.17 km^2 289 acres). The amount of habitat disturbance from the use of jack-up and/or anchored vessels, cable installation, and metocean buoy anchors would be approximately 4.08 km^2 (1,008 acres).[59] The total area of alteration within the SWDA due to foundation and scour protection installation, jack-up and/or anchored vessel use, inter-array and inter-link cable installation, potential cable protection (if required), and metocean buoy anchors is 5.19 km^2 (1,283 acres), which is 1.1% of the maximum size of the SWDA.

SWDA—Phase 1

Within the maximum size of Phase 1, bottom habitat primarily consists of sand and mud-sized sediments. As detailed in Appendix III-T, the amount of permanent habitat alteration from the installation of WTG/ESP foundations, associated scour protection, and potential cable protection (if required) would be approximately 0.35 km^2 (86 acres). The amount of habitat disturbance from the use of jack-up and/or anchored vessels, cable installation, and metocean buoy anchors would be approximately 1. 70 km^2 (421 acres). The total area of alteration within the maximum size of Phase 1 due to foundation and scour protection installation, jack-up and/or anchored vessel use, inter-array and inter-link cable installation, potential cable protection (if required), and metocean buoy anchors is 2.03 km^2 (502 acres), which is 0.9% of the maximum size of the Phase 1 SWDA.

SWDA—Phase 2

As detailed in Appendix III-T, within the maximum size of Phase 2, bottom habitat primarily consists of fine and mud-sized sediments. The amount of permanent habitat alteration from the installation of WTG/ESP foundations, associated scour protection, and potential cable protection (if required) would be approximately 0.89 km^2 (221 acres). The amount of habitat disturbance from the use of jack-up and/or anchored vessels, cable installation, and metocean buoy anchors would be approximately 2.77 km^2 (686 acres). The total area of alteration within the maximum size of Phase 2 due to foundation and scour protection installation, jack-up and/or anchored vessel use, inter-array and inter-link cable installation, potential cable protection (if required), and metocean buoy anchors is 3.63 km^2 (897 acres), which is 1.2% of the maximum size of the Phase 2 SWDA.

OECC—Overview (Phases 1 and 2)

As further described Sections 3.1.3 and 4.1.3 of COP Volume I, the Phase 1 and Phase 2 offshore export cables—two cables for Phase 1 and three cables for Phase 2—will be installed within the same OECC from the SWDA to within approximately 2-3 km (1-2 miles [mi]) from shore, at which point the OECC will diverge for each Phase to make landfall at separate sites in the Town of Barnstable, Massachusetts. As described in Sections 3.3.1.3 and 4.3.1.3 of COP Volume I, activities

[59] The impacts from anchor sweep are not quantified at this time due to the difficulty of estimating potential anchoring practices at the early planning stages of New England Wind.

within the OECC are expected to include cable installation, anchoring, the potential dredging ofthe tops of sand waves in certain locations, the potential use of cable protection (if required), the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing.

As with the SWDA, immobile benthic species or early life stages in the direct path of construction vessels would experience direct mortality or injury. Mobile demersal/benthic and pelagic fish and invertebrates may be temporarily displaced by increased suspended sediments and underwater construction but would likely be able to escape harm and avoid construction and installation areas. Some displaced fish and invertebrates may be subjected to indirect injury or mortality through increased predation or competition in areas surrounding the construction site. Overall, the slower avoidance response of juvenile and adult demersal fish and benthic invertebrate species subjects them to increased injury or mortality during dredging and cable installation. As mentioned above, slow avoidance responses can be further exaggerated if construction activities occur during the cold winter months for some species, such as horseshoe crab, that bury into the offshore sediment in the winter (Walls et al. 2002).

Dredging activities, if necessary, may directly impact organisms in the footprint of the dredging activity (i.e. stationary benthic communities). This includes polychaete worms, amphipods, and shellfish that live in the sediment, and the more motile benthic organisms (e.g. crustaceans), which are unable to escape the dredge or find suitable unoccupied refuge. In general, dredging of material from the top of the bedforms in a limited swath along the OECC is anticipated to have limited impact to the benthic habitat. This conclusion is based to the dynamic mobility of the surficial sand layer, which can migrate daily with the tidal currents, and the fact that the surrounding area is mostly homogeneous sand bottom habitat. There will likely be an evolution of the disturbed bedform back to its original morphology over time; the timing of this evolution will depend upon the tidal forces and resulting sand migration rates for that specific location (Lichtman et al. 2018; Roos and Hulscher 2003).

Once cable installation is complete, temporary to permanent habitat alteration may occur due to the resettling of disturbed finer-grained sediment over gravel substrate. However, because sedimentation thicknesses are typically expected to be less than 5 millimeters (mm) (0.20 inches [in]), dynamic processes will likely mask any changes after some time. For a small portion of the OECC, permanent alteration may also occur where desired burial depth cannot be achieved. In these areas with limited burial depth, cable protection may be placed over the cables. In general, areas where cable protection would be required would consist of harder, more consolidated seabed; thus, addition of cable protection would have a smaller change to habitat type relative to fine unconsolidated seabed. The Proponent's goal, however, is to minimize the use of cable protection to the greatest extent possible and will do so through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route.

OECC—Maximum Impact (Phases 1 and 2)

As detailed in Appendix III-T, within the OECC for Phases 1 and 2, the amount of permanent habitat alteration from the potential installation of cable protection (if required) would be approximately 0.22 km^2 (54 acres). The amount of habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 2.48 km^2 (612 acres).[60] Total seafloor impacts in the OECC would be approximately 2.60 km^2 (642 acres).

If the Western Muskeget Variant is used for one or two Phase 2 export cables[61], the amount of permanent habitat alteration for both Phases combined from the potential installation of cable protection (if required) would be approximately 0.23-0.24 km^2 (57-60 acres). The amount of habitat disturbance for both Phases combined from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 2.47-2.49 km^2 (611-614 acres). Total seafloor impacts in the OECC for both Phases combined would be approximately 2.61 km^2 (646 acres).

OECC—Phase 1

As detailed in Appendix III-T, the maximum impacts within the OECC for Phase 1 include approximately 0.09 km^2 (22 acres) for the potential installation of cable protection (if required). For Phase 1, the amount of habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 1.01 km^2 (251 acres). Total seafloor impacts in the OECC for Phase 1 would be approximately 1.06 km^2 (263 acres).

OECC—Phase 2

As detailed in Appendix III-T, the maximum impacts within the OECC for Phase 2 include approximately 0.13 km^2 (32 acres) for the potential installation of cable protection (if required). For Phase 2, the amount of habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding

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60 The impacts from anchor sweep are not quantified at this time due to the difficulty of estimating potential anchoring practices at the early planning stages of New England Wind.

61 It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 1.46 km^2 (361 acres). Total seafloor impacts in the OECC for Phase 2 would be approximately 1.53 km^2 (379 acres).

OECC—Phase 2 Western Muskeget Variant

If the Western Muskeget Variant is used for Phase 2, there will be either (1) one export cable installed in the Western Muskeget Variant and two export cables installed in the OECC or (2) two export cables installed in the Western Muskeget Variant and one export cable installed in the OECC[62]. In either scenario involving the Western Muskeget Variant, the amount of permanent habitat alteration from the potential installation of cable protection (if required), which alters habitat through the addition of artificial hard substrate, would be approximately 0.14–0.15 km^2 (35–38 acres) for Phase 2. The amount of temporary habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 1.46–1.47 km^2 (360-364 acres).

Recovery in SWDA and OECC (Phases 1 and 2)

Recolonization and recovery to pre-construction species assemblages is expected given the similarity of nearby habitat and species. Nearby, unaffected areas will likely act as refuge areas and supply a brood stock of species, which will begin recolonizing disturbed areas post-construction. Recovery timeframes and rates in a specific area depend on disturbance, sediment type, local hydrodynamics, and nearby species' colonization abilities (Dernie et al. 2003). Previous research conducted on benthic community recovery after disturbance found that recovery to pre-construction biomass and diversity values took two to four years (Van Dalfsen and Essink 2001). Other studies have observed differences in recovery rates based on sediment type, with sandy areas such as the SWDA and much of the OECC recovering more quickly (within 100 days of disturbance) than muddy/sand areas (Dernie et al. 2003).

Operational offshore wind farms in Europe provide insight into potential impacts to the benthic environment. Monitoring programs in Belgium indicated that the main effects of offshore wind farms are caused by infrastructure modifying sediment and benthic communities around the WTGs due to scour, sediment enrichment, and artificial reef effects; however, these effects remain localized within 50 m (164 ft) of WTGs and thus are minor or negligible (English et al. 2017). A report for the Barrow offshore wind farm located in the eastern Irish Sea describes post-construction monitoring after the wind farm became operational in July 2006 (BOWind, 2008). Bathymetry remained consistent between pre- and post-construction surveys, except for remnants of inter-array cable installation and localized scour around some of the individual monopiles ranging from 1–6 m (3–20 ft) deep that increased horizontally over the first year of

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62 It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

observation. Changes in benthic communities did occur, with main differences due to high numbers of *Ophiura* sp. (large brittle star) present post-construction versus more frequent occurrence of *Nephtys* sp. (cat worm) and higher abundance of *Amphirua* sp. (brittle star) pre-construction. There was also higher abundance and diversity of intertidal species in post-construction surveys. These changes correspond with differences in sediment grain size (i.e. coarser sediment) post-construction; however, these changes may be due to natural fluctuation in the area as changes were also observed over time during pre-construction and at reference sites unlikely to be affected by construction (BOWind 2008). Similarly, monitoring along the export cable route for the North Hoyle offshore wind farm in Wales determined that sediment deposition, grain size, and benthic community changes were within the natural variation at the site (English et al. 2017; NWP Offshore Ltd 2007). A comprehensive BOEM review of several monitoring reports from European offshore wind construction noted that changes in subtidal benthic habitat and communities were recorded to some extent but were not attributed to wind farm development due to high environmental variability and insufficient evidence to link cause and effect (English et al. 2017).

6.5.2.1.2 Suspended Sediments (Phases 1 and 2)

SWDA and OECC—Overview (Phases 1 and 2)

Suspended sediments may impact benthic organisms outside the physical footprint of dredged areas, dredging disposal sites, and the cable installation trench. Although many benthic organisms have developed behavioral and physiological mechanisms to deal with the resuspension of sediments that often follows natural events (i.e. storms, tidal flows, and currents), the scope, timing, duration, and intensity of dredging-related suspended sediment plumes may create an environment that some species are less able to tolerate. Sedimentation from suspended sediments can bury benthic organisms and clog the gills and/or filter feeding apparatus of infaunal invertebrates (USACE 2001). Benthic suspension feeders are particularly sensitive because suspended particles can remain suspended in the water column for weeks and interfere with feeding and growth (Smit et al. 2008; Wilber et al. 2005).

Suspended sediment impacts increase as a function of sediment concentration and duration of exposure, or dose (the product of concentration and exposure time) (Newcombe and Jensen 1996). Historically, the effects of suspended sediment on marine and estuarine organisms were viewed only as a function of concentrations (Wilber and Clarke 2001). Therefore, in most experimental studies, concentration was used as the sole variable of interest and exposure durations were not varied, or, in some cases, not reported (LaSalle et al. 1991; Sherk and Cronin 1970; Wilber and Clarke 2001). However, exposure duration has since been recognized as an important factor and has been included in most experiments (Newcombe and MacDonald 1991; Wilber and Clarke 2001). For benthic organisms, the minimum effects threshold (i.e. the exposure at which life stages of organisms are negatively affected either at sublethal or lethal levels) varies by organism group and life stage (see Table 6.5-9). As shown, the suspended sediment threshold for the most sensitive species is 10 milligrams per liter (mg/L) for 24 hours. The value for the most sensitive species is derived from studies of tropical coral that are not present within the SWDA or

OECC; however, cold-water corals have been found along the OECC. The available literature does not provide a definitive threshold for cold-water corals; therefore, the 10 mg/L threshold for tropical coral is conservatively retained as a potential threshold for the most sensitive species (i.e. cold-water coral) that may be present. The suspended sediment threshold for the next most sensitive benthic species that may be present within the Offshore Development Area, which likely provides a more reasonable conservative threshold, is either 100 mg/L for one day or 200 mg/L for 12 hours.

Table 6.5-9 Suspended Sediment Minimum Effects Threshold for Benthic Organisms

Organism Group (Life Stage)	Minimum Effects Threshold for Suspended Sediment
Mollusks (eggs) [1]	200 milligrams per liter (mg/L) for 12 hours
Mollusks (juveniles and adults)[2]	100 mg/L for 24 hours
Crustaceans (all life stages)[3]	100 mg/L for 24 hours
Other invertebrates (e.g. worms)[4]	650 mg/L
Corals (eggs)[5]	50 mg/L for 24 hours (preventing fertilization)
Corals (larvae)[5]	10 mg/L for 24 hours (altering larval settlement)
Corals (adults)[5]	25 mg/L for 24 hours (reducing calcification rate)

Notes:

1. Based on the concentration and duration at which sublethal effects were observed to the development of eastern oyster eggs (Cake 1983; Wilber and Clarke 2001).
2. Based on sublethal effects (i.e. reduced growth and reduced respiration) observed in northern quahog (Murphy 1985; Turner and Miller 1991; Wilber and Clarke 2001).
3. Based on sublethal effects (i.e. reduced growth and reduced respiration) observed in copepods, and euphausiids (Anderson and Mackas 1986).
4. See Rayment 2002; Read et al. 1982; 1983. For worms, no exposure time was indicated, but they are able to tolerate a large range of suspended sediments, as they inhabit areas of high total suspended solids concentrations.
5. See Fabricius 2005; Gilmour 1999; Rogers 1990. Studies investigate tropical species that are not present within the SWDA.

Considering the duration and concentration of suspended sediments, the BOEM DEIS (2018) for Vineyard Wind 1 determined that impacts from increased turbidity during construction will be minor.

SWDA—Phases 1 and 2

Given the broad similarity in grain sizes throughout the SWDA and the range of buildout scenarios for Phases 1 and 2 included in the New England Wind Project Design Envelope (where a significant portion of the SWDA could be included in either Phase 1 or 2), modeling of sediment transport potential in the SWDA was conducted for one representative inter-array cable route (see Appendix III-A). The modeled route was conservatively selected as one of the longer potential inter-array cable routes and in a location where grain sizes were slightly finer (though grain size is broadly similar throughout the SWDA). These model results are representative of inter-array, inter-link, or offshore export cable installation within the SWDA, for either Phase 1 or Phase 2.

Modeling in Appendix III-A indicated that under typical or maximum-impact cable installation methods, the maximum anticipated suspended sediment concentrations that persist for at least 60 minutes could be greater than 200 mg/L but less than 650 mg/L. These concentrations would drop rapidly to below 50 mg/L within a maximum of between one to two hours. Above-ambient total suspended solids concentrations greater than 10 mg/L would substantially dissipate within one to two hours and fully dissipate in less than four hours. Concentrations of suspended sediments with lower concentrations (10 mg/L or less) typically stayed within 200 m (656 ft) of the inter-array cable centerline but could extend up to 2.2 km (1.2 NM) from the inter-array cable centerline. Therefore, these concentrations and durations of exposure are below those causing sublethal or lethal effects to benthic organisms.

OECC—Phases 1 and 2

Modeling of sediment transport potential was conducted for a representative cable installation within the OECC that is illustrative of expected impacts for each of the five offshore export cables that may be installed within the OECC.

Installation along the OECC may require discontinuous (i.e. intermittent) dredging of the tops of sand waves to achieve sufficient burial depths. As described in Appendix III-A, this will likely be accomplished with a trailing suction hopper dredge (TSHD) or with jetting by controlled flow excavation for smaller sand waves. Sediment dispersion modeling of the TSHD indicated that concentrations of suspended sediments above 10 mg/L extended up to a maximum of 16 km (8.6 NM) from the area of activity; however, concentrations above 10 mg/L persist for less than six hours. For export cable installation, TSS concentrations greater than 10 mg/L typically stayed within 200 m (656 ft) of the alignment but could extend a maximum distance of approximately 2.1 km (1.1 NM). The modeling showed that most of the sediment settles out in less than three to four hours. Finfish and invertebrates may be affected by the mobilization and suspension of sediments during dredging and cable installation activities, but all sediments settle out of suspension within three to six hours, thus concentrations do not exceed the potential impact thresholds.

The Proponent may elect to use a vertical injector cable installation tool with deeper penetration in some areas. A representative section of injector installation was modeled, and results indicated that concentrations of suspended sediments above 10 mg/L extended up to a maximum of 1.2 km (0.6 NM) from the cable trench centerline. Most of the sediment settles out in less than three hours; however, suspended sediments at this concentration could persist for between four to six hours in smaller areas. Overall, this method is not anticipated to affect benthic organisms because all sediments settle out of suspension within six hours and do not exceed the sublethal or lethal sensitivity thresholds.

The OECC is the same for Phases 1 and 2 until approximately 2-3 km (1-2 mi) from shore, at which point the OECC will diverge for each Phase to reach separate landfall sites in Barnstable. Modeling of the Phase 1 Landfall Site was considered as a conservative representation of a worst-case plume for the Phase 2 Landfall Site because this location has a relatively high fraction of fine sediments compared with those of Phase 2.

OECC—Phase 2 Western Muskeget Variant

As mentioned above, modeling of sediment transport potential was conducted for one representative cable installation within the OECC that is illustrative of expected impacts for each of the five cables that may be installed within the OECC. Given the similarities in substrate type, ocean conditions, and the shorter corridor distance within the Western Muskeget Variant, suspended sediment concentrations and durations are expected to be similar or less than the values presented for the OECC. Therefore, potential effects to benthic resources as a result of sediment suspension from installation of the Western Muskeget Variant cables are expected to be the same or less than those presented above for the OECC because of the shorter length of the cable.

6.5.2.1.3 Sediment Deposition (Phases 1 and 2)

SWDA and OECC—Overview (Phases 1 and 2)

The resettlement of sediments disturbed during cable installation activities may smother and cause mortality of benthic fauna in nearby areas. Taxonomic groups react differently and have varying levels of tolerance for sedimentation, with sessile and attached organisms having the lowest tolerance and highest mortality rate during sedimentation events (Gates and Jones 2012; Wilber et al. 2005). For example, in the SWDA, attached/sessile organisms, such as sea squirts, will likely be the most sensitive to burial, as these taxa are immobile filter feeders. However, some attached bivalve species, such as mussels and oysters, have survived deposition levels of several millimeters (Wilber et al. 2005). Organisms that burrow or feed in subsurface sediments, such as sand dollars which are prevalent within the SWDA, will likely be less sensitive to burial as they can unbury themselves.

Two thresholds of concern have been identified for sediment deposition: one for demersal eggs and one for shellfish. The most sensitive life stage of the species considered for New England Wind is demersal eggs. Several species of fish and invertebrates have demersal eggs, including the Atlantic wolffish (*Anarhichas lupus)*, Atlantic herring (*Clupea harengus*), winter flounder (*Pseudopleuronectes americanus*), longfin inshore squid, and whelk species. For demersal eggs, deposition greater than 1 mm (0.04 in) can result in the burial and mortality of that life stage (Berry et al. 2011). Although the early life stages of some warm, shallow water coral species can be sensitive to deposition levels of 0.2 mm (0.008 in), the coral species likely present in the region, star coral (*Astrangia poculata*), is a cold-water species that is less sensitive to sedimentation (Peters and Pilson 1985). In addition, cold-water corals tend to form in areas with strong bottom currents, which keep corals free of sediment and prevent local deposition (Freiwald et al. 2004; Rogers 2004). Therefore, greater than 1 mm (0.04 in) of deposition is the lowest threshold of concern for New England Wind.

For shellfish, reported thresholds for the lethal burial depths of bivalves vary among species, but it is currently understood that the most sensitive species are those that are sessile or surface-oriented, such as blue mussel, soft-shell clam, and oysters (*Ostrea* spp.) (Essink 1999). One of the more comprehensive studies available is an early lab and field experiment of the effect of sudden burial on 25 species of bivalves from eight different "life habit types" defined by habitat (infaunal, epifaunal), feeding method (suspension, deposit), and burrowing behavior (Kranz 1974). The author determined that epibenthic suspension-feeders that use byssal attachments (i.e. sessile and lack a digging foot) are less capable of escaping deposition via traveling through the sediment, while many deposit feeder mollusks (e.g. *Macoma* clams and others within the Tellinacea or Nuculacea superfamilies) and infaunal mucus tube feeders (e.g. Lucinidae family bivalves) can escape burial thicknesses in native sediment up to 400 mm (16 in) by rapidly burrowing and/or better tolerating anoxic conditions (Kranz 1974).

In a recent mesocosm experiment by Colden and Lipcius (2015), the authors concluded that oysters are highly tolerant to short-term partial and shallow total burial. The study determined that adult oyster survival declined significantly only when 90% of more of the oyster (as measured relative to total shell height) was buried for 28 days. The authors concluded that the overall low mortality rates in their study for durations less than 28 days indicated that oysters are highly tolerant to partial and shallow total burial on weekly time scales. They also found that increased mortality occurred at burial depths of 108% shell height, which for oysters with shell heights between 25–90 mm (0.98–3.5 in) in size would occur at burials of 27–97 mm (1.1–3.8 in).

Most subtidal shellfish in the genera *Ostrea* (oysters), *Mytilus* (mussels), *Petricola* (Venus clams), and *Chlamys* (scallops) displayed lethal responses to deposition of either fine sand or mud[63] at thicknesses greater 50 mm (2 in), with oysters and mussels sensitive to around 20 mm (0.8 in) of deposition. Some less sensitive bivalves did not display a lethal response until sedimentation reached thicknesses of 200–500 mm (7.9–19.7 in) (Essink 1999). Conclusions regarding burial thresholds for individual species that can be drawn from the literature cited in the Essink (1999) study are somewhat limited because the studies did not always define "sensitive" or explain the level of effects (i.e. lethal versus sublethal). For community-level effects, Essink (1999) reported that after the dumping of dredged materials, decreases in species richness and abundance of major species in the benthic community were greatest in areas where the thicknesses of deposited sediments were greater than 300 mm (12 in).Several studies have indicated that many benthic species can tolerate deposition by coarser sediment sizes more than finer mud/silt sediment sizes and by sediments more similar to their native sediment type than by sediments of very different grain size (Essink 1999; Kranz 1974). However, burial tolerance thresholds are

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[63] General sediment classification, not CMECS-specific.

difficult to generalize as they are highly species-specific as well as substrate-specific. For example, large percentages of amethyst gem clam (*Gemma gemma)*, a species of Venus clam, can cope with 230-mm (9.1-in) thick burial by sand or a 57-mm (2.2-in) thick burial by silt for up to six days (Shulenberger 1970, as cited in Kranz 1974). Meanwhile, Venus clams in the genus *Petricola* appear unable to survive burial of either sediment type greater than 50 mm (2.0 in) (Essink 1999).

Research into the survival of queen scallops (*Aequipecten opercularis*) and sedimentation indicated depth of burial and sediment type significantly affected emergence ability and therefore survival of individuals (Hendrick et al. 2016). The highest emergence and survival rates for queen scallops occurred with burials of coarse sediment that were less than 20 mm (0.8 in) deep while the highest mortality occurred with fine sediment at depths of 70 mm (2.8 in) (Hendrick et al. 2016). Mortality increased with duration of burial; however, scallops can be highly mobile and may escape burial by rapidly opening and closing their shells to jettison water, unless deposition is very sudden and deep. Similarly, other mobile benthic species such as lobsters, crabs, and demersal fish would be temporarily displaced by sedimentation events but are likely able to avoid burial. For example, dungeness crab (*Cancer magister*) is able to survive burial depths over 120 mm (5 in) through escape responses and other adaptive behaviors (Vavrinec et al. 2007).

While the literature has shown sensitivity of bivalves to sedimentation varies greatly among species and can range up to several hundred millimeters of deposition, a sedimentation threshold of 20 mm (0.8 in) was used as the general threshold for shellfish. This threshold is inclusive of most shellfish and life stages, including more sensitive subtidal mussel and oyster beds, and is conservatively based on the work of Colden and Lipcius (2015), Essink (1999), and Hendrick et al. (2016). While Kranz (1974) reported zero escape potential (i.e. cannot move through sediment) for attached epifauna, he also noted that mussels can withstand burial for several months, so the escape potential thickness is not synonymous with a sedimentation tolerance threshold. Therefore, while attached shellfish may be unable to escape burial by burrowing up to the sediment surface similar to other bivalve groups (Kranz 1974), they have other adaptive responses that enable survival under sedimentation. For example, oysters can clear themselves of sediment (Wilber and Clarke 2010) and partial burial can lead to increased shell growth rates to reach the sediment surface (Colden and Lupcius 2015). Thus, based on these findings and on the wide range of sedimentation thicknesses and durations tolerated by bivalves in general, a 20 mm (0.8 in) threshold is a reasonably conservative threshold for assessment of impacts. In addition, sedimentation in the Offshore Development Area will be subject to currents and tidal flushing over time that may remove sediment before it can affect benthic organisms. The BOEM DEIS (2018) for Vineyard Wind 1 determined that impacts from sedimentation during construction would be minor and short-term.

SWDA—Phases 1 and 2

Given the broad similarity in grain sizes throughout the SWDA and the range of buildout scenarios for Phases 1 and 2 included in the New England Wind Project Design Envelope (where a significant portion of the SWDA could be included in either Phase 1 or 2), modeling of sediment transport and deposition potential in the SWDA was conducted for one representative inter-array cable route (see Appendix III-A).

Simulations of typical and maximum impact cable installation methods in the SWDA indicated that deposition of 1 mm (0.04 in) or greater (i.e. the threshold of concern for demersal eggs) extended up to 100 m (328 ft) from the route centerline for typical installation parameters (see Appendix III-A). At this deposition thickness, there are limited areas with potential temporary negative impacts to demersal eggs and species of similar sensitivity. The sediment dispersion modeling with typical and maximum impact installation techniques (see Appendix III-A) also indicated that, for the representative cable installation activities in the SWDA, there would be no area of deposition greater than 5 mm (0.20 in) for the typical installation parameters, and only small areas (0.01 km^2 [2.5 acres] for representative section) of deposition greater than 5 mm (0.2 in) for the maximum impact installation parameters. For both the typical and maximum impact installation parameters, there were no areas with deposition above 10 mm (0.4 in). Therefore, cable installation is not anticipated to affect shellfish or other organisms of similar sensitivity to deposition.

OECC—Phases 1 and 2

Modeling of sediment transport potential was conducted for one representative cable installation within the OECC that is illustrative of expected impacts for each of the up to five cables that may be installed within the OECC.

Simulations of typical cable installation parameters (without sand wave removal) in the OECC indicated that deposition of 1 mm (0.04 in) or greater (i.e. the threshold of concern for demersal eggs) was constrained to within 100 m (328 ft) from the route centerline and maximum deposition was typically less than 5 mm (0.20 in), though there was a small isolated area associated with the vertical injector model scenario with deposition between 5 to 10 mm (0.2 to 0.4 in) (see Appendix III-A). At this deposition thickness, there are limited areas with potential temporary negative impacts to demersal eggs and species of similar sensitivity. In areas along the OECC where sand wave dredging was simulated to occur, deposition greater than 1 mm (0.04 in) associated with the TSHD was mainly constrained to within 1 km (0.54 NM) but extended up to 2.3 km (1.2 NM) in isolated patches when subject to swift currents through Muskeget Channel.

At this deposition thickness, there are limited areas with potential temporary negative impacts to demersal eggs and species of similar sensitivity. Modeling results also indicated that there will be some small areas of deposition greater than 20 mm (0.8 in) from dredging and dumping extending up to 900 m (0.49 NM) from the route centerline. At this deposition thickness, there are limited areas with potential temporary negative impacts to all life stages of shellfish and species of similar sensitivity to deposition.

The OECC is the same for Phases 1 and 2 until approximately 2-3 km (1-2 mi) from shore, at which point the OECC will diverge for each Phase to reach separate landfall sites in Barnstable. As noted previously, modeling of the Phase 1 Landfall Site was considered a conservative representation of a worst-case plume for the Phase 2 Landfall Site because this location has a relatively high fraction of fine sediments compared with those of Phase 2.

OECC—Phase 2 Western Muskeget Variant

As mentioned above, modeling of sediment transport potential was conducted for one representative cable installation within the OECC that is illustrative of expected impacts for each of the five cables that may be installed within the OECC. Given the similarities in substrate type, ocean conditions, and the shorter corridor distance within the Western Muskeget Variant, sediment deposition levels are expected to be similar or less than the values presented for the OECC. Therefore, potential effects to benthic resources as a result of sediment deposition from installation of the Western Muskeget Variant cables are expected to be the same or less than those presented above for the OECC because of the shorter length of the cable.

6.5.2.1.4 Water Withdrawals (Phases 1 and 2)

SWDA and OECC—Overview (Phases 1 and 2)

Direct mortality of planktonic life stages could occur via water withdrawals for vessel functions and potentially from the cable installation and dredging vessels during construction and operation of both Phases of New England Wind. Mortality of organisms entrained in water withdrawal pumps is expected to be 100% because of the physical stresses associated with being flushed through a pump system and potential temperature changes (USDOE MMS 2009). The BOEM DEIS (2018) for Vineyard Wind 1 determined that impacts from entrainment of benthic organisms and their planktonic stages during construction would be moderate but would not have population-level effects.

SWDA—Maximum Impact (Phases 1 and 2)

Water withdrawals for the maximum size of the SWDA can be estimated using the following assumptions:

- Cable installation occurs at a rate of up to 200 meters per hour (m/hr) (656 feet per hour [ft/hr])[64]

- A jetting technique uses 11,300–45,000 liters per minute (3,000–12,000 gallons per minute) of water

- The maximum total length of inter-array, inter-link, and offshore export cables within the SWDA is 701 km (379 NM)

Under these assumptions, water withdrawal volumes for the maximum size of the SWDA are expected to be approximately 2.4–9.5 billion liters (0.6–2.5 billion gallons).

SWDA – Phase 1

Water withdrawals for the maximum size of Phase 1 can be estimated using the above assumptions and a maximum total length of inter-array, inter-link, and offshore export cables within the SWDA of approximately 281 km (152 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 1.0–3.8 billion liters (0.3–1.0 billion gallons) for Phase 1.

SWDA—Phase 2

Water withdrawals for the maximum size of Phase 2 can be estimated using the above assumptions and a maximum total length of inter-array, inter-link, and offshore export cables within the SWDA of approximately 495 km (267 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 1.7–6.7 billion liters (0.4–1.8 billion gallons) for Phase 2.

OECC—Maximum Impact (Phases 1 and 2)

Water withdrawals for the up to five offshore export cables within the OECC can be similarly estimated using the following assumptions:

- Cable installation occurs at a rate of up to 120 m/hr (394 ft/hr)[65]

- A jetting technique uses 11,300–45,000 liters per minute (3,000–12,000 gallons per minute) of water

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64 The final installation speed will be specific to the contractor and cable installation equipment and may be different than listed here. A speed of 200 m/hr (656 ft/hr) is used to provide a general estimate of water usage.

65 The final installation speed will be specific to the contractor and cable installation equipment and may be different than listed here. A speed of 120 m/hr (394 ft/hr) is used to provide a general estimate of water usage.

- The maximum total length of offshore export cables (outside the SWDA) is 412 km (222 NM)

Under these assumptions, water withdrawal volumes for the installation of five cables within the OECC for Phases 1 and 2 are expected to be approximately 2.3–9.3 billion liters (0.6–2.4 billion gallons).

OECC—Phase 1

The maximum water withdrawals within the OECC for Phase 1 can be estimated using the above assumptions and a maximum total length of offshore export cables (outside the SWDA) for Phase 1 of approximately 166 km (89 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 0.9–3.7 billion liters (0.2–1.0 billion gallons) for Phase 1.

OECC—Phase 2

The maximum water withdrawals within the OECC for Phase 2 can be estimated using the above assumptions and a maximum total length offshore export cables (outside the SWDA) for Phase 2 of approximately 246 km (133 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 1.4–5.5 billion liters (0.4–1.5 billion gallons) for Phase 2. Given the shorter corridor distance within the Western Muskeget Variant, potential effects to pelagic life stages of benthic organisms as a result of water withdrawals for installation of the Western Muskeget Variant cables are expected to be the same or less than those presented above for the OECC.

6.5.2.1.5 Increased Sound Exposure (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Construction of New England Wind would introduce underwater noise and may result in increased sound exposure of finfish and invertebrates. Underwater sounds would include repetitive, high-intensity (impulsive) sounds produced by pile driving, and continuous (non-impulsive), lower-frequency sounds produced by vessel propulsion and cable installation. Intensity of produced sound would vary with some sounds being louder than ambient noise. Ambient noise within Lease Area OCS-A 0501 was measured as, on average, between 76.4 and 78.3 decibels re 1 $\mu Pa^2/Hz$ (dB) (Alpine Ocean Seismic Surveying, Inc. 2017). This study was performed prior to the segregation of Lease Area OCS-A 0501 into OCS-A 0501 and OCS-A 0534. For further description of characteristics of sound from proposed actions refer to Appendix III-M, and for their potential effects on finfishes and commercially important invertebrates refer to Section 6.6.

Many marine invertebrates are permanently in contact with bottom sediment. The sediment, however, does not follow exactly, or at all, the movement of the surrounding water. Therefore, exposure to underwater sound will result in a relative movement between the body of these animals and the oscillating water column. Accordingly, it is important to also consider the propagation of vibration through the seabed. For benthic organisms, this type of vibration is likely of similar or greater importance than the water-borne vibration or even the compressional component of a sound (Roberts and Elliott 2017).

The published scientific information on vibration sensitivity in marine invertebrates is extremely scarce (Roberts et al. 2016a; 2016b). Only a small number of studies have indicated reception of vibration and behavioral responses in bivalves, which include the closure of the syphons and, in more active mollusks, movement away from the substrate (Ellers 1995; Kastelein et al. 2008; Mosher 1972). To date, there is no convincing evidence for any significant effects induced by non-impulsive noise in benthic invertebrates. Moreover, given the rapid attenuation of vibrational signals beyond the near-field of a sound source (Morley et al. 2014), it is unlikely that these stimuli are causing more than behavioral effects (e.g. flight or retraction) or physiological (e.g. stress) responses.

From 2013–2015, a long-term study evaluated the acoustic impacts from seismic exposure on scallops in Australia (Day et al. 2016a; 2017). The experimental field research maintained the scallops in mesh enclosures while a vessel with the acoustic source passed close to the animals. Seismic sound exposure did not cause mass mortality of scallops during the experiment; however, repeated exposure (i.e. more than one pass of the air gun) where maximum exposure levels were in the range of 181 to 188 dB SEL (191 to 213 dB re 1µPa peak-peak SPL) was thought to possibly increase the risk of mortality.

Though Day et al. (2016a) recorded increased mortality with repeated exposure to a seismic source, it has not been established whether this was due to the seismic source exposure or another mechanism related to the study design (Przeslawski et al. 2016). Assuming mortality was due to the seismic source, then the increased mortality identified translates to an annual increase in mortality of between 5% and 15% in mortality above the controls (Day et al. 2016a). Scallops exposed to repeated seismic sound suffered physiological damage with no signs of recovery over the four-month period, suggesting potentially reduced tolerance to subsequent stressors. In addition, changes in behavior and reflexes during and following seismic exposure were observed. Day et al. (2016a; 2016b), however, cautioned that it was unclear from the study whether the observed physiological (and behavioral) impairments would result in mortality beyond the timeframes considered in their study.

Przeslawski et al. (2018) concluded that there was no evidence of increased scallop mortality, or effects on scallop shell size, adductor muscle diameter, gonad size, or gonad stage due to the seismic sound from an actual seismic survey. The authors concluded that the study provided no clear evidence of adverse effects on scallops, fish, or commercial catch rates due to the 2015 seismic survey undertaken in the Gippsland Basin. Przeslawski et al. (2018) further concluded that the study provided a robust and evidence-based assessment of the potential effects of a seismic survey on some fish and scallops.

Heyward et al. (2018) monitored corals during and after a 3-D seismic survey. There were no detectable impacts on coral mortality, skeletal damage, or visible signs of stress immediately after and up to four months following the 3-D marine seismic survey. Similarly, there was no evidence of a behavioral response, such as polyp withdrawal or flaccidity in soft corals. There is limited published literature on the potential impacts of impulsive sounds on hard and soft corals, and unlike other faunal groups, currently there are no peer-reviewed criteria against which potential impacts from anthropogenic sound to coral can be assessed.

In addition to those potential impacts stated in Section 6.6, impacts to most sessile and/or infaunal species from sound exposure related to proposed New England Wind construction actions are expected to be insignificant.

6.5.2.1.6 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Several mitigation measures will be employed to avoid and minimize potential impacts to benthic resources within the SWDA and OECC. One of the most important measures is that the MA WEA has been sited to avoid the most sensitive areas for benthic and other resources. Other measures include the following:

- Utilize widely-spaced WTGs and ESPs, so that the foundations (and associated scour protection) for the WTGs and ESPs, along with cable protection for inter-array and inter-link cables, only occupy a minimal portion of the SWDA, leaving a huge portion of the SWDA undisturbed.
- Where feasible and considered safe, mid-line buoys on anchor lines will be used to minimize impacts from anchor line sweep.
- As described in Sections 3.3.1.8 and 4.3.1.8 of COP Volume I, horizontal directional drilling (HDD) is expected to be used to avoid or minimize impacts to benthic habitat at the Phase 1 and Phase 2 landfall sites.[66]

The Proponent is also committed to developing an appropriate benthic monitoring framework for New England Wind, should it be necessary, in consultation with BOEM and other agencies as appropriate (see Appendix III-U for the draft framework). The framework for New England Wind will consider the draft Benthic Habitat Monitoring Plan for Vineyard Wind 1 in Lease Area OCS-A 0501. Due to the similarities in habitat across the Lease Areas OCS-A 0501 and OCS-A 0534, the monitoring data collected during the Vineyard Wind 1 monitoring effort may also inform expected impacts to and recovery of benthic communities within the SWDA.

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[66] At the Phase 1 and Phase 2 landfall sites, HDD is expected to be used, though open trenching may also be used during Phase 2 if it is not feasible to use the Dowses Beach Landfall Site and open trenching is needed at the Wianno Avenue Landfall Site.

6.5.2.1.7 Summary of Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

In summary, impacts to benthic habitat due to installation of WTG/ESP foundations are expected to result in short-term loss of habitat within a localized area, such that population level impacts are unlikely. Potential impacts may be minimized or offset through the addition of structured habitat.

While mortality of benthic organisms is expected in the Offshore Development Area where temporary disturbance of the seafloor would occur due to cable, scour protection, and foundation installation, the impacts are expected to be localized and population-level effects are unlikely due to the following factors:

1. The surrounding vicinity of the SWDA has an abundant area of similar habitat type.

2. The portion of the SWDA that will be disturbed is relatively small, given the size of adjacent similar habitat. For the maximum size of the SWDA and encompassing both Phases 1 and 2, the total area of alteration due to foundation and scour protection installation, jack-up and/or anchored vessel use, inter-array and inter-link cable installation, potential cable protection (if required) and metocean buoy anchors is 5.19 km^2 (1,283 acres) which is 1.1 % of the maximum size of the SWDA.

3. The sandy bottom community typical to the Offshore Development Area has adapted to frequent natural sediment movement that already creates temporary impacts. Previous scientific research indicated that certain benthic invertebrate species will opportunistically invade substrate areas that are unoccupied once disturbances have occurred (Howes et al. 1997; Rhoads et al. 1978; Rosenberg and Resh 1993; USDOE MMS 2009).

Overall, impacts from the alteration of habitat in the SWDA and along the OECC (including the Western Muskeget Variant) are expected to be minimal and recovery of natural assemblages likely.

6.5.2.2 Operations and Maintenance

Activities associated with the operations and maintenance (O&M) of New England Wind that could affect benthic resources include cable maintenance or repair (including associated dredging, if required); geotechnical sampling surveys; WTG and ESP maintenance and associated use of jack-up vessels (if required for repairs); use of anchored vessels; electromagnetic fields (EMFs); and installation of additional scour or cable protection installation (if any).

6.5.2.2.1 Habitat Alteration (Phases 1 and 2)

SWDA—Phases 1 and 2

The installation of WTGs and ESPs in the SWDA introduces structures that would be a source of new hard substrate with vertical orientation, and these structures would be present for the entire life of New England Wind. Since Horseshoe Shoal and Nantucket Sound have limited amounts of this habitat type, this would be considered a direct impact of operation. Organisms that may affix to the foundations could include algae, sponges, tunicates, anemones, hydroids, bryozoans, barnacles, and mussels. These organisms are known to occur on other hard substrate areas in Nantucket Sound including navigation buoys or pier pilings. Organisms including polychaetes, oligochaetes, nematodes, nudibranchs, gastropods, and crabs are expected to be present on or near the foundations as growth of fouling organisms develops.

A 2005 Macroinvertebrate Survey of the Meteorological Tower (ESS Group 2006) indicated that a benthic macroinvertebrate community similar to the surrounding seafloor community had colonized the support pilings of Cape Wind's meteorological tower. It was noted that these new taxa were likely to be in the site of the proposed action but would be expected to inhabit hard substrates such as rocky shoals or boulders (ESS Group 2006). Therefore, it is expected that the foundations would support greater biodiversity because they provide available habitat that could be exploited by organisms from nearby habitats. Impacts due to the installation of additional scour or cable protection (if any) for O&M will be similar to impacts from scour protection and cable protection installation during construction of New England Wind (see Section 6.5.2.1).

The presence of the ESPs and their foundations may affect nearby soft-bottom benthic invertebrate communities due to shading. However, these possible effects would be dependent upon the approximate height of the structure above the water and would be minimized due to the fact that the shadow from the structure would move rapidly across the seafloor during daylight hours.

OECC—Phases 1 and 2

The Proponent's goal is to minimize the use of cable protection to the greatest extent possible through careful route assessment and selection of the most appropriate cable burial tool for each segment of the cable route. Nevertheless, some cable protection may be required. In the event cable protection is required, the addition of cable protection will result in the permanent alteration of habitat to hard-bottom substrate as described in Section 6.5.2.1.

6.5.2.2.2 Cable Maintenance (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Impacts associated with cable maintenance and/or repair could include a temporary increase in turbidity and some localized deposition of sediment during the repair process. The increase in turbidity would be caused by the removal of sediments to uncover the damaged portion of the cable, hoisting of the cable after it is cut, laying the cable back down, and then jetting or otherwise removing sediments for reburial of the repaired cable. Temporary impacts would also occur where anchors are deployed or where anchor cable sweeps the bottom. Such impacts would be confined to the specific area of the repair(s) and, given the limited area(s) where repair(s) may occur, would be considerably less than the impacts during construction.

6.5.2.2.3 Electromagnetic Fields (Phases 1 and 2)

EMFs consist of two components: electric fields and magnetic fields. EMFs would be generated by inter-array cables connecting WTGs in the SWDA, inter-link cables between the ESPs, and offshore export cables along the OECC. The electrosensitive invertebrate species that have been identified thus far, such as sea slugs and sea urchins, have sensitivity thresholds above the modeled level of induced electric fields from undersea cables (Normandeau et al. 2011) and are therefore not expected to be impacted by those fields. As is the case with fish (discussed in more detail in Section 6.6), invertebrate species that use earth's geomagnetic field to guide their movements may be confused as they encounter the magnetic field from an undersea cable (Gill and Kimber 2005). Certain species could change their direction of travel or alter their homing capabilities if they rely on a magnetic sense for these actions; however, these potential effects would be restricted to an area in close proximity of certain cable systems where EMF strengths exceed the threshold known to cause an effect (Normandeau et al. 2011).

A study funded by BOEM found that although there were changes in the behavior of little skate and American lobster in the presence of energized cables, EMFs from cables did not act as a barrier to movement in any way (Hutchison et al. 2018; 2020). In addition, research investigating habitat use around energized cables found no evidence that fishes or invertebrates were attracted to or repelled by EMFs emitted by cables (Love et al. 2017). A BOEM-funded review by Snyder et al. (2019) determined that the significance of potential impacts of EMFs from alternating current sources in offshore wind on six demersal invertebrates (Atlantic sea scallop, deep-sea red crab [scientific name not given], Atlantic surf clam, ocean quahog, American lobster, and Jonah crab) and other demersal fauna was negligible, as was also stated in the BOEM DEIS (2018) for Vineyard Wind 1. Furthermore, there are already subsea transmission cables present in the Offshore Development Region, with three between Martha's Vineyard and Falmouth and two more between Nantucket and Cape Cod (see Section 7.9).

The effects of submarine cable EMFs on infaunal species are lesser-known but a study of the impacts on a species of polychaete worms found that individuals did not exhibit avoidance or attraction but there was increased burrowing and decreased ammonia excretion in the presence of the EMF (Jakubowska et al. 2019).

Modeling of the New England Wind-specific cables was conducted to assess potential effects of EMFs. As submarine offshore export cables will not produce any electric fields in the seafloor or ocean due to the shielding effect of the cable covering, modeling of potential effects from the New England Wind cables was focused on magnetic fields (MFs). High voltage alternating current (HVAC) cables (which will be used for Phase 1 and Phase 2) were modeled. All modeling assumed cables were buried beneath 1.5 m (5 ft) of sediments. In areas where sufficient burial is not achieved and cable protection is used, the protection will serve as a physical barrier in the same manner as cable burial, preventing organisms from experiencing the full strength of the magnetic field.

Modeling of the 220 kV and 275 kV HVAC cables demonstrated that MFs at the seafloor from the buried cables decrease with distance, with a maximum MF of 84.3 mG directly above the centerline that decreases to 5.6 mG at 6 m (20 ft) from the centerline (Gradient 2020, Gradient 2021).

These model results indicate that MFs are likely only able to be sensed, if at all, directly over the buried cable centerline. Consistent with the modeled MF levels and the findings on 60-Hz AC EMFs (Snyder et al. 2019), and because cables in the Offshore Development Area will have a minimum target burial depth of approximately 1.5 m (5 ft), it is unlikely that demersal or benthic organisms will be affected by MFs from the offshore cable system.

6.5.2.2.4 Other Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Geophysical or geotechnical survey work may occur during O&M. Geotechnical sampling may have highly localized impacts to benthic organisms that are limited to the immediate area of the geotechnical sample location or any benthic grab or drop camera sampling stations.

Anchoring of crew transfer vessels or other accommodation vessels may occur within the SWDA during normal operations. If repair work is required, both anchoring (within the SWDA or along the OECC) and the use of jack-up vessels (within the SWDA) may occur. As described in Section 7.8, approximately 290 vessel round trips are expected to take place annually during the O&M of each Phase (assuming each Phase's maximum design scenario), which is significantly less than during construction. Such impacts would be highly localized and short-term.

6.5.2.2.5 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

The mitigation measures would be the same as discussed previously for construction and installation (see Section 6.5.2.1.6). However, there will be no HDD occurring during the O&M period.

6.5.2.2.6 Summary of Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Impacts to benthic resources due to introduction of structured habitat (WTG/ESP foundations, scour protection, and cable protection [if required]) will be direct, long-term (over the operational lifetime of New England Wind), and localized. It is possible that the foundations will support more taxa than the surrounding primarily homogenous sand habitats. While not anticipated, impacts due to the installation of additional scour protection will be similar to impacts from scour protection installation during construction (see Section 6.5.2.1).

Impacts to benthic resources from cable maintenance/repair, use jack-up and/or anchored vessels, and geotechnical sampling surveys are anticipated to be short-term and localized to a very small area of the seafloor.

Impacts to benthic resources from EMFs are expected to be unlikely and mitigated by cable burial.

6.5.2.3 Decommissioning

6.5.2.3.1 Overall Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

The removal of the WTG/ESP foundations and scour protection may result in a local shift in habitat type from structure-oriented to the original type of habitat present prior to installation of New England Wind. Therefore, decommissioning would cause a return to pre-construction conditions and remove any communities that developed on New England Wind components while they were present. Decommissioning may also include removal or retirement in place of the inter-array, inter-link, and offshore export cables. Retirement in place would result in temporary resuspension of bottom sediments along each cable path and impacts from anchor usage (if an anchored vessel is used); these impacts would be similar to those previously described for the construction period of New England Wind. A literature review funded by BOEM determined that full recovery of benthic habitats after offshore wind project decommissioning usually takes between three months and 2.5 years (Latham et al. 2017). In addition, the BOEM DEIS (2018) for Vineyard Wind 1 determined that impacts from decommissioning would be minor and short-term.

6.5.2.3.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

The avoidance, minimization, and mitigation measures would be the same as discussed previously for construction and installation (see Section 6.5.2.1.6).

6.5.2.3.3 Summary of Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

In summary, impacts from decommissioning will be very similar to impacts from construction and are expected to be localized and short-term. Due to the long lifespan of New England Wind, it is also expected that technology will be enhanced by the time decommissioning occurs allowing for impacts to be reduced.

6.6 Finfish and Invertebrates

This section describes finfish and invertebrate resources in the Offshore Development Region and Offshore Development Area of New England Wind. Essential Fish Habitat (EFH) is discussed in Appendix III-F.

6.6.1 Description of the Affected Environment

The Offshore Development Area is the offshore area where the Proponent's offshore facilities are physically located, which includes all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]), as well as the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]). New England Wind will be developed in two Phases with a maximum of 130 wind turbine generator (WTGs) and electrical service platform (ESP) positions in the SWDA, and five offshore export cables in the OECC.

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the option to install one or two Phase 2 cables[67] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[68] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

With respect to finfish and invertebrates, the Offshore Development Region is the broader offshore geographic region surrounding the SWDA and OECC that could be affected by New England Wind-related activities, which includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, and the Massachusetts Wind Energy Area (MA WEA) where Lease Areas

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[67] It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

[68] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

OCS-A 0501 and OCS-A 0534 are located. The Offshore Development Region has a diverse and abundant fish assemblage that is generally categorized according to life habits or preferred habitat associations, such as pelagic, demersal, and highly migratory.

This discussion of finfish and invertebrates is based on a review of existing literature and site-specific data. Existing data support characterization of distribution, abundance, and composition of fish species within the area potentially affected by New England Wind-related activities. The most relevant data sources are the:

- Northeast Fisheries Science Center (NEFSC) multispecies bottom trawl surveys
- Massachusetts Division of Marine Fisheries (MA DMF) trawl surveys
- Northeast Ocean Data Portal (NEODP)
- University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST) fisheries surveys for Lease Area OCS-A 0534 and Lease Area OCS-A 0501,[69] including:
    - Demersal trawl survey reports for Vineyard Wind 1 and New England Wind (Rillahan and He 2020a; 2020b; 2020c; 2020d; 2020e; 2020f; 2020g; 2021)
    - 2019 and 2020 drop camera surveys (Bethoney et al. 2019 and Stokesbury et al. 2021)
    - 2019 ventless trap survey (Stokesbury et al. 2020)
- SMAST video survey of the western portion of the MA WEA (2013; 2014)
- BOEM's Revised Environmental Assessment for the MA WEA (BOEM 2014)
- BOEM's Biological Assessment (BA) for Vineyard Wind 1 (BOEM 2018a)
- BOEM's Draft Environmental Impact Statement (DEIS) for Vineyard Wind 1 (BOEM 2018b)

Additional studies that contribute to the available fisheries information in the region of southern New England include, but are not limited to, the following:

- Vineyard Wind Offshore Wind Energy Project Essential Fish Habitat Assessment (BOEM 2019)

[69] The results of ongoing fisheries studies are published on the Proponent's website at the following link: https://www.parkcitywind.com/fisheries

- Fishery Physical Habitat and Epibenthic Invertebrate Baseline Data Collection (BOEM and NOAA NEFSC—ongoing study)
- Habitat Mapping and Assessment of Northeast Wind Energy Areas (BOEM and NOAA NEFSC 2017)
- Northeast Area Monitoring and Assessment Program (NEAMAP)
- The Nature Conservancy and SMAST Offshore Video Survey and Oceanographic Analysis: Georges Bank to the Chesapeake (2003–2012) (Bethoney et al. 2015)
- Southern New England Juvenile Fish Habitat Research Study (2017)
- Spatial and Temporal Distributions of Lobsters and Crabs in the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) (Collie and King 2016)
- Vineyard Wind Construction and Operations Plan (2018)
- Vineyard Wind Fisheries Monitoring Plan (Cadrin et al. 2019)
- Southern New England Industry-Based Yellowtail Flounder Survey (2003–2005)

A list of the major fish assemblage found in the Offshore Development Area is presented in Table 6.6-1 and described in more detail below. Additional information, including federal listing, presence of EFH in the Offshore Development Area, habitat association, and fishery importance, is also noted in the table. A list of species recorded in at least 1 of 66 NEFSC Ecosystem Monitoring program (EcoMon) ichthyoplankton samples taken between 1977 and 2017 within the SWDA is provided in Table 6.6-2 (NEFSC 2020).

SMAST currently conducts ten tow trawl surveys in the spring, summer, fall, and winter (except when disrupted by COVID-19) within the SWDA, and these started in the spring of 2019 as described in the fisheries monitoring plan. These surveys (up through spring 2021) recorded the presence of 44 species, all of which are included in Table 6.6-1. The surveys had an average catch weight between 95 kg (209 lb) and 1,468 kg (3,236 lb) of finfish and invertebrates with typically smaller catches in the winter and spring. Species with large catches include spiny dogfish (*Squalus acanthias)*, little skate (*Leucoraja erinacea*), red hake (*Urophycis chuss*), silver hake (*Merluccius bilinearis)*, haddock (*Melanogrammus aeglefinus*), scup (*Stenotomus chrysops*), butterfish (*Peprilus triacanthus),* and northern sea robin *(Prionotus carolinus)*. More details are included in quarterly survey reports (Rillahan and He 2020a; 2020b; 2020c; 2020d; 2020e; 2020f; 2020g; 2021). In addition, six tows conducted as part of the spring 2019 Vineyard Wind 1 trawl survey occurred wholly within the SWDA. These tows did not produce any species outside of those already included in Table 6.6-1 (Rillahan and He 2020c). Overlapping stations with the SWDA from the ventless trap (Stokesbury et al. 2020) and drop camera surveys (Bethoney et al. 2019, Stokesbury et al. 2021) conducted by SMAST also did not capture any additional species outside of those listed in Table 6.6-1.

Table 6.6-1 Major Fish and Invertebrate Species Potentially Occurring in the Offshore Development Area[1]

Common Name	Scientific Name	EFH	Listing Status[2]	Commercial/ Recreational Importance	Habitat Association
Acadian redfish	*Sebastes fasciatus*			●	Demersal
Alewife	*Alosa pseudoharengus*		S	●	Pelagic
American conger	*Conger oceanicus*				Demersal
American eel	*Anguilla rostrata*			●	Pelagic
American lobster	*Homarus americanus*			●	Benthic
American shad	*Alosa sapidissima*			●	Pelagic
American sand lance	*Ammodytes americanus*			●	Demersal
Atlantic albacore tuna	*Thunnus alalunga*	●		●	Pelagic
Atlantic bluefin tuna	*Thunnus thynnus*	●	S	●	Pelagic
Atlantic butterfish	*Peprilus triacanthus*	●		●	Demersal / Pelagic
Atlantic cod	*Gadus morhua*	●		●	Demersal
Atlantic menhaden	*Brevoortia tyrannus*			●	Pelagic
Atlantic mackerel	*Scomber scombrus*	●		●	Pelagic
Atlantic skipjack tuna	*Katuwonus pelamis*	●		●	Pelagic
Atlantic sea herring	*Clupea harengus*	●		●	Pelagic
Atlantic sea scallop	*Placopecten magellanicus*			●	Benthic
Atlantic surf clam	*Spisula solidissima*	●		●	Benthic
Atlantic wolffish	*Anarhichas lupus*	●	S		Demersal
Atlantic yellowfin tuna	*Thunnus albacares*	●		●	Pelagic
Barndoor skate	*Dipturus laevis*	●			Demersal
Basking shark	*Cetorhinus maximus*	●	S		Pelagic
Bay scallops	*Argopecten irradians*			●	Benthic
Beardfish	*Polymixia lowei*				Demersal
Black sea bass	*Centropristis striata*	●		●	Demersal
Blue mussels	*Mytilus edulis*			●	Benthic
Blue shark	*Prionace glauca*	●			Pelagic
Bluefin tuna	*Thunnus thynnus*			●	Pelagic
Bluefish	*Pomatomus saltatrix*	●		●	Pelagic
Blueback herring	*Alosa aestivalis*		S	●	Pelagic
Channeled whelk	*Busycotypus canaliculatus*			●	Benthic
Cobia	*Rachycentron canadum*	●			Pelagic
Common thresher shark	*Alopias vulpinus*	●			Pelagic
Cunner	*Tautogalabrus adspersus*			●	Demersal
Cusk	*Brosme brosme*		C/S	●	Demersal
Dusky shark	*Carcharhinus obscurus*	●	S		Pelagic
Eastern oyster	*Crassostrea virginica*			●	Benthic
Fourspot flounder	*Hippoglossina oblonga*			●	Demersal
Golden tilefish	*Lopholatilus chamaeleonticeps*			●	Demersal
Gulfstream Flounder	*Citharichthys arctifrons*				Demersal
Haddock	*Melanogrammus aeglefinus*	●		●	Demersal
Hagfish	*Myxine glutinosa*			●	Demersal
Horseshoe crab	*Limulus Polyphemus*			●	Benthic
Jonah crab	*Cancer borealis*			●	Benthic
King mackerel	*Scomberomorus cavalla*	●			Pelagic
Knobbed whelk	*Busycon carica*			●	Benthic
Lightning whelk	*Busycon contrarium*			●	Benthic
Little skate	*Leucoraja erinacea*			●	Demersal

Table 6.6-1 Major Fish and Invertebrate Species Potentially Occurring in the Offshore Development Area[1] (Continued)

Common Name	Scientific Name	EFH	Listing Status[2]	Commercial/ Recreational Importance	Habitat Association
Longfin squid	*Doryteuthis pealeii*	●		●	Pelagic
Longhorn sculpin	*Myoxocephalus octodecemspinosus*				Demersal
Monkfish	*Lophius americanus*	●		●	Demersal
Northern quahog	*Mercenaria mercenaria*			●	Benthic
Northern sand lance	*Ammodytes dubius*			●	Demersal
Northern sea robin	*Prionotus carolinus*			●	Demersal
Ocean pout	*Macrozoarces americanus*	●			Demersal
Ocean quahog	*Artica islandica*	●		●	Benthic
Pollock	*Pollachius pollachius*			●	Demersal
Porbeagle shark	*Lamna nasus*	●	S		Pelagic
Red hake	*Urophycis chuss*	●		●	Demersal
Rock crab	*Cancer irroratus*				
Round herring	*Etrumeus teres*			●	Pelagic
Sand tiger shark	*Carcharias taurus*	●	S		Pelagic
Sandbar shark	*Carcharhinus plumbeus*	●			Pelagic
Sea Raven	*Hemitripterus americanus*				
Scup	*Stenotomus chrysops*	●		●	Demersal/ Pelagic
Shortfin mako	*Isurus oxyrinchus*	●		●	Pelagic
Shortfin squid	*Illex illecebrosus*	●		●	Pelagic
Shortnose greeneye	*Chlorophthalmus agassizi*				Demersal
Silver hake	*Merluccius bilinearis*			●	Demersal
Smooth dogfish	*Mustelus canis*	●		●	Demersal
Spanish mackerel	*Scomberomorus maculatus*	●			Pelagic
Spotted hake	*Urophycis regius*				Demersal
Spiny dogfish	*Squalus acanthias*	●		●	Demersal
Striped bass	*Morone saxatilis*			●	Pelagic
Summer flounder	*Paralichthys dentatus*	●		●	Demersal
Swordfish	*Xiphias gladius*			●	Pelagic
Tautog	*Tautoga onitis*			●	Demersal
Thorny skate	*Amblyraja radiata*	●	S		Demersal
Tiger shark	*Galeocerdo cuvier*	●			Pelagic
Weakfish	*Cynoscion regalis*			●	Demersal
White hake	*Urophycis tenuis*			●	Demersal
White shark	*Carcharadon carcharias*	●			Pelagic
Windowpane flounder	*Scopthalmus aquosus*	●		●	Demersal
Winter flounder	*Pseudopleuronectes americanus*	●		●	Demersal
Winter skate	*Leucoraja ocellata*			●	Demersal
Witch flounder	*Glyptocephalus cynoglossus*	●		●	Demersal
Wrymouth	*Cryptacanthodes maculatus*				Demersal
Yellowtail flounder	*Limanda ferruginea*	●		●	Demersal

Notes:

1. BOEM 2014; BOEM 2018b; Rillahan and He 2020a; 2020b; 2020c; 2020d; 2020e; 2020f; 2020g; 2021.
2. C= candidate, S= species of concern, T= threatened, E = endangered.

Table 6.6-2 Ichthyoplankton Species Present in at Least One of 69 NEFSC EcoMon Ichthyoplankton Samples Taken between 1977 and 2017 within the SWDA[1]

Common name	Scientific Name
American plaice	*Hippoglossoides platessoides*
Sand lances	*Ammodytes* spp.
Atlantic cod	*Gadus morhua*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic sea herring	*Clupea harengus*
Bluefish	*Pomatomus saltatrix*
Bothus flounders	*Bothus* spp.
Cunner	*Tautogolabrus adspersus*
Etropus flounders	*Etropus* spp.
Fourbeard rockling	*Enchelyopus cimbrius*
Fourspot flounder	*Hippoglossina oblonga*
Frigate tunas	*Auxis* spp.
Gulf Stream flounder	*Citharichthys arctifrons*
Haddock	*Melanogrammus aeglefinus*
Hakes	*Urophycis* spp.
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Monkfish	*Lophius americanus*
Myctophid sp.	*Ceratoscopelus maderensis*
Offshore silver hake	*Merluccius albidus*
Butterfishes and Harvestfishes	*Peprilus* spp.
Pollock	*Pollachius virens*
Rock gunnel	*Pholis gunnellus*
Silver hake	*Merluccius bilinearis*
Summer flounder	*Paralichthys dentatus*
Symphurus flounders	*Symphurus* spp.
Windowpane flounder	*Scopthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*
Witch flounder	*Glyptocephalus cynoglossus*
Yellowtail flounder	*Limanda ferruginea*

Notes:
1. NEFSC 2020.

NEFSC has been conducting fishery-independent autumn bottom trawl surveys annually since 1963. Two metrics—total biomass and species richness—derived from this survey show the distribution of fish assemblages in the Offshore Development Area relative to surrounding locations (see Figure 6.6-1 through Figure 6.6-7). The total biomass of fish is moderate to high across the Offshore Development Area, while species richness is relatively high. High species richness has been linked to increased ecosystem resilience or the ability of an ecosystem to recover from disturbance (MacArthur 1955).

Additional information on habitat and forage preferences and life stage presence in the Offshore Development Area for finfish and invertebrate species with EFH designations is provided in Appendix III-F.

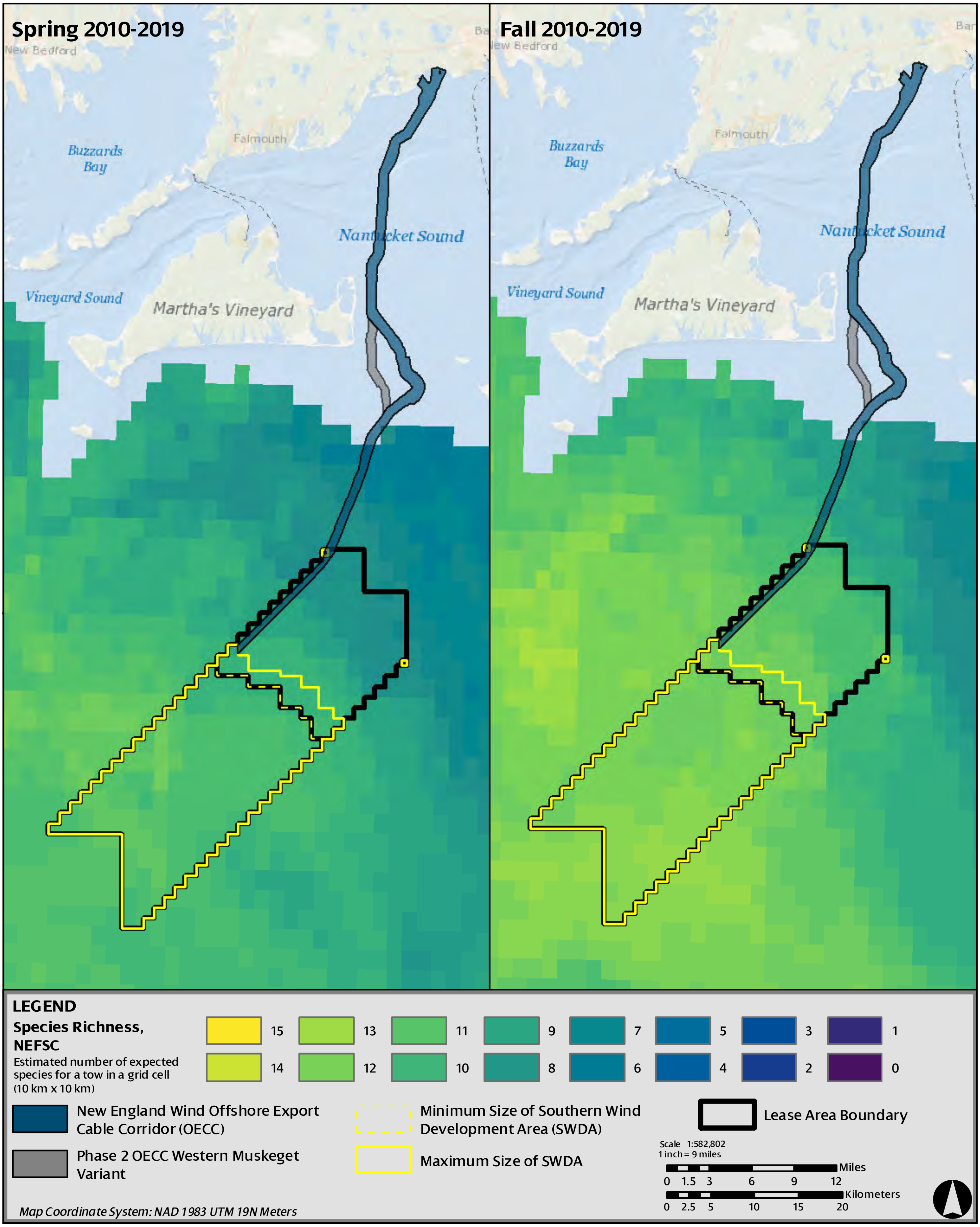
6.6.1.1 Finfish

Pelagic Fishes

Pelagic species spend most of their adult lives swimming in the water column rather than occurring on or near the bottom. Many coastal pelagic species rely on coastal wetlands, seagrass habitats, and estuaries to provide habitat for specific life stages and many of these species migrate north and south along the Atlantic Coast during some periods of the year. In general, movement is related to sea surface temperature. These fish use the highly productive coastal waters within the Atlantic region during the summer months and migrate to deeper and/or more distant waters for the rest of the year. Important pelagic finfish with ranges that overlap the Offshore Development Area include forage species, such as Atlantic herring (*Clupea harengus*) and Atlantic mackerel (*Scomber scombrus*), and predatory fish, such as yellowfin tuna (*Thunnus albacares*) and silver hake. Trawl surveys conducted seasonally by NEFSC from 2003–2016 found that Atlantic herring, butterfish, and round herring (*Etrumeus teres*) had the highest biomass of forage fish across all seasons in the MA WEA. Seasonal variations in biomass were apparent for all three species, with Atlantic herring primarily caught in the colder seasons (spring/winter) and butterfish and round herring primarily caught in the warmer seasons (fall/summer) (NEODP 2021) (see Figure 6.6-3 and 6.6-4).

Demersal Fishes

Demersal fishes (groundfish) are those fish that spend at least a portion of their life cycle in association with the ocean bottom. Demersal fishes are often found in mixed species aggregations that differ depending upon the specific area and time of year (see Figure 6.6-5 and 6.6-6). Many demersal fish species have pelagic eggs or larvae that are sometimes carried long distances by oceanic surface currents. The Offshore Development Area supports both the intermediate and shallow demersal finfish assemblages as defined by Overholtz and Tyler 1985. Many of the fish species in these assemblages are important because of their value in the commercial and/or recreational fisheries. Important demersal fishes in the Offshore Development Area include winter flounder (*Pseudopleuronectes americanus*), yellowtail flounder (*Limanda ferruginea*), and monkfish (*Lophius americanus*). According to bottom trawl surveys conducted by MA DMF from 1978–2007 in Massachusetts state waters within and surrounding the OECC (region 2 of survey), the most common fish species captured in the spring included winter flounder, windowpane flounder (*Scopthalmus aquosus*), and little skate and in the fall included scup (*Stenotomus chrysops*), butterfish, and black sea bass (*Centropristis striata*) (King et al. 2010) (see Figure 6.6-7). Year-round trawl surveys conducted by NEFSC from 2003–2016 found that little skate, winter skate (*Leucoraja ocellata*), silver hake, and spiny dogfish were consistently dominant in catches from the MA WEA (Guida et al. 2017; NEODP 2021) (see Figure 6.6-5 and 6.6-6).



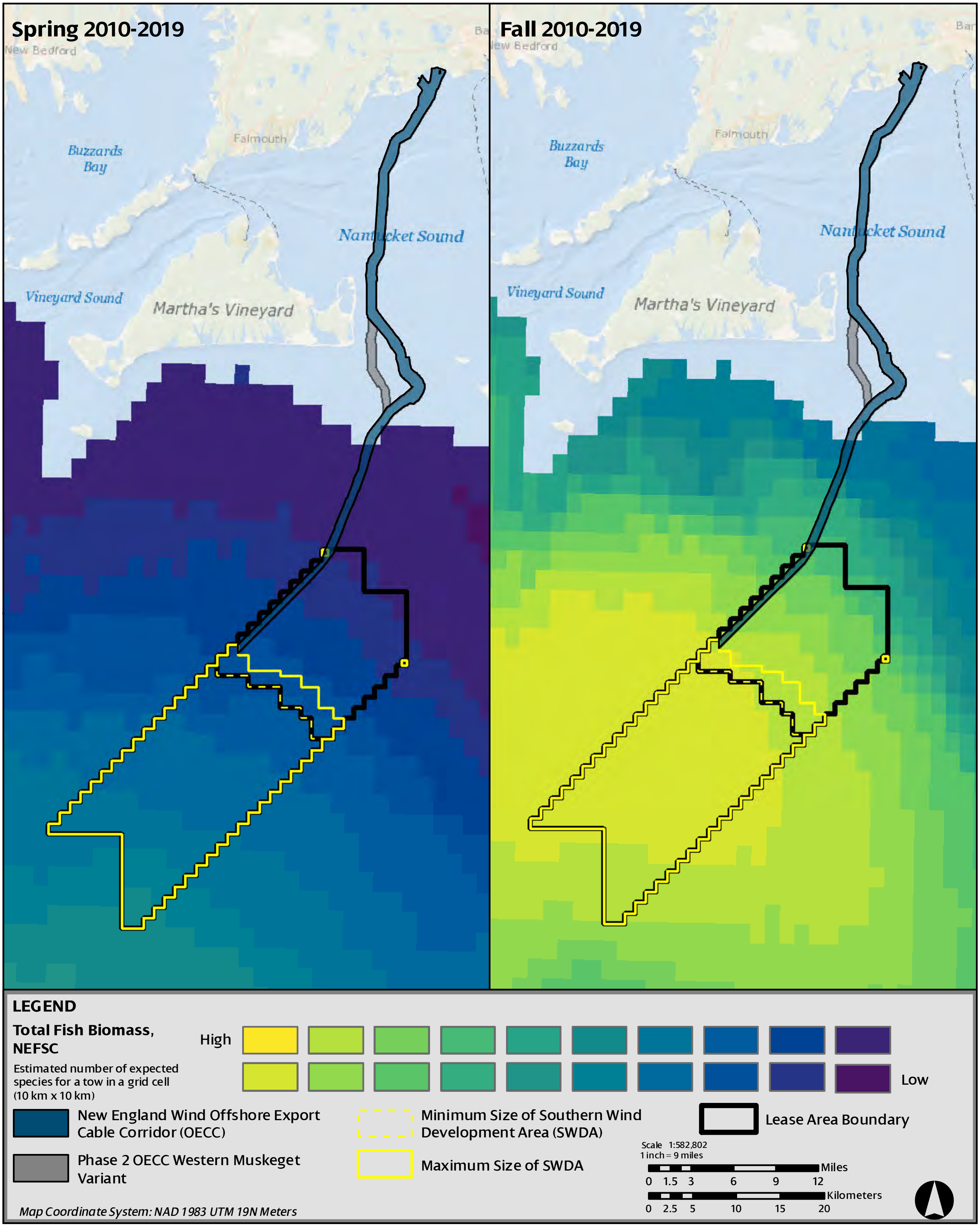
Service Layer Credits: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

New England Wind

AVANGRID RENEWABLES

Figure 6.6-1

Expected Species Richness of the Fish Captured in Spring (2010-2019) and Fall (2010-2019) NEFSC Bottom Trawl Surveys (NEODP 2021)

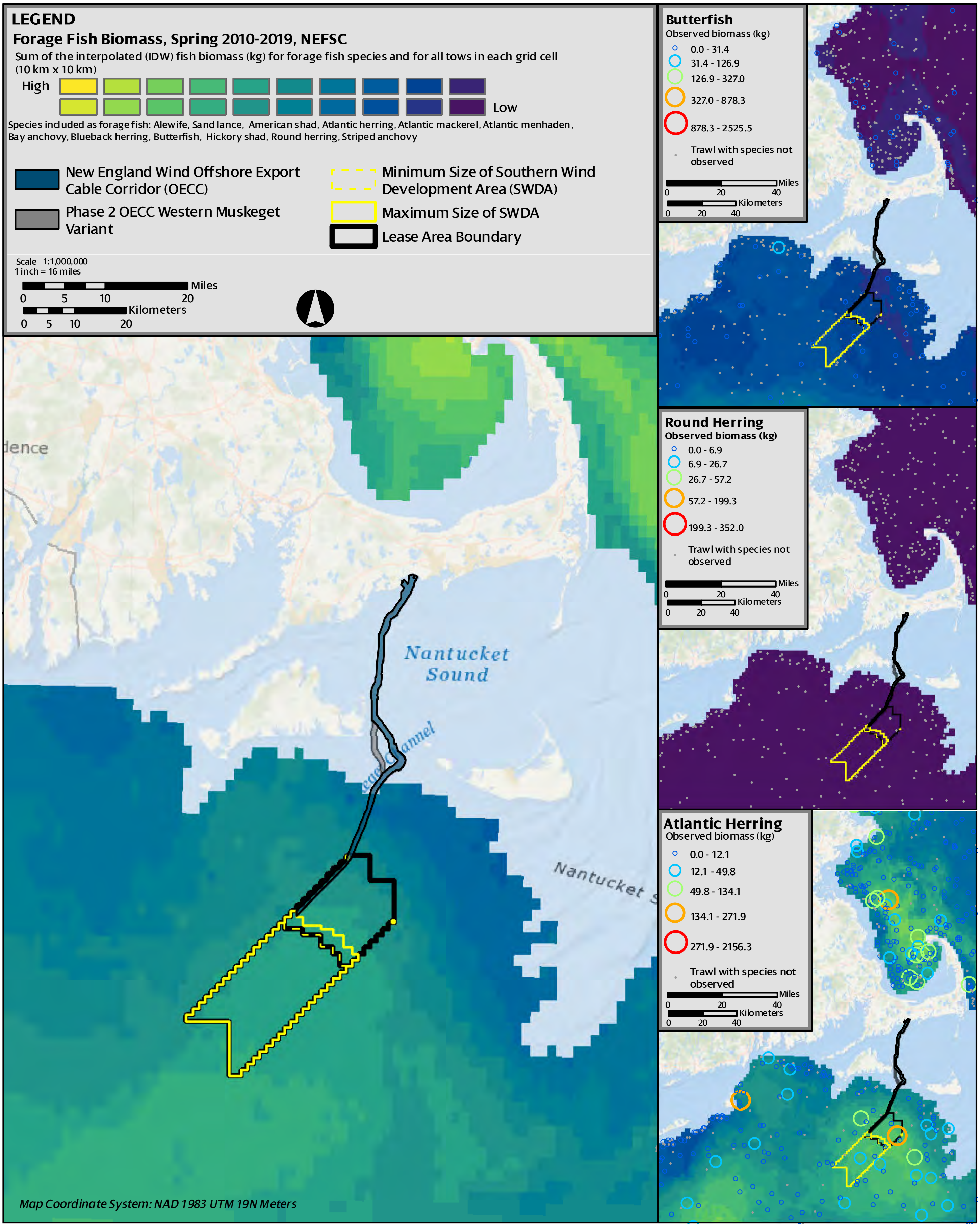


Service Layer Credits: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

New England Wind
AVANGRID RENEWABLES

Figure 6.6-2

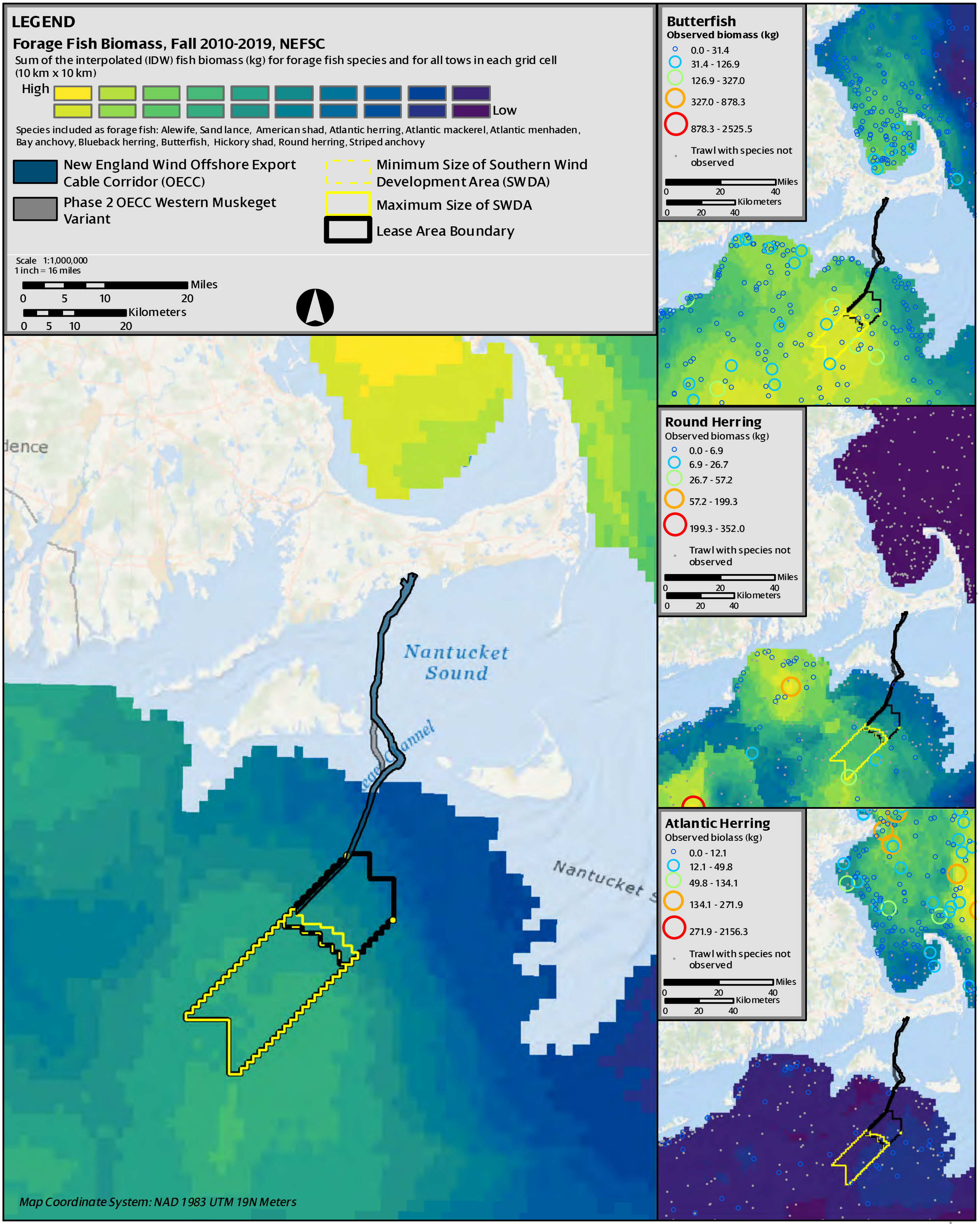
Expected Biomass of the Fish Captured in Spring (2010-2019) and Fall (2010-2019) NEFSC Bottom Trawl Surveys (NEODP 2021)



New England Wind

Figure 6.6-3

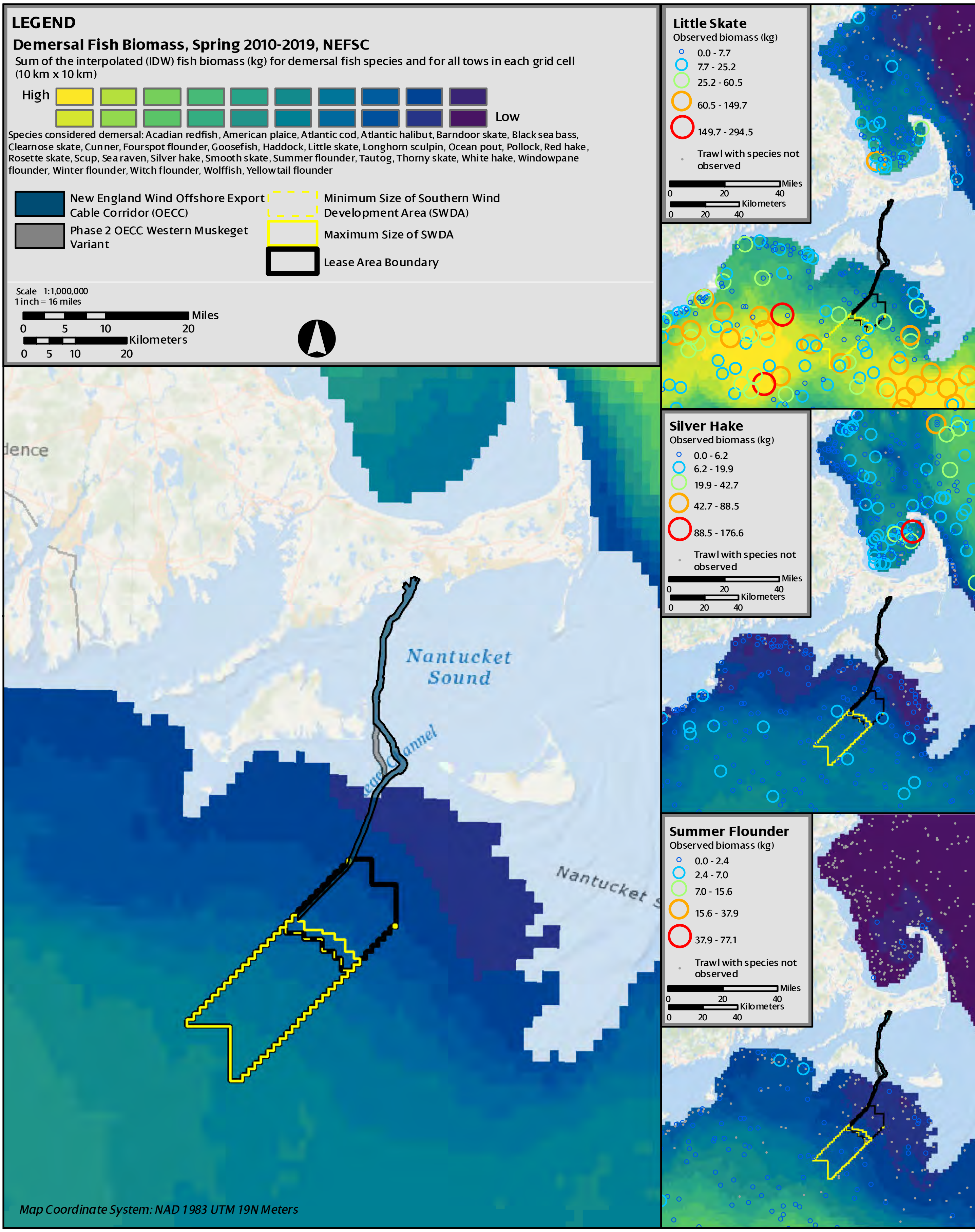
Expected Forage Fish Biomass and Individual Biomass for Butterfish, Round Herring, and Atlantic Herring Captured in Spring NEFSC Bottom Trawl Surveys from 2010-2019 (NEODP 2021)



New England Wind
AVANGRID RENEWABLES

Figure 6.6-4

Expected Forage Fish Biomass and Individual Biomass for Butterfish, Round Herring, and Atlantic Herring Captured in Fall NEFSC Bottom Trawl Surveys from 2010-2019 (NEODP 2021)

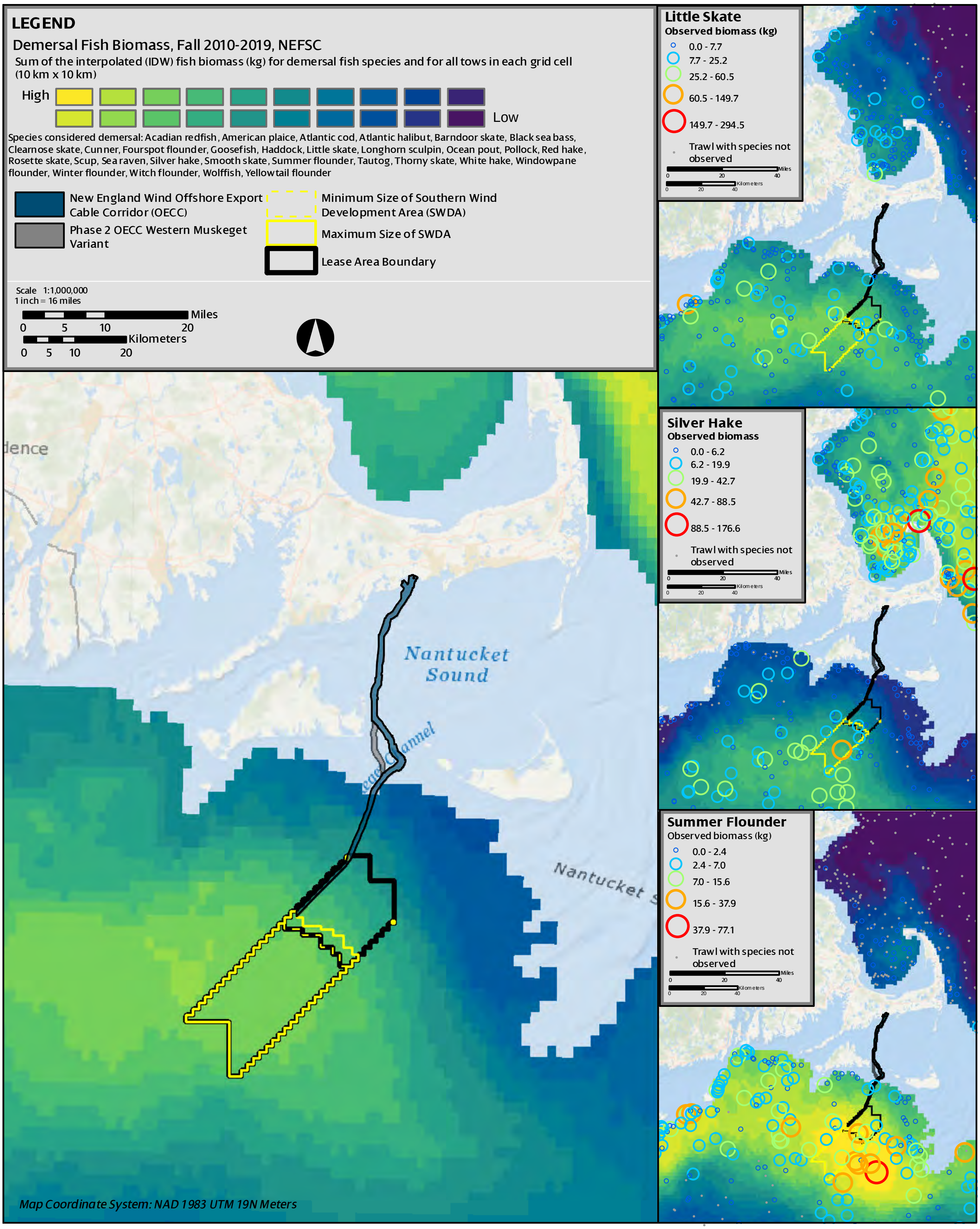


New England Wind

AVANGRID RENEWABLES

Figure 6.6-5

Expected Demersal Fish Biomass and Individual Biomass for Little Skate, Silver Hake, and Summer Flounder Captured in Spring NEFSC Bottom Trawl Surveys from 2010-2019 (NEODP 2021)

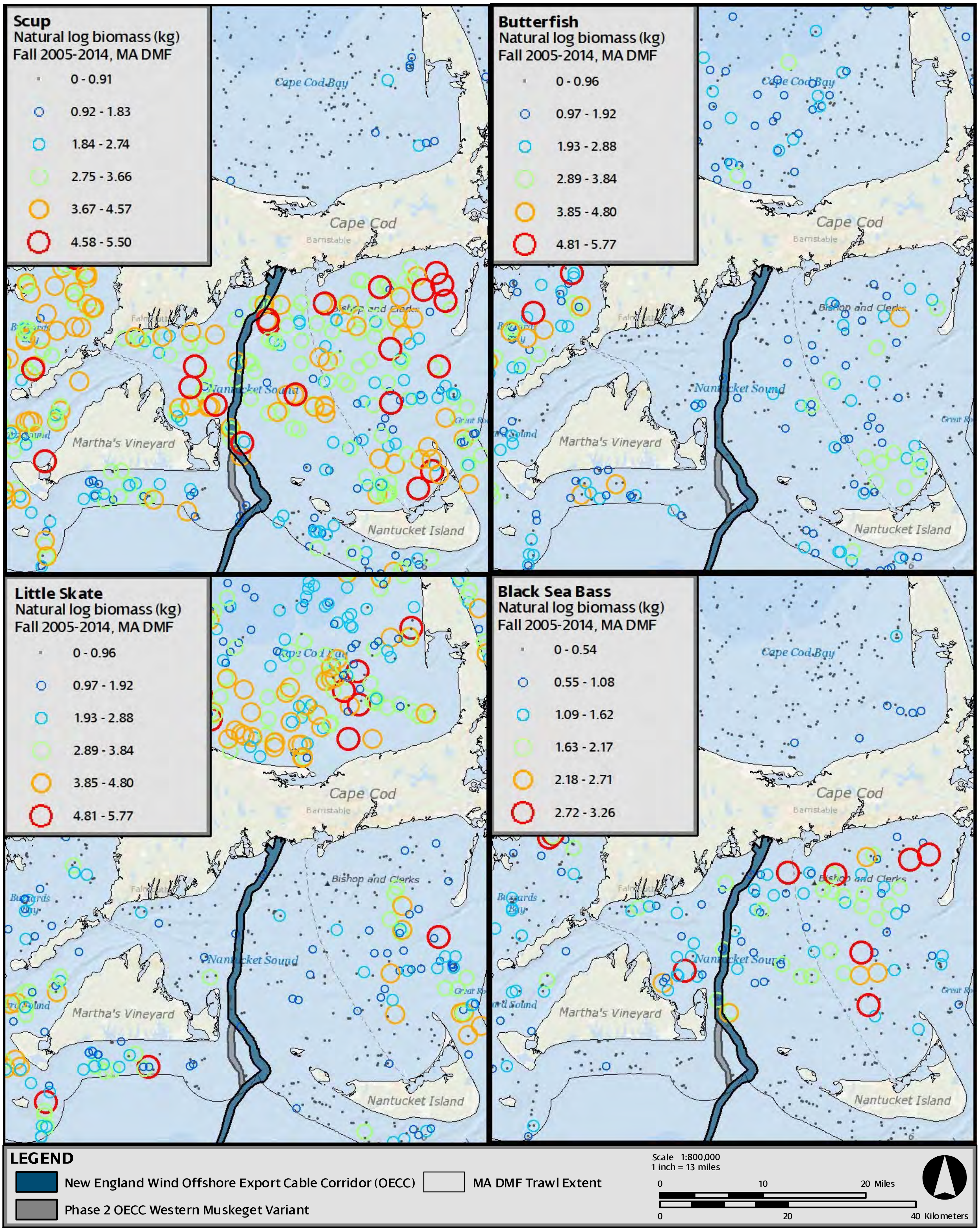


New England Wind

AVANGRID RENEWABLES

Figure 6.6-6

Expected Demersal Fish Biomass and Individual Biomass for Little Skate, Silver Hake, and Summer Flounder Captured in Fall NEFSC Bottom Trawl Surveys from 2010-2019 (NEODP 2021)



New England Wind

AVANGRID RENEWABLES

Figure 6.6-7

Biomass (natural log) of Commonly Caught Fish in the MA DMF Fall Trawl Surveys (2005-2014). Species included: Scup, Butterfish, Little Skate, Black Sea Bass (NEODP 2021).

Highly Migratory Fishes

Highly migratory fishes often migrate from southern portions of the South Atlantic to as far north as the Gulf of Maine. Migrations are correlated with sea surface temperature and these species generally migrate to northern waters in the spring where they remain to spawn or feed until the fall or early winter (NOAA 2016a). Examples of these species with ranges that overlap the Offshore Development Area include Atlantic bluefin tuna (*Thunnus thynnus*) and basking shark (*Cetorhinus maximus*).

Threatened and Endangered Fish

Four federally listed threatened or endangered fish species may occur off the northeast Atlantic coast, including the shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Atlantic salmon (*Salmo salar*), and giant manta ray (*Manta birostris*) (see Table 6.6-3). A further description of these species is provided follows. Additional species that have been proposed for endangered status and not deemed candidates (or are currently candidates for listing and the status determination has not yet been made) are known as "Species of Concern" and are included in Table 6.6-3.

Atlantic Sturgeon

The Atlantic sturgeon is an anadromous species that spends much of its life in estuarine and marine waters throughout the Atlantic Coast, but adults ascend coastal rivers in spring to spawn in flowing freshwater. Sturgeon eggs are adhesive and attach to gravel or other hard substrata. Larvae develop as they move downstream to the estuarine portion of the spawning river, where they reside as juveniles for years. Subadults will move into coastal ocean waters where they may undergo extensive movements usually confined to shelly or gravelly bottoms in 10–50 meters (m) (33–164 feet [ft]) water depths (Dunton et al. 2010).

Atlantic sturgeon distribution varies by season. They are primarily found in shallow coastal waters (bottom depth less than 20 m [66 ft]) during the summer months (May to September) and move to deeper waters (20–50 m [66–165 ft]) in winter and early spring (December to March) (Dunton et al. 2010).

There are five distinct population segments (DPSs) of Atlantic sturgeon along the Atlantic coast: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. The Gulf of Maine DPS is listed as threatened whereas the remaining four DPSs are listed as federally endangered (ASSRT 2007; NMFS 2017). Currently, there are no published population abundance estimates for any of the five DPSs. Population abundance estimates of mature or spawning adults exists for some of the 22 confirmed spawning rivers. Estimates of mature adults for individual rivers in the US range from 0–23 in the Neuse River, North Carolina to 1,000–2,000 in the Altamaha River, Georgia (NOAA Fisheries 2019). There were an estimated 18,000–21,000 adults between 2013–2015 in the St. John River, Canada (Dadswell et al. 2017).

The National Marine Fisheries Service (NMFS) presumed that Atlantic sturgeon in the MA WEA would most likely be from the New York Bight DPS; however, genetic analyses and tagging studies indicated that the range of all five DPSs overlaps and extends from Canada to Florida (ASSRT 2007; NMFS 2017).

For the New York Bight DPS, spawning is only known to occur in the Delaware and Hudson Rivers, with some habitat utilization also occurring in the Connecticut and Taunton Rivers (ASSRT 2007; NMFS 2017). An individual Atlantic sturgeon was found near the mouth of the Thames River in 2016, but it has not been confirmed that the river is regularly used by this species (Benson 2016). Federally regulated Critical Habitat for Atlantic Sturgeon is assigned in the freshwater and coastal estuarine regions of the known spawning rivers, none of which overlap with the Offshore Development Area (NMFS 2017). Primary threats to Atlantic sturgeon include bycatch in trawl and gillnet fisheries, habitat degradation and loss, ship strikes, and general depletion from historical fishing. Very few Atlantic sturgeon have been captured as bycatch in fisheries or in fisheries-independent surveys in the MA WEA, with no recorded catches within the SWDA (Dunton et al. 2010; Stein et al. 2004). The BA for the Vineyard Wind 1 project determined that the proposed action may affect, but is not likely to adversely affect, Atlantic sturgeon with the exception of noise from pile driving which may affect, likely to adversely affect, Atlantic sturgeon (BOEM 2018a).

Shortnose Sturgeon

The shortnose sturgeon is an anadromous species found in larger rivers and estuaries on the east coast of North America from the St. Johns River in Florida to the St. Johns River in Canada. The shortnose sturgeon was listed as endangered in 1967 because the US Fish and Wildlife Service concluded that the fish had been eliminated from the rivers in its historic range (except the Hudson River) and was in danger of extinction because of pollution, loss of access to spawning habitats, and direct and incidental overfishing in the commercial fishery for Atlantic sturgeon (NOAA 2015). DPSs are currently identified in North Carolina, South Carolina, Georgia, and northern Florida river systems (NOAA 2015).

In the northern portion of its range, shortnose sturgeon are found in the Chesapeake Bay system, Delaware River, Hudson River, Connecticut River, Housatonic River, the lower Merrimack River, and the Kennebec River northward to the St. John River in New Brunswick, Canada. The closest populations to the Offshore Development Area are the Connecticut and Housatonic rivers, which drain into Long Island Sound (Shortnose Sturgeon Status Review Team 2010). Shortnose sturgeon occur primarily in fresh and estuarine waters and occasionally enter the coastal ocean. Adults ascend rivers to spawn from February to April, and eggs are deposited over hard bottom, in shallow, fast-moving water (Dadswell et al. 1984). Because of their preference for mainland rivers and fresh and estuarine waters, shortnose sturgeon are unlikely to be found near the Offshore Development Area, and the BA for Vineyard Wind 1 determined there to be no effects on the species from the proposed Offshore Development Area (BOEM 2018a).

Atlantic Salmon

Atlantic salmon is an anadromous species that historically ranged from northern Quebec southeast to Newfoundland and southwest to Long Island Sound. The Gulf of Maine DPS of the Atlantic salmon, which spawns within eight coastal watersheds within Maine, is federally listed as endangered. In 2009, the DPS was expanded to include all areas of the Gulf of Maine between the Androscoggin River and the Dennys River (NOAA 2016b).

The life history of Atlantic salmon consists of spawning and juvenile rearing in freshwater rivers to extensive feeding migrations in the open ocean. Adult Atlantic salmon ascend the rivers of New England in the spring through fall to spawn. Suitable spawning habitat consists of gravel or rubble in areas of moving water. Juvenile Atlantic salmon remain in the rivers for one to three years before migrating to the ocean. The adults will undertake long marine migrations between the mouths of US rivers and the northwest Atlantic Ocean, where they are widely distributed seasonally over much of the region. Typically, most Atlantic salmon spend two winters in the ocean before returning to freshwater to spawn (NOAA 2016b).

It is possible that adult Atlantic salmon may occur off the Massachusetts coast while migrating to rivers to spawn. However, only certain Gulf of Maine populations are listed as endangered, and Gulf of Maine salmon are unlikely to be encountered south of Cape Cod (BOEM 2014). The BA for Vineyard Wind 1 determined that there will be no detectable effects from the Vineyard Wind 1 project on Atlantic salmon (BOEM 2018a).

Giant Manta Ray

The giant manta ray is a global pelagic species listed as threatened under the Endangered Species Act (ESA) throughout its range with scattered individual populations found both offshore and along productive coastlines (CITES 2013). The species is highly migratory and inhabits mostly tropical and subtropical waters with presence in temperate waters. Individuals have been observed as far north as New Jersey in the Western Atlantic basin indicating that the Offshore Development Area is located at the northern boundary of the species' range. Giant manta rays are viviparous, producing live neonate offspring about 1 m (3.3. ft) in length capable of swimming, so there is no potential for effects on eggs or larvae in the Offshore Development Area (Miller and Klimovich 2017). The BA for Vineyard Wind 1 determined that giant manta ray presence in the SWDA or OECC would be rare and giant manta rays are not expected to be influenced by the Vineyard Wind 1 project (BOEM 2018a).

Table 6.6-3 List of Northeast Atlantic Threatened and Endangered Species and Species of Special Concern with ranges that may overlap the MA WEA (BOEM 2014)

Common Name	Scientific Name	ESA Status
Alewife	*Alosa pseudoharengus*	Species of concern
Atlantic bluefin tuna*	*Thunnus thynnus*	Species of concern
Atlantic halibut	*Hippoglossus hippoglossus*	Species of concern
Atlantic salmon	*Salmo salar*	Endangered
Atlantic sturgeon	*Acipense oxyrinchus oxyrinchus*	Endangered/ Threatened
Atlantic wolffish*	*Anarhichas lupus*	Species of concern
Basking shark*	*Cetorhinus maximus*	Species of concern
Blueback herring	*Alosa aestivalis*	Species of concern
Cusk	*Brosme brosme*	Species of concern/candidate
Dusky shark*	*Carcharhinus obscurus*	Species of concern
Giant manta ray	*Manta birostris*	Threatened
Porbeagle shark*	*Lamna nasus*	Species of concern
Rainbow smelt	*Osmerus mordax*	Species of concern
Sand tiger shark*	*Carcharias taurus*	Species of concern
Shortnose sturgeon*	*Acipenser brevirostrum*	Endangered
Thorny skate	*Amblyraja radiata*	Species of concern

Notes:

1. * indicates species with EFH in Offshore Development Area.

Note that there are differences between the species listed in Table 6.6-1 and those listed in Table 6.6-3. The species in Table 6.6-1 are known to have a range and/or habitat overlapping the Offshore Development Area whereas the species in Table 6.6-3 are those listed as either threatened, endangered, candidate species, and/or species of concern in the entire Northeast Atlantic. The species in Table 6.6-3 that have designated EFH within the Offshore Development Area are designated with an asterisk (*).

Commercially and Recreationally Important Fish

Many of the fish species found off the coast of Massachusetts are important due to their value as commercial and/or recreational fisheries. A detailed description of fishing activities and the economic value of fisheries is provided in Section 7.6.

6.6.1.2 Invertebrates

Important managed invertebrates with ranges that overlap the Offshore Development Area include Atlantic sea scallop (*Plactopecten magellanicus*), longfin squid (*Doryteuthis pealeii*), shortfin squid (*Illex illecebrosus*), Atlantic surf clam (*Spisula solidissima*), whelks, American lobster (*Homarus americanus*), ocean quahog (*Artica islandica*), Jonah crab (*Cancer borealis)*, and horseshoe crab (*Limulus polyphemus)*. While several of these species (e.g. longfin and shortfin squid, Atlantic surf clam, and ocean quahog) have designated EFH in the area (discussed in more detail in Appendix III-F), other species, such as the American lobster, Jonah crab, horseshoe crab, and whelks, are managed in the area but do not have designated EFH.

American lobster, Jonah crab, and horseshoe crab are ecologically and commercially important crustacean species within the MA WEA. The American lobster is distributed in coastal rocky habitats and muddy burrowing areas with sheltering habitats offshore in submarine canyon areas along the continental shelf edge. This species has been found to use the following substrates: mud/silt, mud/rock, sand/rock, bedrock/rock, and clay[70] (Cooper and Uzmann 1980). However, firm, complex, rocky substrate is the preferred habitat for all life stages of lobster. While post-larval and juvenile lobsters tend to stay in shallow, inshore waters (Lawton and Lavalli 1995), adolescent and adult lobster are highly adaptable in their choice of substrate and can be found in nearly all substrate types.

The life history and habitat preferences of Jonah crab are poorly understood. Large adults are commonly encountered in offshore rocky habitats; however, they are caught in both hard and soft sediments (ASMFC 2015; ASMFC 2018). Seasonal movement to nearshore habitats during the later spring and summer have been observed although the motivation for those migrations is unclear (ASMFC 2018). Horseshoe crabs migrate from deeper waters to sandy beach areas to spawn from May–July and juveniles reside in nearshore habitats close to those beaches for two years upon hatching (ASMFC 2010). Little data exists on adult distribution, with trawl sampling data from NEFSC suggesting they prefer depths less than 30 m (98 ft) (ASMFC 1998). Section 6.5 includes a more detailed review of invertebrate species distribution within the Offshore Development Area.

The term "conch" is the generic classification for a variety of whelks found in southern New England waters, including knobbed whelk (*Busycon carica*), channeled whelk (*Busycotypus canaliculatus*), and lightning whelk (*Busycon contrarium*). Channeled whelk tend to be the most prevalent whelk in commercial catches. Other shellfish with important commercial fisheries near the MA WEA include bay scallops (*Argopecten irradians*), Atlantic sea scallops, blue mussels (*Mytilus edulis*), ocean quahogs, sea clams (various species), and soft shell clams (*Mya arenaria*). Bay scallops are found in the subtidal zone, sandy and muddy bottoms, and offshore in shallow to moderately deep water. Atlantic sea scallops are generally found in water depths of 25–200 m (82–650 ft) south of Cape Cod, mainly on sand and gravel where bottom temperatures remain below 20°Celsius (68°Farenheit) (Hart 2006). Blue mussels are most common in the littoral and sublittoral zones (less than 99 m [325 ft] depths) of oceanic and polyhaline to mesohaline estuarine environments; however, the species can also be found in deeper and cooler waters

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70 This is a generic substrate classification and is not Coastal and Marine Ecological Classification Standard-specific.

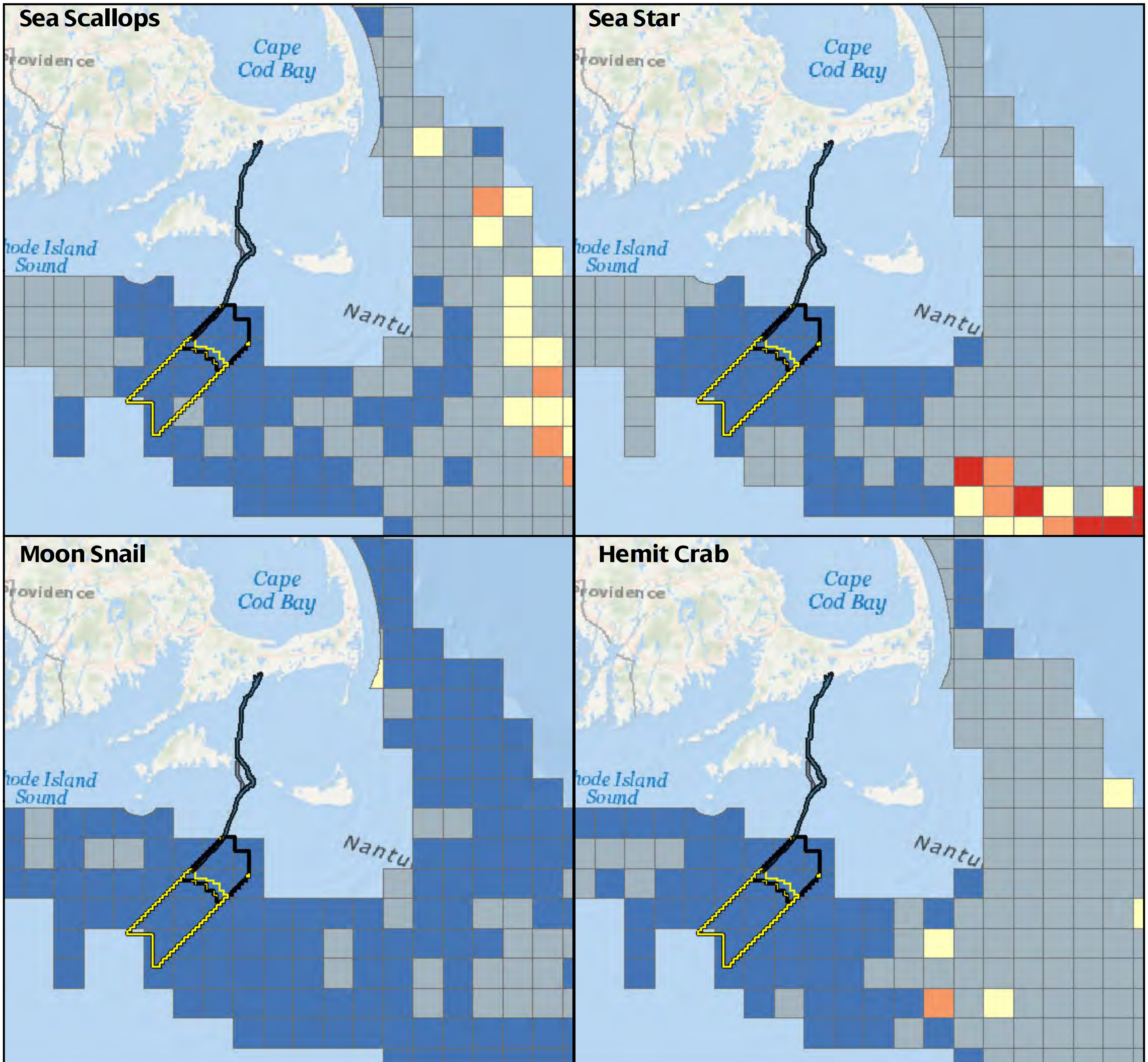
(100–499 m [328–1,637 ft depths) (Newell 1989). Adult soft shell clams live in sandy, sand-mud, or sandy-clay bottoms, with their highest densities at depths of three to four meters (10–13 ft) (Abraham and Dillon 1986).

Video surveys conducted by SMAST within the MA WEA between 2003–2012, indicated low abundances of most benthic invertebrates in the SWDA (see Figure 6.6-8 and Figure 6.6-9). The most common benthic invertebrates in the SWDA were sea stars, found in 11 of 22 video transects collected within the SWDA in 2019 (RPS 2020), and burrowing anemones, the most abundant organism across 12 transects in July of 2020 (RPS 2021). New England Wind-specific drop-down video sampling conducted within the SWDA in 2019 also observed bryozoans/hydrozoans frequently (SMAST 2019) (see Section 6.5 for more info on benthic resources).

MA DMF has been sampling longfin squid and squid egg mops in Massachusetts state waters as part of their spring and fall bottom trawls since 1978. Figure 6.6-10 and Figure 6.6-11 provide the distribution of longfin squid (as number per tow) and squid egg mops (as kilogram per tow) in the OECC between the years 2007 and 2021 for squid and 2007 and 2017 for egg mops (MA DMF, personal communication, August 2021). Longfin squid are widely distributed throughout the Offshore Development Area and were observed in spring and fall surveys throughout Nantucket Sound, Vineyard Sound, and Buzzards Bay. The highest concentrations of longfin squid occurred just south of Nantucket Island in the fall and south of Martha's Vineyard in the spring.

Given their widespread distribution throughout the Offshore Development Area, adult longfin squid were present along the OECC (including the Western Muskeget Variant) in both the spring and the fall with concentrations highest along the route through Nantucket Sound. Although longfin squid spawn year-round and egg mops can be found throughout the year, spawning typically peaks in the spring and eggs hatch in the summer (Jacobson 2005). In Massachusetts state waters, squid egg mops were observed in both the spring and fall in the OECC.

The MA DMF has also been recording other valuable slow-moving invertebrate species as part of their spring and fall trawl surveys. Figure 6.6-12 provides the distribution of blue mussel, knobbed whelk, and channeled whelk (as kilogram per tow) in the region surrounding the OECC (including the Western Muskeget Variant) between the years 2007 and 2021 (MA DMF, personal communication, August 2021). Blue mussel presence was rare in the trawl survey whereas knobbed and channeled whelk were caught occasionally throughout Nantucket Sound in both the spring and fall.



LEGEND

- New England Wind Offshore Export Cable Corridor (OECC)
- Phase 2 OECC Western Muskeget Variant
- Minimum Size of Southern Wind Development Area (SWDA)
- Maximum Size of SWDA
- Lease Area Boundary

Sea Scallops	Sea Star	Moon Snail	Hermit Crab
0	0	0	0
>0 - 4	0 - 24	>0 - 0.2	>0 - 0.78
5 - 7	25 - 40	0.3	0.79 - 1.2
8 - 10	41 - 56	0.4	1.3 - 1.7
11 - 32	57 - 140	0.5 - 0.8	1.8 - 6.2

0 20 40 Miles

0 40 80 Kilometers

Scale 1:2,000,021
1 inch = 32 miles

Map Coordinate System: NAD 1983 UTM 19N Meters

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New England Wind
AVANGRID RENEWABLES

Figure 6.6-8
Average Abundance of Benthic Invertebrates Observed in SMAST Video Surveys from 2003–2012 (SMAST 2016)

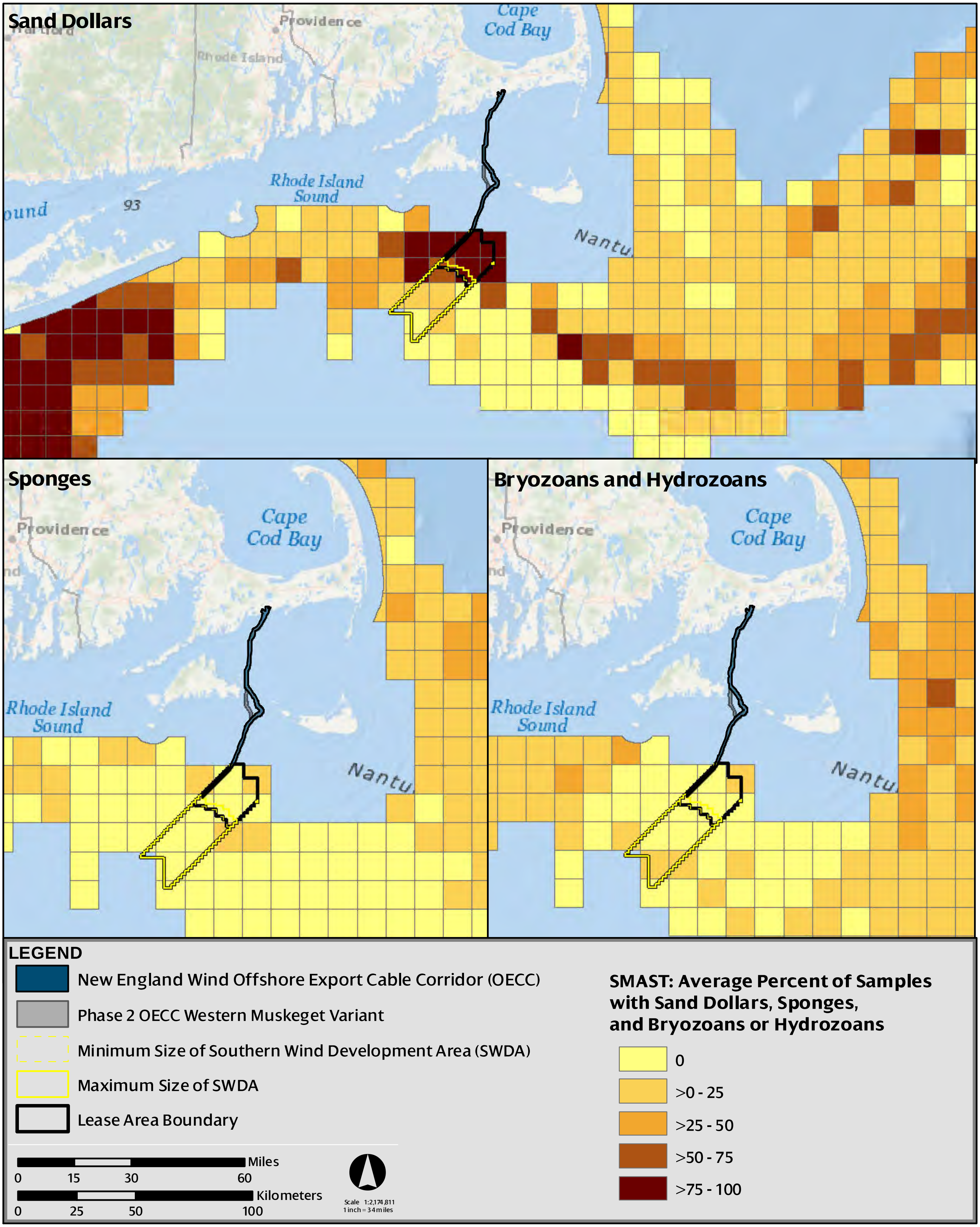
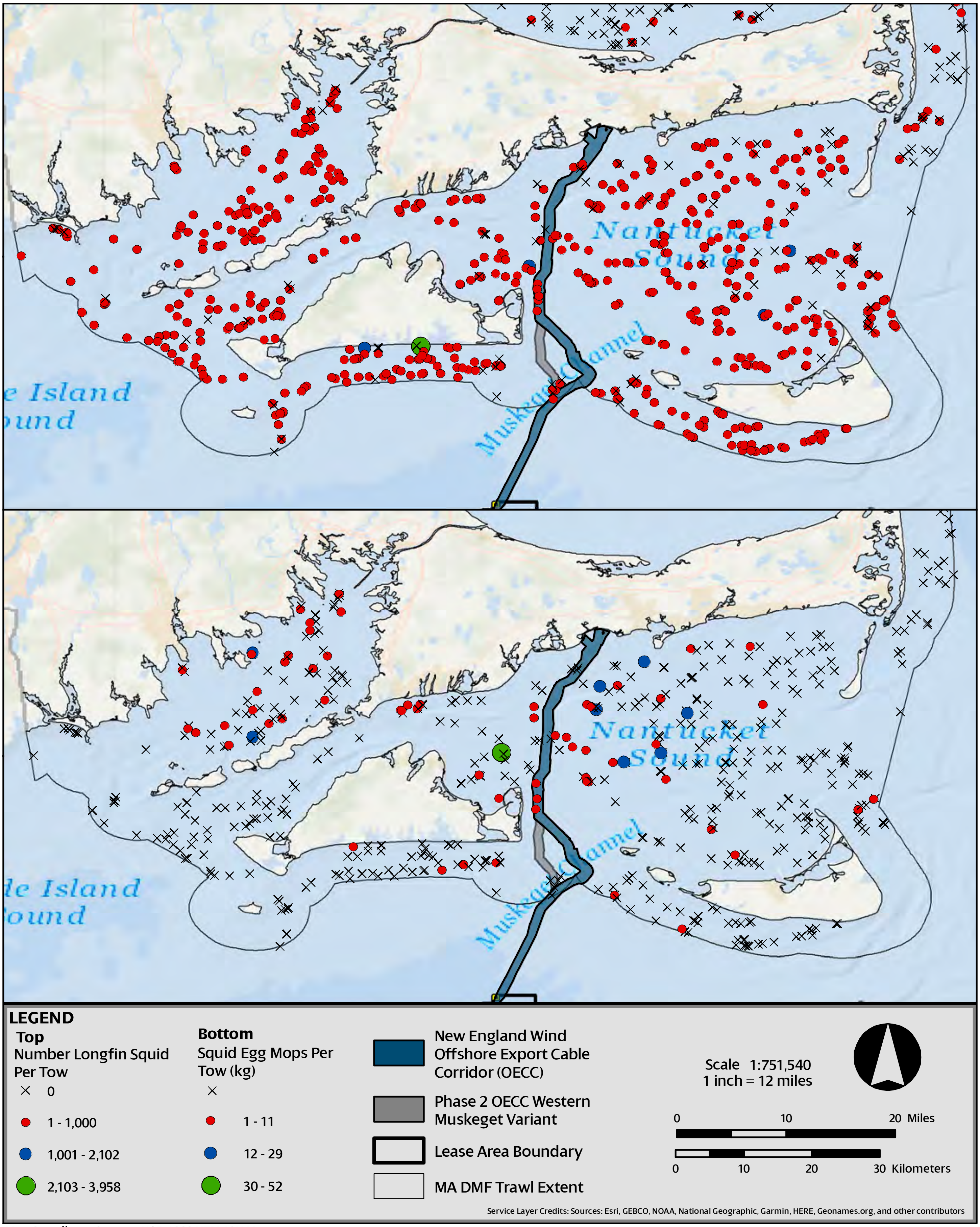


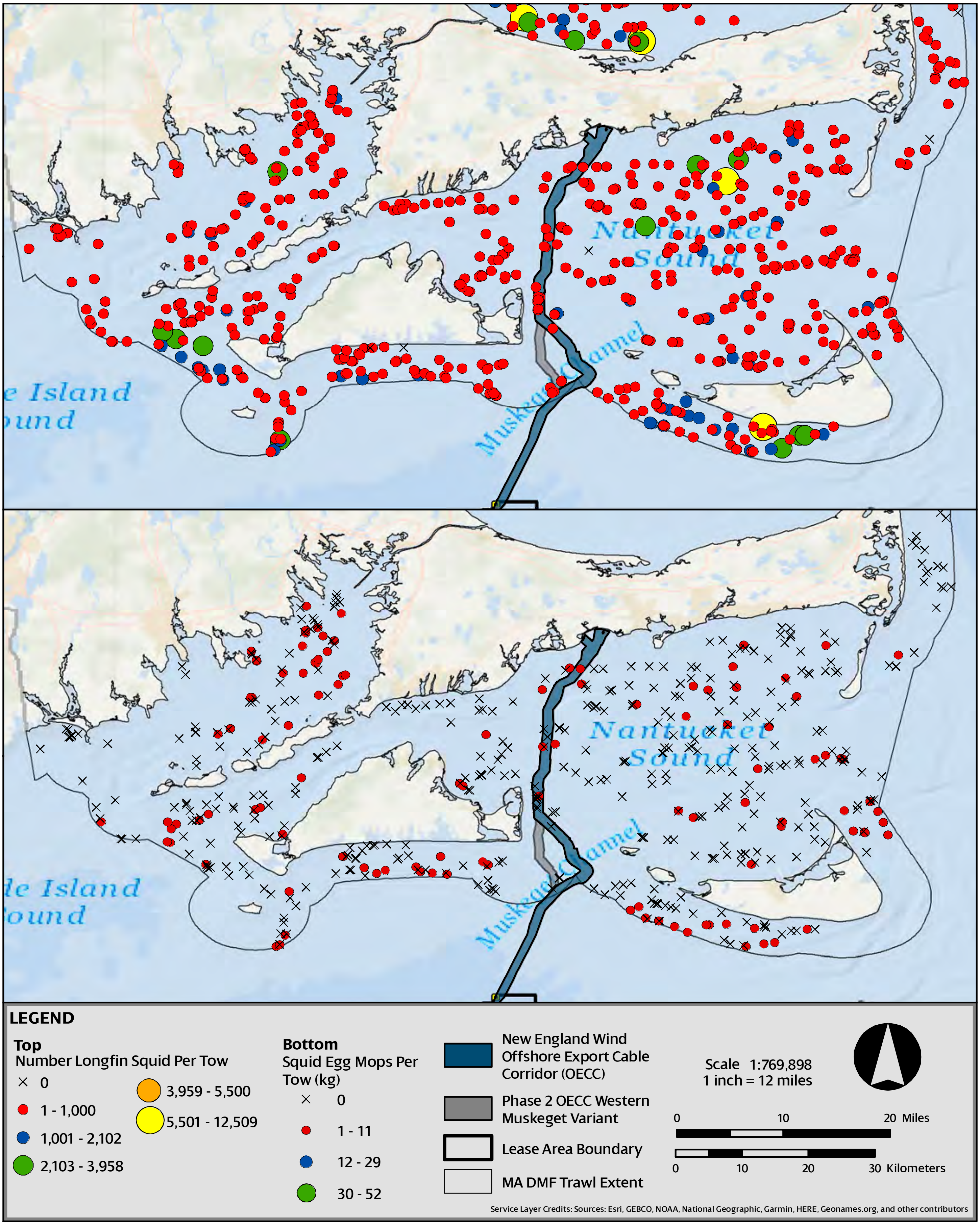
Figure 6.6-9

Average Percent of Samples with Sand Dollars, Sponges, or Bryozoans and Hydrozoans in SMAST Video Surveys from 2003-2012 (SMAST, 2016)



Map Coordinate System: NAD 1983 UTM 19N Meters

Figure 6.6-10
Longfin Squid (2007-2021) and Egg Mop (2007-2017) Catch Data from MA DMF Bottom Trawl Spring Surveys

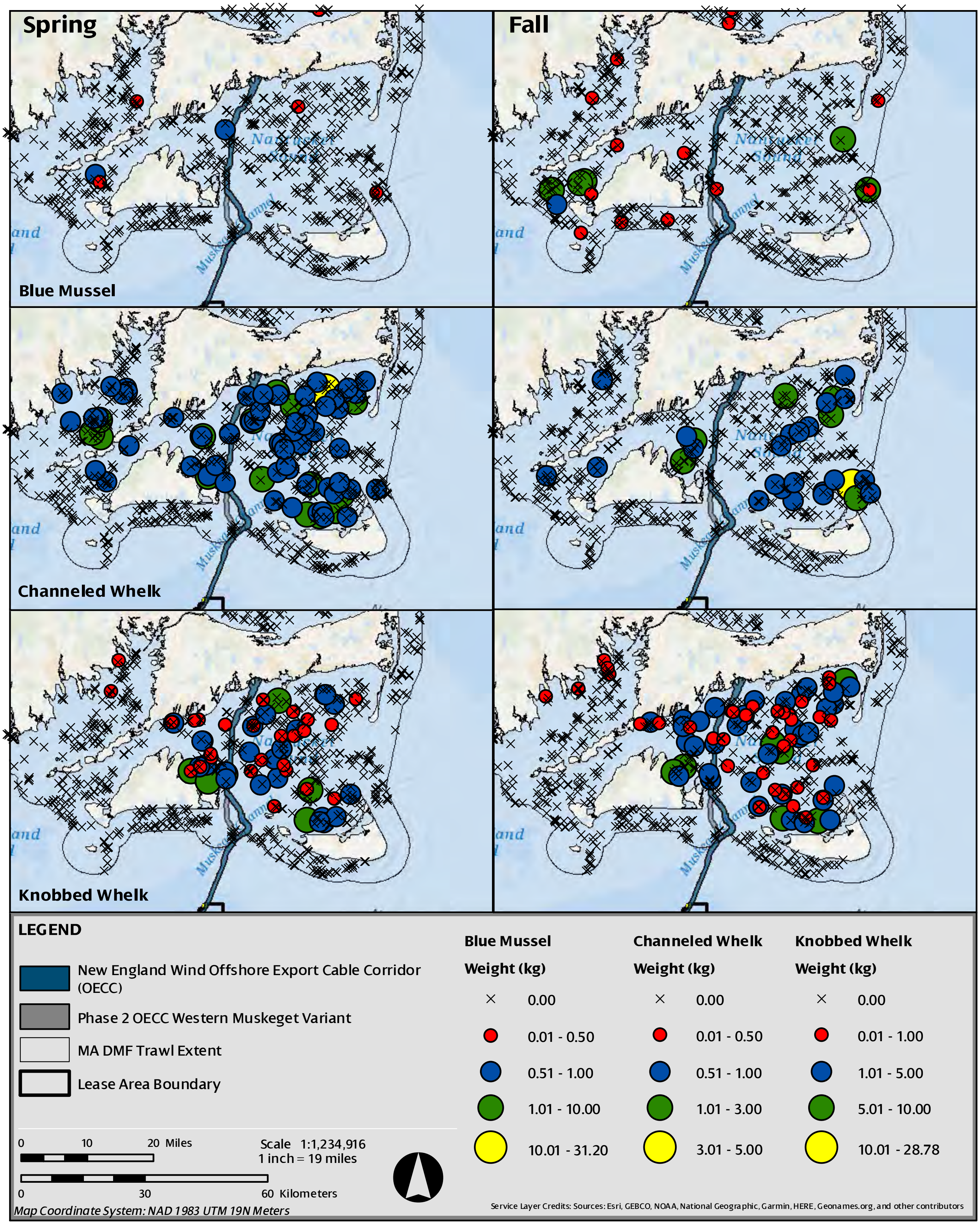


Map Coordinate System: NAD 1983 UTM 19N Meters

New England Wind
AVANGRID RENEWABLES

Figure 6.6-11

Longfin Squid (2007-2021) and Egg Mop (2007-2017) Catch Data from MA DMF Bottom Trawl Fall Surveys



New England Wind

AVANGRID RENEWABLES

Figure 6.6-12

Blue Mussel (top), Channeled Whelk (middle), and Knobbed Whelk (bottom) Catch Data from Spring and Fall MA DMF Bottom Trawl Surveys (2007-2021)

6.6.1.3 Essential Fish Habitat

EFH is designated in both benthic substrate and water column habitats for 48 fish and invertebrate species within the SWDA and OECC. The primary goal of EFH is to identify and protect important fish habitat from certain fishing practices and coastal and marine development. EFH is generally assigned by egg, larvae, juvenile, and adult life stages and defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. § 1802(10)). A detailed assessment of EFH and potential New England Wind-related impacts is included in Appendix III- F.

6.6.2 Potential Impacts of New England Wind

The potential impacts of New England Wind to finfish and invertebrates are related to the specific sizes of offshore components, including offshore cables, WTGs, ESPs, associated foundations, scour protection, and the portion of the seafloor occupied by the components. This section assesses the full 130 WTG/ESP buildout of the SWDA.

As described in Section 3 of COP Volume III, the seafloor impacts presented for the full buildout of the SWDA assume the smallest area for Phase 1 and the largest possible area for the greater potential seafloor disturbance associated with Phase 2 (e.g. larger areas of scour protection and larger areas of cable installation impacts). This section also presents the maximum amount of seafloor disturbance within the SWDA associated with the maximum size of each individual Phase. Because New England Wind includes the installation of five offshore export cables—two for Phase 1 and three for Phase 2—seafloor impacts are presented for installation of five cables for seafloor impacts within the OECC (including the Western Muskeget Variant).

The impact producing factors for finfish and invertebrate resources are provided in Table 6.6-4.

Table 6.6-4 Impact Producing Factors for Finfish and Invertebrates

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Habitat alteration	•	•		•	•	•
Suspended sediments	•	•		•	•	•
Sediment deposition	•	•		•	•	•
Water withdrawals	•	•		•	•	•
Cable installation/ maintenance	•	•		•	•	
Electromagnetic fields	•	•			•	
Noise	•	•		•	•	•

6.6.2.1 Construction and Installation

Offshore construction activities will involve installation of WTGs, ESPs (with their associated foundations and scour protection), installation of offshore export, inter-array, and inter-link cables, and installation of cable protection (if required). These offshore construction activities will require an array of vessels, many of which are 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 dynamic positioning (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 ocean floor to elevate the hull to provide a safe, stable working platform.

6.6.2.1.1 Habitat Alteration (Phases 1 and 2)

SWDA—Overview (Phases 1 and 2)

During the construction of New England Wind, habitat alteration will occur through the installation of WTG and ESP foundations, scour protection, inter-array and inter-link cables, offshore export cables within the SWDA, and cable protection (if used). Use of jack-up vessels or anchored vessels may also cause temporary habitat alteration. Immobile life stages of fish species in or on benthic sediment (i.e. demersal eggs and larvae), demersal fish species, and benthic invertebrates with limited or no motility in the direct path of foundations, scour protection, inter-array and inter-link cables, offshore export cables within the SWDA, cable protection (if any), jack-up vessel legs, or anchors would be the most at risk of direct injury or mortality during construction and installation in the SWDA. Mobile demersal/benthic and pelagic fish and invertebrates would be temporarily displaced by increased suspended sediments and underwater construction but would likely be able to escape harm and avoid construction and installation areas. Construction activities conducted in the winter, if any, may further reduce the avoidance ability of some benthic organisms as low temperatures can influence metabolic rates and locomotion (Brockington and Clarke 2001).

Temporary and permanent habitat loss or alteration is expected for both demersal and pelagic fish. Demersal fish species are expected to be the most affected by bottom habitat loss and alteration because of their strong association with benthic environments. Bottom habitat will be permanently altered to hard substrate from the installation of WTG/ESP foundations and associated scour protection. Bottom habitat may also be permanently altered to hard bottom substrate through the installation of cable protection (as described in Sections 3.2.1.5.4 and 4.2.1.5.4 of COP Volume I) in areas where sufficient cable burial depths cable cannot be achieved. The BOEM DEIS (2018) for Vineyard Wind 1 determined that impacts from the long-term conversion of habitat would be moderate but not affect fishes and invertebrates at a population-level.

Additional bottom habitat alteration is expected from the use of jack-up and/or anchored vessels and from installation of the inter-array, inter-link, and offshore export cables within the SWDA as described in Sections 3.3.1.3 and 4.3.1.3 of COP Volume I. Anchored vessels may be equipped with spud legs that are deployed to secure the cable laying vessels while its anchors are being repositioned. Bottom habitat in the direct path of the inter-array, inter-link, and offshore export cables within the SWDA will be disturbed from the surface to a depth of 1.5–2.5 meters (5–8 ft). Additionally, to monitor weather and sea state conditions during construction, the Proponent may deploy meteorological oceanographic ("metocean") buoys within the SWDA; if so, anchors for the metocean buoys will also temporarily disturb bottom habitat.

The following sections present impacts (1) within the maximum size of New England Wind associated with a total buildout of 130 WTG/ESP positions (453 square kilometers [km^2] [111,939 acres]), (2) within the maximum size of Phase 1 associated with a total buildout of 62 WTGs and two ESPs (231 km^2 [57,081 acres]), and (3) within the maximum size of Phase 2 associated with a total buildout of 88 WTG/ESP positions (303 km^2 [74,873 acres]). As described in Section 3 of COP Volume III, due to the range of buildout scenarios for Phases 1 and 2 where certain parts of the SWDA could be included in either Phase 1 or 2, the sum of the maximum design scenarios for Phase 1 and Phase 2 does not equal the total maximum design scenario of New England Wind. In other words, it is not possible to have both the maximum size of Phase 1 (231 km^2 [57,081 acres]) and the maximum size of Phase 2 (303 km^2 [74,873 acres]) as the total size of the SWDA is a maximum of 453 km^2 (111,939 acres). Nonetheless, impacts are provided for the maximum size of each Phase to provide the maximum potential impact associated with each Phase.

SWDA—Maximum Impact (Phases 1 and 2)

As detailed in Appendix III-T, within the maximum size of the SWDA and encompassing both Phases 1 and 2, the amount of permanent habitat alteration from the installation of WTG/ESP foundations, associated scour protection, and potential cable protection (if required) would be approximately 1.17 square kilometers (km^2) (289 acres). The amount of habitat disturbance from the use of jack-up and/or anchored vessels, cable installation, and metocean buoy anchors would be approximately 4.08 km^2 (1,008 acres).[71] The total area of alteration within the SWDA due to foundation and scour protection installation, jack-up and/or anchored vessel use, inter-array and inter-link cable installation, potential cable protection (if required), and metocean buoy anchors is 5.19 km^2 (1,283 acres), which is 1.1% of the maximum size of the SWDA.

[71] The impacts from anchor sweep are not quantified at this time due to the difficulty of estimating potential anchoring practices at the early planning stages of New England Wind.

SWDA–Phase 1

Within the maximum size of Phase 1, bottom habitat primarily consists of sand and mud-sized sediments. As detailed in Appendix III-T, the amount of permanent habitat alteration from the installation of WTG/ESP foundations, associated scour protection, and potential cable protection (if required) would be approximately 0.35 km^2 (86 acres). The amount of habitat disturbance from the use of jack-up and/or anchored vessels, cable installation, and metocean buoy anchors would be approximately 1.70 km^2 (421 acres). The total area of alteration within the maximum size of Phase 1 due to foundation and scour protection installation, jack-up and/or anchored vessel use, inter-array and inter-link cable installation, potential cable protection (if required), and metocean buoy anchors is 2.03 km^2 (502 acres), which is 0.9% of the maximum size of Phase 1.

SWDA—Phase 2

Within the maximum size of Phase 2, bottom habitat primarily consists of fine and mud-sized sediments. As detailed in Appendix III-T, the amount of permanent habitat alteration from the installation of WTG/ESP foundations, associated scour protection, and potential cable protection (if required) would be approximately 0.89 km^2 (221 acres). The amount of habitat disturbance from the use of jack-up and/or anchored vessels, cable installation, and metocean buoy anchors would be approximately 2.77 km^2 (686 acres). The total area of alteration within the maximum size of Phase 2 due to foundation and scour protection installation, jack-up and/or anchored vessel use, inter-array and inter-link cable installation, potential cable protection (if required), and metocean buoy anchors is 3.63 km^2 (897 acres), which is 1.2% of the maximum size of Phase 2.

OECC—Overview (Phases 1 and 2)

As further described in Sections 3.1.3 and 4.1.3 of COP Volume I, the Phase 1 and Phase 2 offshore export cables—two cables for Phase 1 and three cables for Phase 2—will be installed within the same OECC from the SWDA to within approximately 2-3 km (1-2 mi) from shore, at which point the OECC will diverge for each Phase to make landfall at separate sites in the Town of Barnstable, Massachusetts. As described in Sections 3.3.1.3 and 4.3.1.3 of COP Volume I, activities within the OECC are expected to include cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential use of cable protection (if required), the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing.

As with the SWDA, immobile benthic species or early life stages in the direct path of construction vessels would experience direct mortality or injury. Mobile demersal/benthic and pelagic fish and invertebrates may be temporarily displaced by increased suspended sediments and underwater construction but would likely be able to escape harm and avoid construction and installation areas. Some displaced fish and invertebrates may be subjected to indirect injury or mortality through increased predation or competition in areas surrounding the construction site. Overall, the slower avoidance response of juvenile and adult demersal fish and benthic invertebrate species subjects them to increased injury or mortality during dredging and cable installation. As mentioned above, slow avoidance responses can be further exaggerated if construction activities occur during the cold winter months for some species, such as horseshoe crab, that bury into the offshore sediment in the winter (Walls et al. 2002).

Benthic habitat in the direct path of the cable installation vessels, dredging vessels, vessel anchors, and anchor sweep zone will be disturbed while cables are being installed along the OECC. As described in COP Volume II, the OECC will pass through a variety of sediment types, including sand/mud, pebble-cobble, and dispersed boulders. Much of the OECC is considered low complexity, sandy, soft bottom habitat and the majority of video transects taken along the OECC recorded flat sand/mud or sand waves (see COP Volume II). Coarser complex substrates, including pebble-cobble and boulders,[72] were found mainly in Muskeget Channel and are important for habitat for the juveniles of some fish species, like Atlantic cod (*Gadus morhua*) (Lindholm et al. 2001; Grabowski et al. 2018).

Once cable installation is complete, temporary to permanent habitat alteration may occur due to the resettling of disturbed finer-grained sediment over gravel and other coarse substrate. However, because sedimentation thicknesses are typically expected to be less than 5 millimeters (mm) (0.20 inches [in]), dynamic processes will likely uncover larger grains with time. For a small portion of the OECC, permanent alteration may also occur where desired burial depth cannot be achieved. In these areas with limited burial depth, cable protection may be placed over the cables. The Proponent's goal, however, is to minimize the use of cable protection to the greatest extent possible and will do so through a careful route assessment and the selection of the most appropriate cable burial tool for each segment of the cable route.

OECC—Maximum Impact (Phases 1 and 2)

BAs detailed in Appendix III-T, within the OECC for Phases 1 and 2, the amount of permanent habitat alteration from the potential installation of cable protection (if required) would be approximately 0.22 km^2 (54 acres). The amount of habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 2.48 km^2 (612 acres).[73] Total seafloor impacts in the OECC would be approximately 2.60 km^2 (642 acres).

[72] Refers to Auster (1998) substrate classifications.

[73] The impacts from anchor sweep are not quantified at this time due to the difficulty of estimating potential anchoring practices at the early planning stages of New England Wind.

If the Western Muskeget Variant is used for one or two Phase 2 export cables, the amount of permanent habitat alteration for both Phases combined from the potential installation of cable protection (if required) would be approximately 0.23-0.24 km^2 (57-60 acres). The amount of habitat disturbance for both Phases combined from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 2.47-2.49 km^2 (611-614 acres). Total seafloor impacts in the OECC for both Phases combined would be approximately 2.61 km^2 (646 acres).

OECC—Phase 1

As detailed in Appendix III-T, the maximum impacts within the OECC for Phase 1 include approximately 0.09 km^2 (22 acres) for the potential installation of cable protection (if required). For Phase 1, the amount of habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 1.01 km^2 (251 acres).[5] Total seafloor impacts in the OECC for Phase 1 would be approximately 1.06 km^2 (263 acres).

OECC—Phase 2

As detailed in Appendix III-T, the maximum impacts within the OECC for Phase 2 include approximately 0.13 km^2 (32 acres) for the potential installation of cable protection (if required). For Phase 2, the amount of habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 1.46 km^2 (361 acres).[5] Total seafloor impacts in the OECC for Phase 2 would be approximately 1.53 km^2 (379 acres).

OECC—Phase 2 Western Muskeget Variant

The Western Muskeget Variant contains a mix of soft (sand) and hard (gravel) substrate types and is designated as Complex habitat in the northern reach and Heterogeneous Complex habitat in the southern portion. If the Western Muskeget Variant is used for Phase 2, there will be either (1) one export cable installed in the Western Muskeget Variant and two export cables installed in the OECC or (2) two export cables installed in the Western Muskeget Variant and on export cable installed in the OECC. In either scenario involving the Western Muskeget Variant, the amount of permanent habitat alteration from the potential installation of cable protection (if required), which alters habitat through the addition of artificial hard substrate, would be approximately 0.14–0.15 km^2 (35–38 acres) for Phase 2. The amount of temporary habitat disturbance from cable installation, anchoring, the potential dredging of the tops of sand waves in certain locations, the potential for limited vessel grounding in the nearshore, and the limited use of jack-up vessels for cable splicing would be approximately 1.46–1.47 km^2 (360–364 acres). Although sedimentation from cable installation could also convert some hard bottom habitat to soft bottom as fine sand settles over coarse substrates, sediment transport modeling indicated that deposition above 5 mm (0.2 in) did not occur and deposition of 1 mm (0.04 in) or greater was constrained within 100 m (328 ft) of the route centerline. Under the NMFS-modified Coastal and Marine Ecological Classification Standard (CMECS) system, gravel includes particles with >2 mm (0.08 in) to < 4,096 mm (161 in) diameter, therefore, only gravel particles between 2 – 5 mm have the potential to be fully buried through deposition from cable installation and it is expected that dynamic processes will uncover smaller (2-5 mm) grains with time.

6.6.2.1.2 Suspended Sediments (Phases 1 and 2)

SWDA and OECC—Overview (Phases 1 and 2)

Temporary increases in suspended sediments in the water column during construction are expected and may affect demersal and pelagic fish species and benthic invertebrates (see Section 5.2). Increased suspended sediment can impair the visual abilities of fish species and impact foraging, navigation, and sheltering behaviors. For mollusks, such as soft shell clams and northern quahog (*Mercenaria mercenaria*), suspended sediments can reduce oxygen consumption and filter feeding abilities and lead to reduced growth (Wilber and Clarke 2001).

Concentration and duration of sediment suspension dictate the severity of the effects to fish and benthic organisms. Reduced growth and oxygen consumption of some mollusk species has been observed when sediment concentrations of 100 milligrams per liter (mg/L) persisted for two days (Wilber and Clarke 2001). Sublethal effects (i.e. fine sediment coating gills and cutting off gas exchange with water thus resulting in asphyxiation) were observed for adult white perch (*Morone americana*) when 650 mg/L of suspended sediments persisted for five days (Sherk et al. 1974). Lethal effects were observed for other adult fish species at concentrations greater than 1,000 mg/L that persisted for at least 24 hours (Sherk et al. 1974; Wilber and Clarke 2001). Fish eggs and larvae are typically more sensitive, with delayed hatching observed for white perch at a sediment concentration of 100 mg/L for one day (Sherk et al. 1974), which will be considered herein as a conservative threshold for potential impacts to finfish and invertebrates.

Further details on suspended sediment thresholds are provided in Section 6.5. Considering the duration and concentration of suspended sediments, the BOEM DEIS (2018) for Vineyard Wind 1 determined that impacts on fishes and invertebrates from increased turbidity during construction will be minor.

SWDA—Phases 1 and 2

Given the broad similarity in grain sizes throughout the SWDA and the range of buildout scenarios for Phases 1 and 2 included in the New England Wind Project Design Envelope (where a significant portion of the SWDA could be included in either Phase 1 or 2), modeling of sediment transport potential in the SWDA was conducted for one representative inter-array cable route (see

Appendix III-A). The modeled route was conservatively selected as one of the longer potential inter-array cable routes and in a location where grain sizes were slightly finer (though grain size is broadly similar throughout the SWDA). These model results are representative of inter-array, inter-link, or offshore export cable installation within the SWDA, for either Phase 1 or Phase 2.

Modeling in Appendix III-A indicated that under typical or maximum-impact cable installation methods, suspended sediments would be present within the lower portion of the water column for short periods of time. The maximum anticipated suspended sediment concentrations that persist for at least 60 minutes would be greater than 200 mg/L but less than 650 mg/L. These concentrations would drop rapidly to below 50 mg/L within a maximum of between one to two hours. As described in Section 6.5, 10 mg/L is an extremely conservative threshold and a more reasonable, yet still conservative threshold, is 100 mg/L for one day. Concentrations of suspended sediments of at least 10 mg/L typically stayed within 200 m (656 ft) of the inter-array cable centerline but could extend up to 2.2 km (1.2 nautical miles [NM]) from the inter-array cable centerline. Total suspended solids concentrations greater than 10 mg/L above ambient would substantially dissipate within one to two hours and fully dissipate in less than four hours. Therefore, these concentrations and durations of exposure are below those causing sublethal or lethal effects to fish and invertebrates even with an overly conservative threshold.

OECC—Phases 1 and 2

Modeling of sediment transport potential was conducted for a representative cable installation within the OECC that is illustrative of expected impacts for each of the five offshore export cables that may be installed within the OECC.

Installation along the OECC may require discontinuous (i.e. intermittent) dredging of the tops of sand waves to achieve sufficient burial depths. As described in Appendix III-A, this will likely be accomplished with a trailing suction hopper dredge (TSHD) or by jetting by controlled flow excavation for smaller sand waves. Sediment dispersion modeling of the TSHD indicated that concentrations of suspended sediments above 10 mg/L extended up to a maximum of 16 km (8.6 NM) from the area of activity; however, concentrations above 10 mg/L persist for less than six hours. For export cable installation, total suspended solid concentrations greater than 10 mg/L typically stayed within 200 m (656 ft) of the alignment but could extend a maximum distance of approximately 2.1 km (1.1 NM). Most of the sediment settles out in less than three to four hours. Finfish and invertebrates may be affected by the mobilization and suspension of sediments during dredging and cable installation activities, but all sediment settles out of suspension within three to six hours, thus concentrations do not exceed the potential impact thresholds.

The Proponent may elect a vertical injector cable installation tool with deeper penetration such that dredging of the tops of sand waves is not required to achieve sufficient burial depths. A representative section of deeper installation was modeled, and results indicated that concentrations of suspended sediments above 10 mg/L extended up to a maximum of 1.2 km (0.6 NM) from the cable trench centerline. Most of the sediment settles out in less than three hours;

however, suspended sediments at this concentration could persist for between four to six hours in smaller areas. Overall, this method is not anticipated to affect finfish and invertebrates because all sediments settle out of suspension within six hours and thus do not exceed the sublethal and lethal sensitivity thresholds.

The OECC is the same for Phases 1 and 2 until approximately 2-3 km (1-2 mi) from shore, at which point the OECC will diverge for each Phase to reach separate landfall sites in Barnstable. Modeling of the Phase 1 Landfall Site was considered as a conservative representation of a worst-case plume for the Phase 2 Landfall Site because this location has a relatively high fraction of fine sediments compared with those of Phase 2.

OECC—Phase 2 Western Muskeget Variant

Modeling of sediment transport potential was conducted for one representative cable installation within the OECC that is illustrative of expected impacts for each of the five cables that may be installed within the OECC. Given the similarities in substrate type, ocean conditions, and the shorter corridor distance within the Western Muskeget Variant, suspended sediment concentrations and durations are expected to be similar or less than the values presented for the OECC. Therefore, potential effects to finfish and invertebrates as a result of sediment suspension from installation of the Western Muskeget Variant cables are expected to be the same or less than those presented above for the OECC because of the shorter length of the cable.

6.6.2.1.3 Sediment Deposition (Phases 1 and 2)

SWDA and OECC—Overview (Phases 1 and 2)

The resettlement of disturbed sediments may cause additional mortality or injury to immobile species or life stages through burial and smothering. For demersal eggs (fish [e.g. Atlantic wolffish (*Anarhichas lupus)*, Atlantic herring, and winter flounder], squid [e.g. longfin inshore squid], and whelk species), deposition greater than 1 mm (0.04 in) can result in the burial and mortality of that life stage (Berry et al. 2011). As mentioned in Section 6.5, many benthic bivalve species can withstand deposition levels up to 300 mm (12 in) (Essink 1999). However, sessile or seafloor surface-dwelling species, such as blue mussels and queen scallops (*Aequipecten opercularis*), are more sensitive to deposition levels and lethal effects have been observed with burial depths between 20–100 mm (0.8–4 in) (Essink 1999; Hendrick et al. 2016). Therefore, the two conservative thresholds for potential impacts to finfish and invertebrates that will be considered herein for sediment deposition are 1 mm (0.04 in) deposition for demersal eggs and 20 mm (0.8 in) deposition for shellfish. For further details on sediment deposition threshold, refer to Section 6.5. Considering the thickness and distribution of sedimentation, the BOEM DEIS (2018b) for Vineyard Wind 1 determined that impacts from sedimentation on finfishes and invertebrates during construction would be minor and short-term.

SWDA—Phases 1 and 2

Given the broad similarity in grain sizes throughout the SWDA and the range of buildout scenarios for Phases 1 and 2 included in the New England Wind Project Design Envelope (where a significant portion of the SWDA could be included in either Phase 1 or 2), modeling of sediment transport and deposition potential in the SWDA was conducted for one representative inter-array cable route (see Appendix III-A).

Simulations of typical and maximum impact cable installation methods in the SWDA indicated that deposition of 1 mm (0.04 in) or greater (i.e. the threshold of concern for demersal eggs) extended up to 100 m (328 ft) from the route centerline for typical installation parameters (see Appendix III-A). At this deposition thickness, there are limited areas with potential temporary negative impacts to demersal eggs and species of similar sensitivity. The sediment dispersion modeling with typical and maximum impact installation techniques (see Appendix III-A) also indicated that, for the representative cable installation activities in the SWDA, there would be no area of deposition greater than 5 mm (0.2 in) for the typical installation parameters, and only small areas (0.01 km^2 [2.5 acres] for representative section) of deposition greater than 5 mm (0.2 in) for the maximum impact installation parameters. For both the typical and maximum impact installation parameters, there were no areas with deposition above 10 mm (0.4 in). Therefore, cable installation is not anticipated to affect shellfish or other organisms of similar sensitivity to deposition.

OECC—Phases 1 and 2

Modeling of sediment transport potential was conducted for one representative cable installation within the OECC that is illustrative of expected impacts for each of the five cables that may be installed within the OECC.

Simulations of typical cable installation parameters (without sand wave removal) in the OECC indicated that deposition of 1 mm (0.04 in) or greater (i.e. the threshold of concern for demersal eggs) was constrained to within 0.1 km (328 ft) from the route centerline and maximum deposition was typically less than 5 mm (0.2 in), though there was a small isolated area associated with the vertical injector model scenario with deposition between 5 mm (0.2 in) to 10 mm (0.4 in) (see Appendix III-A). At this deposition thickness, there are limited areas with potential temporary negative impacts to demersal eggs and species of similar sensitivity. In areas along the OECC where sand wave dredging was simulated to occur, deposition greater than 1 mm (0.04 in) associated with the TSHD was mainly constrained to within 1 km (0.54 NM) but extended up to 2.3 km (1.2 NM) in isolated patches when subject to swift currents through Muskeget Channel.

At this deposition thickness, there are limited areas with potential temporary negative impacts to demersal eggs and species of similar sensitivity. Modeling results also indicated that there will be some small areas of deposition greater than 20 mm (0.8 in) from dredging and dumping extending up to 0.9 km (0.49 NM) from the route centerline. At this deposition thickness, there are limited areas with potential temporary negative impacts to all life stages of shellfish and species of similar sensitivity to deposition.

The OECC is the same for Phases 1 and 2 until approximately 2-3 km (1-2 mi) from shore, at which point the OECC will diverge for each Phase to reach separate landfall sites in Barnstable. As noted previously, modeling of the Phase 1 Landfall Site was considered as a conservative representation of a worst-case plume for the Phase 2 Landfall Site because this location has a relatively high fraction of fine sediments compared with those of Phase 2.

OECC—Phase 2 Western Muskeget Variant

As mentioned above, modeling of sediment transport potential was conducted for one representative cable installation within the OECC that is illustrative of expected impacts for each of the five cables that may be installed within the OECC. Given the similarities in substrate type, ocean conditions, and the shorter corridor distance within the Western Muskeget Variant, sediment deposition levels are expected to be similar or less than the values presented for the OECC. Therefore, potential effects to finfish and invertebrates as a result of sediment deposition from installation of the Western Muskeget Variant cables are expected to be the same or less than those presented above for the OECC because of the shorter length of the cable.

6.6.2.1.4 Water Withdrawals (Phases 1 and 2)

SWDA and OECC—Overview (Phases 1 and 2)

Direct mortality of planktonic life stages could occur via water withdrawals for vessel functions and potentially from the cable installation and dredging vessels during construction and operation of both Phases of New England Wind. Mortality of organisms entrained in water withdrawal pumps is expected to be 100% because of the physical stresses associated with from being flushed through a pump system and potential temperature changes (USDOE MMS 2009). Species most at risk of mortality from water withdrawals are those with pelagic eggs (see Appendix III-F). Considering the duration and relative size of the impact area, the BOEM DEIS (2018b) for Vineyard Wind 1 determined that impacts from entrainment of fishes and invertebrates during construction would be minor.

SWDA—Maximum Impact (Phases 1 and 2)

Water withdrawals for the maximum size of the SWDA can be estimated using the following assumptions:

- Cable installation occurs at a rate of up to 200 meters per hour (m/hr) (656 feet per hour [ft/hr])[74]

- A jetting technique uses 11,300–45,000 liters per minute (3,000–12,000 gallons per minute) of water

- The maximum total length of inter-array, inter-link, and offshore export cables within the SWDA is 701 km (379 NM)

Under these assumptions, water withdrawal volumes for the maximum size of the SWDA are expected to be approximately 2.4–9.5 billion liters (0.6–2.5 billion gallons).

SWDA—Phase 1

Water withdrawals for the maximum size of Phase 1 can be estimated using the above assumptions and a maximum total length of inter-array, inter-link, and offshore export cables within the SWDA of approximately 281 km (152 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 1.0–3.8 billion liters (0.3–1.0 billion gallons) for Phase 1.

SWDA—Phase 2

Water withdrawals for the maximum size of Phase 2 can be estimated using the above assumptions and a maximum total length of inter-array, inter-link, and offshore export cables within the SWDA of approximately 495 km (267 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 1.7–6.7 billion liters (0.4–1.8 billion gallons) for Phase 2.

OECC—Maximum Impact (Phases 1 and 2)

Water withdrawals for the up to five offshore export cables within the OECC can be similarly estimated using the following assumptions:

- Cable installation occurs at a rate of up to 120 m/hr (394 ft/hr)75

- A jetting technique uses 11,300–45,000 liters per minute (3,000–12,000 gallons per minute) of water

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[74] The final installation speed will be specific to the contractor and cable installation equipment and may be different than listed here. A speed of 200 m/hr (656 ft/hr) is used to provide a general estimate of water usage.

[75] The final installation speed will be specific to the contractor and cable installation equipment and may be different than listed here. A speed of 120 m/hr (394 ft/hr) is used to provide a general estimate of water usage.

- The maximum total length of offshore export cables (outside the SWDA) is 412 km (222 NM)

Under these assumptions, water withdrawal volumes for the installation of five cables within the OECC for Phases 1 and 2 are expected to be approximately 2.3-9.3 billion liters (0.6-2.4 billion gallons).

OECC—Phase 1

The maximum water withdrawals within the OECC for Phase 1 can be estimated using the above assumptions and a maximum total length of export cables (outside the SWDA) for Phase 1 of approximately 166 km (89 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 0.9–3.7 billion liters (0.2–1.0 billion gallons) for Phase 1.

OECC—Phase 2

The maximum water withdrawals within the OECC for Phase 2 can be estimated using the above assumptions and a maximum total length of offshore export cables (outside the SWDA) for Phase 2 of approximately 246 km (133 NM). Under these assumptions, water withdrawal volumes are expected to be approximately 1.4-5.5 billion liters (0.4-1.5 billion gallons) for Phase 2. Given the shorter corridor distance within the Western Muskeget Variant, potential effects to finfish and invertebrates as a result of water withdrawals for installation of the Western Muskeget Variant cables are expected to be the same or less than those presented above for the OECC.

6.6.2.1.5 Increased Sound Exposure (Phases 1 and 2)

SWDA and OECC—Overview (Phases 1 and 2)

Construction of New England Wind would introduce underwater noise and may result in increased sound exposure of finfish and invertebrates. Underwater sounds would include repetitive, high-intensity (impulsive) sounds produced by pile driving, and continuous (non-impulsive), lower-frequency sounds produced by vessel propulsion and cable installation. Intensity of produced sound would vary with some sounds being louder than ambient noise. Ambient noise within Lease Area OCS-A 0501 was measured as, on average, between 76.4 and 78.3 decibels (dB) re 1 $\mu Pa^2/Hz$) (Alpine Ocean Seismic Surveying, Inc. 2017). This study was performed prior to the segregation of Lease Area OCS-A 0501 into OCS-A 0501 and OCS-A 0534. Ambient noise can influence how fish detect other sounds as fish have localized noise filters that separate background noise and other sounds simultaneously (Popper and Fay 1993). All fish have hearing structures that allow them to detect sound particle motion. Some fishes also have swim bladders near or connected to the ear that allows them to detect sound pressure, which increases hearing sensitivity and broadens hearing abilities (Hawkins and Popper 2017; Popper et al. 2014). The most relevant metric associated with sound perception for most fish species is particle motion; however, except for a few species, there is an almost complete lack of relevant data on particle motion sensitivity in fish (Popper and Fay 2011; Popper et al. 2014).

In general, increased sound sensitivity and the presence of a swim bladder makes a fish more susceptible to injury from anthropogenic sounds because loud, usually impulsive, noises can cause swim bladders to vibrate with enough force to inflict damage to tissues and organs around the bladder (Casper et al. 2012; Halvorsen et al. 2011). The least sound-sensitive fish species are those that do not have a swim bladder, including flatfishes such as winter flounder and elasmobranchs. Fishes with swim bladders not connected to or near inner-ear structures, such as Atlantic sturgeon, also primarily detect noise through particle motion and are therefore less sensitive to sound. The most sensitive species are those with swim bladders connected or close to the inner ear, such as Atlantic herring and Atlantic cod. These species can acquire both recoverable and mortal injuries at lower noise levels than other species (Popper et al. 2014; Thomsen et al. 2006).

The Popper et al. (2014) criteria for impulsive pile driving sound are described in Table 6.6-5. NMFS lists separate "interim guidance" of peak onset of injury or mortality regardless of source type, fish size, or hearing type, and a cumulative Sound Exposure Level (SEL) onset of injury or mortality for fish 2 grams (0.07 ounces) or larger; and fish smaller than 2 grams (0.07 ounces) (FHWG 2008) (see Table 6.6-6). There is no American National Standards Institute (ANSI) accredited behavioral threshold for fish.

To assess the potential impacts of anthropogenic sound on fish, Popper et al. (2014) classified fishes into three animal groups comprising: (1) fishes with swim bladders whose hearing does not involve the swim bladder or other gas volumes (e.g. tuna [*Thunnus* sp.] or Atlantic salmon); (2) fishes whose hearing does involve a swim bladder or other gas volume (e.g. Atlantic cod or herring); and (3) fishes without a swim bladder (e.g. sharks) that can sink and settle on the substrate when inactive (Carroll et al. 2017; Popper et al. 2014). The most sensitive species are those with swim bladders connected or close to the inner ear. These species can experience both recoverable and mortal injuries at lower sound levels than other species (Popper et al. 2014; Thomsen et al. 2006). Quantitative acoustic criteria are therefore defined for these species. The suite of generally accepted acoustic thresholds used in this assessment to determine potential effects on fish exposed to sounds likely to occur during construction are described in Table 6.6-6.

Table 6.6-5 Acoustic Thresholds Used to Evaluate Impacts to Fish Exposed to Impulsive Impact Pile Driving Sound[1]

Faunal Group	Mortality or Potential Mortal Injury[2]		Impairment[3]				Behavior[3]
			Recoverable Injury		Temporary Threshold Shift	Masking	
	L_{PK}	$L_{E,24hr}$	L_{PK}	$L_{E,24hr}$	$L_{E,24hr}$		
Fishes without swim bladder	>213	>219	>213	>216	>>186[4]	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fishes with swim bladder not involved in hearing	> 207	210	>207	203	>186	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fishes with swim bladder involved in hearing	>207	207	>207	203	186	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate
Eggs and larvae	>207	>210	(N) Moderate (I) Low (F) Low		(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Notes:

1. Adapted from ANSI-accredited Popper et al. 2014; all thresholds are unweighted. Recoverable injury thresholds were modeled for this study (Appendix III-M).
2. L_{PK} = peak sound pressure (dB re 1 µPa); $L_{E,24hr}$ = 24 hr cumulative sound exposure level (dB re 1 µPa^2·s).
3. N = near (tens of meters), I = intermediate (hundreds of meters), and F = far (thousands of meters).
4. >> = much greater than.

Table 6.6-6 General Interim Acoustic Thresholds for Fish Currently Used or Recommended by NMFS and BOEM[1]

Fish Group	Injury[2]		Behavior[3]
	L_{PK}	$L_{E,24hr}$	L_p
Fish ≥2 g	206[4,5]	187[4,5]	150[5]
Fish <2 g		183[4,5]	
Fish without swim bladder[6]	213	216	-
Fish with swim bladder not involved in hearing[6]	207	203	-
Fish with swim bladder involved in hearing[6]	207	203	-

Notes:

1. All thresholds are unweighted.
2. L_{PK} = peak sound pressure (dB re 1 µPa); $L_{E,24hr}$ = 24 hr cumulative sound exposure level (dB re 1 µPa^2·s).
3. L_p = root mean square sound pressure (dB re 1 µPa).
4. NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
5. References in the NMFS Greater Atlantic Regional Fisheries Office (GARFO) (2016) tool: Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
6. Popper et al. 2014.

Exposure to anthropogenic sound sources could have a direct consequence on the functionality and sensitivity of the sensory systems of marine invertebrates. Numerous studies have investigated the effect of sound on marine invertebrates but have been conducted in confined environments that make it difficult to control and assess the acoustic conditions. Moreover, by measuring and reporting only the pressure component of sound, the results are of reduced relevance for assessing any observed effects. Most crustacean species lack swim bladders and are considered less sensitive to sound, though understanding of the impact of sound on invertebrates is limited (Edmonds et al. 2016).

The BOEM DEIS (2018b) for Vineyard Wind 1 determined that impacts on fishes and invertebrates from vessel sounds and pile driving during construction would be minor and short-term.

SWDA—Phases 1 and 2

Impact Pile Driving

Sound generated from pile driving could impact fishes and invertebrates nearby because the high-intensity, impulsive sounds of pile driving can produce noise over 200 dB at the source and have been linked to mortality, ruptured gas bladders, damage to auditory processes, and altered behavior in some fish species (Casper et al. 2012; Popper and Hastings 2009; Riefolo et al. 2016).

Impact pile driving is carried out using an impact hammer, which consists of a falling ram that strikes the top of a pile repeatedly and drives it into the ground. When the ram strikes the pile, the impact creates stress waves traveling down the length of the pile, which couples with the surrounding medium, radiating acoustic energy into the water (see Appendix III-M). Pile driving also generates vibration waves in the sediment, which can radiate acoustic back into the water from the seabed. The sound from impact pile driving is transient, repetitive, and discontinuous (McPherson et al. 2017; Reinhall and Dahl 2011). Pile driving can be conducted both above the surface and subsea and has a typical strike interval of 1.5 to 2 seconds.

Field measurements of pile driving show that source, or near-source, levels are typically in the range of 210 to 250 dB re 1 µPa (Bailey et al. 2010; McHugh 2005; Tougaard et al. 2009) and frequency is predominantly <1 kilohertz (kHz) (Robinson et al. 2007; Tougaard and Henriksen 2009), although they can extend to much higher frequencies (MacGillivray 2018), including at least 100 kHz (Tougaard and Henriksen 2009). Sound thresholds derived from Popper et al. (2014) indicated that pile driving sound above 207 dB peak can lead to mortality of the most sensitive fish species, such as Atlantic herring, while noise above 186 dB can lead to impairment. Longfin squid exhibited a startle response to recorded pile driving sound played at 190–194 dB but habituated quickly and startle responses typically diminished within the first eight strikes, although the response returned when the squid were tested again 24 hours later (Jones et al. 2020). The authors did not report any physical harm from the sound exposure but speculated that it could reduce the ability to detect and avoid predators.

The effects of impulsive sound on fish eggs and larvae have been studied in the context of offshore pile driving. Bolle et al. (2012) investigated the risk of mortality in Common sole (*Solea solea)* larvae by exposing them to impulsive stimuli in an acoustically well-controlled study. Even at the highest exposure level tested, at an SEL of 206 dB re 1 µPa2·s (corresponding to 100 strikes at a distance of 100 m [328 ft]), no statistically significant differences in mortality were found between exposure and control groups.

Popper et al. (2014) published exposure guidelines for fish eggs and larvae, which are based on pile driving data. The guidelines proposed a precautionary threshold for mortality of fish eggs and larvae of greater than 207 dB re 1 µPa PK, which they note is likely conservative.

There are no studies available on the potential effects of pile driving sounds on plankton and no established acoustic thresholds for plankton. Although air guns are not a proposed action for New England Wind, they provide insight on potential effects from impulsive sound. Parry et al. (2002) studied the abundance of plankton after exposure to impulsive air gun sounds but found no evidence of mortality or changes in catch-rate on a population-level. However, McCauley et al. (2017) found that after exposure to impulsive air gun sounds generated with a single air gun (2,460 cm^3 or 150 in^3), zooplankton abundance decreased and mortality in adult and larval zooplankton increased two- to three-fold when compared with controls. In this first large-scale field experiment on the impact of seismic activity on zooplankton, a sonar and net tows were used to measure the effects on plankton. They determined there was a horizontal maximum effect-range of 1.2 km (0.65 NM). Their findings contradicted the conventional idea of limited and very localized impact of intense sound in general, and seismic air gun signals in particular, on zooplankton. The results indicated that there may be noise-induced effects on these taxa and that these effects may even be negatively affecting ocean ecosystem function and productivity. However, the study was compromised by methodological design issues (small sample sizes, large daily variability in the baseline and experimental data), the statistical robustness of the data, and conclusions (large number of speculative conclusions that appear inconsistent with the data collected over a two-day period). The lead author stressed that even though their conclusions were based on numerous assumptions, the combined likelihood of all measured parameters occurring without being correlated to the air gun survey is extremely low (McCauley, pers. comm.).

The Commonwealth Scientific and Industrial Research Organization (CSIRO) (Richardson et al. 2017) simulated the large-scale impact of a seismic survey on zooplankton using the mortality rate found by McCauley et al. (2017). The aim of the CSIRO study was to estimate the spatial and temporal impact of seismic activity on zooplankton on the Northwest Shelf of Western Australian. The major findings of the CSIRO study were that seismic activity had substantial impacts on zooplankton populations on a local scale within or close to the survey area; however, on a regional scale, the impacts were minimal and not discernible over the entire Northwest Shelf Bioregion. The study found that the time for the zooplankton biomass to recover to pre-seismic levels inside the survey area, and within 15 km (8 NM) of the area, was only three days following the completion of the survey. This relatively quick recovery was due to the fast growth rates of zooplankton as well as the dispersal and mixing of zooplankton from both inside and outside of the impacted region (Richardson et al. 2017).

Fields et al. (2019) exposed zooplankton (copepods) to seismic pulses at various distances up to 25 m (82 ft) from a seismic air gun source. The source levels produced were estimated to be 221 dB re 1 µPa2·s. The study observed an increase in immediate mortality rates of up to 30% of copepods in samples compared to controls at distances of 5 m (16 ft) or less from the air guns. Mortality one week after exposure was significantly higher by 9% relative to controls in the copepods placed 10 m (33 ft) from the air guns. Fields et al. (2019) also reported that no sublethal effects occurred at any distance greater than 5 m (16 ft) from the seismic source. The findings of the study indicated that the potential effects of seismic pulses to zooplankton are limited to within approximately 10 m (33 ft) from the seismic source. Fields et al. (2019) also note that the findings of the McCauley et al. (2017) study are difficult to reconcile with the body of other available research and may, therefore, provide an overly conservative estimate of the potential effects of seismic pulses to zooplankton.

There are indications that New Zealand scallop (*Pecten novaezelandiae*) larvae exposed to extended periods of air gun signals during their ontogeny may be negatively affected as reported by Aguilar de Soto et al. (2013). The authors found an increase in abnormality and mortality rates in scallop larvae after continued exposure to playbacks of intense air gun signals in a laboratory experiment. These results indicated that there may be species-specific differences in sensitivity of early life stages to sound exposure. In addition, research on the response of blue mussels to pile driving indicated that clearance or filtration rate increased with pile driving noise, likely in response to increased metabolic demands triggered by stress (Spiga et al. 2016).

Day et al. (2016a) conducted a study on the effects of exposures of southern rock lobster (*Jasus edwardsii)* and scallop to impulsive sounds produced by an air gun. Their study used field and laboratory experimental approaches to investigate potential impacts of marine seismic surveys on these species. The study used a real air gun and had improved control over experimental parameters compared to other reported studies, as it is likely that particle motion and interface waves are the more relevant stimulus. Accordingly, their results are more relevant than those obtained under laboratory conditions with animals exposed to simulated signals. Day et al. (2016a) provide a regression of particle acceleration versus range for the single 2,460 cm^3 (150 in^3) air gun used in the study and showed that acceleration at the 10 and 100 m (33 and 328 ft) ranges were typically 26 and 5 m s^{-2} (85 and 16 ft s^{-2}), respectively. The study also references an unpublished maximum particle acceleration measurement of 6.2 m s^{-2} (20 ft s^{-2}) from a 3,130 in^3 (51,300 cm^3) air gun array at 477 m (1,565 ft) range in 36 m (118 ft) of water. Consistent with other studies of high-intensity, low-frequency sound exposure of crustaceans and mollusks (Carroll et al. 2017; Edmonds et al. 2016), the study found no evidence of mass mortality directly following air gun exposure. Consequently, the authors rejected the hypothesis that exposure to seismic air guns causes immediate mass mortality. Unlike other studies, this study uncovered a few issues concerning long-term health and ecology. Two reflex behaviors, tail tonicity or extension and righting behavior, were assessed. These reflexes have been used in lobster fishery industries in grading animals for their likelihood of survival. While results for tail tonicity were inconclusive, there was a significant response to exposure in the righting response, which is a more complex reflex requiring neurological control and muscle coordination.

André et al. (2011) and Solé et al. (2013) provide evidence of acoustic trauma in four cephalopod species—common cuttlefish (*Sepia officinalis),* common octopus *(Octopus vulgaris),* European squid *(Loligo vulgaris),* and southern shortfin squid *(Illex condietii*)—which they exposed (underwater) for two hours to low-frequency sweeps between 50–400 hertz (Hz) (1 second duration) generated by an in-air speaker. The received level at the animals' position was 157 dB re 1 µPa with peak levels (unspecified) up to 175 dB re 1 µPa. Both studies reported permanent and substantial morphological and structural alterations of the sensory hair cells of the statocysts following noise exposure, with no indication of recovery.

In a recent experiment, Solé et al. (2017) exposed common cuttlefish to tonal sweeps between 100–400 Hz in a controlled exposure experiment in open water. Their results showed a clear statistical relationship between the cellular damage detected in the sensory cells of the individuals exposed to the sound sweeps and their distance from the sound source. The authors measured the particle motion and pressure of the signals received by the animals, but due to the signal type (frequency sweep), they only provided the maximum received levels or an estimate thereof, respectively. The maximal particle motion level was 0.7 ms^{-2} (2.3 ft^{-2}) observed at 1 m (3.3 ft) depth, the pressure reached levels of 139–142 dB re 1 μPa^2. The reported sound pressure levels were only slightly higher than the hearing threshold determined for longfin squid measured by Mooney et al. (2010). The maximum particle motion (reported in terms of particle acceleration) reported by Solé et al. (2017) is in the same order of magnitude as the behaviorally thresholds measured at 100 Hz by Packard et al. (1990) using a standing wave acoustic tube.

The Proponent conducted acoustic modeling (see Appendix III-M) to estimate the noise propagation of pile driving assuming broadband noise attenuation levels of 6, 10, and 12 dB in relation to thresholds of mortality and recoverable injury for fishes with different hearing structures (based on thresholds in Popper et al. 2014). Although noise attenuation mitigation technology is expected to be implemented to reduce sound levels by a target of approximately 12 dB or greater, impacts to marine species were conservatively assessed based on 10 dB of noise attenuation.

Sound with peak sound pressure (dB re 1 µPa) up to 213 dB and frequency-weighted sound exposure level (dB re 1 $\mu Pa^2 \cdot s$) up to 219 dB was predicted to occur. Popper et al. 2014 does not define quantitative acoustic thresholds for behavioral response in fish. GARFO (2016) uses a 150 dB SPL threshold for all fish (see Appendix III-M).

Distances to injury or behavioral disturbance thresholds are presented in Appendix III-M. Impairment from pile driving noise is less likely to occur during construction because a soft-start technique will be employed, and mobile fishes and invertebrates will be able to leave the area before full strength pile driving occurs.

Unexploded Ordnance

Detonation of unexploded ordnance (UXO) could occur, if potential UXOs are discovered in the SWDA or OECC. The Proponent will prioritize avoidance of UXO wherever possible by micro-siting structures and cables around the object. In instances where avoidance, physical UXO removal, or an alternative combustive removal technique (e.g., deflagration) are infeasible due to layout restrictions or are not considered safe for project personnel, UXOs may need to be detonated in situ to conduct seabed-disturbing activities such as foundation installation and cable laying during construction of New England Wind. The exact number and type of UXO that may be present, and which subset of those UXO cannot be avoided by micro-siting, are continuing to be evaluated. To assess the impacts of underwater sound during UXO detonation, acoustic modeling was completed (see Appendix III-M, sub-Appendix J).

Underwater explosive detonations generate impulsive sound waves with high pressure levels that could cause disturbance and/or injury to marine fauna. An explosion produces hot gases that create a large oscillating sphere and a shock wave (Chapman 1985). The extreme increase in pressure followed by a decrease to below ambient pressure caused by an explosive shock wave can cause injury to soft tissues, membranes, and cavities filled with air (Keevin and Hempen 1997). However, these events produce a short signal duration and the extent of impact will depend on the proximity of the receiver to the detention.

Injury to fish from exposures to explosion are called barotrauma injuries. Rapid changes in gas volume and rapid changes in the solubility of gas in the blood and tissues cause barotrauma injuries. When pressure increases, solubility increases and vice versa. Injury mechanisms include bubble formation in fluids/tissues (i.e., decompression sickness), and rapidly expanding gas-filled bodies (i.e., swim bladder) push against surrounding tissues, thereby damaging surrounding tissues [Carlson 2012; Halvorsen 2012a].

Effects of detonation pressure exposures to fish have been assessed according to the Lpk limits for onset of mortality or injury leading to mortality due to explosives, as recommended by the American National Standards Institute (ANSI) expert working group (Popper et al. 2014).

There is no available research in invertebrates on the effect of sound from UXO detonation causes particle motion changes, which may result in behavioral response, injury, mortality, sensory damage, and physiological changes (Fitzgibbon et al. 2017; McCauley et al. 2017). Vibration caused by anthropogenic sound, such as UXO detonation, can propagate to the seabed (Roberts and Elliott 2017). Researchers have reported substrate-borne vibrations from anthropogenic sound to affect their behavior (Roberts et al. 2015) (Roberts et al. 2016).

Vibratory Pile Setting

As described further in Appendix III-M, sub-Appendix K, a vibratory hammer could be used to install the monopile through surficial sediments in a controlled fashion to avoid the potential for a “pile run,” where a pile sinks rapidly through surficial sediments. Once the pile has penetrated the surficial sediments with the vibratory hammer, an impact hammer would be used for the remainder of the installation. During vibratory pile driving, piles are driven into the substrate due to longitudinal vibration motion at the hammer's operational frequency and corresponding amplitude. This causes the soil to liquefy, allowing the pile to penetrate into the seabed. Sounds generated by vibratory pile setting are non-impulsive, which are known to be less damaging than impulsive sounds to marine fauna.

There are few data on the effects of vibratory pile driving on fish. Further, generalizations can be difficult because sound affects species differently, particularly with regards to the presence or absence of a swim bladder and its proximity to the ear. Nedwell et al. (2003) detected no changes in activity level or startle response in brown trout, a species with no specialized hearing structures, when exposed to vibratory piling at close ranges (<50 m [164 ft]). There are no direct data available on the behavioral response to continuous noise in fish species with more specialized hearing. The masking of communicative signals, as well as signals produced by predators and prey, may be the most likely behavioral impact to fish (Popper and Hawkins 2019). However, the effect is expected to be short term (Popper et al. 2014). Additionally, high risks of any behavioral impacts from continuous sound sources (e.g., vibratory pile driving) are likely to only occur at close range to the source (Popper et al. 2014).

There are no data linking continuous noise to mortality or permanent threshold shift in fish (Popper et al. 2014). Continuous noise has been linked to temporary threshold shift (TTS) in some fish species; however, exposure times to these sounds were at least 12 hours (Amoser and Ladich 2003, Smith et al. 2006). Overall, the sounds emitted by vibratory setting of piles for wind farm construction are expected to be of short duration and intermittent, and the risk of impact on fish from the acoustic sound generated by this activity is expected to be low.

There is a lack of data involving the effects of vibratory pile installations on invertebrates. Among the marine invertebrates, some can detect particle motion and are sensitive to noise (André et al. 2016; Popper et al. 2014; Jézéquel et al. 2023). Being invertebrates generally do not possess air-filled spaces like lungs, middle ears, or swim bladders, they have been considered less susceptible than fish to noise and vibration. Invertebrates display measurable behavioral responses to noise, such as interruptions to feeding and resource gathering, startle responses, and escape behaviors (Mooney et al. 2020; Roberts et al. 2015).

Drilling

As described further in Appendix III-M, sub-Appendix L, there may be instances during construction of New England Wind where large sub-surface boulders or hard sediment layers are encountered, which will require drilling to pass through these barriers. The duration of drilling activity throughout pile driving depends on the degree of site-specific sediment resistance and is not known, however is it possible that drilling could occur up to 24 hours in a day. During drilling activities, a drill head produces vibrations that propagate as sound through the sediment and water column (Hall and Francine 1991, Nguyen 1996, Willis et al. 2010). Most measurements of offshore drilling sounds have been made for oil exploration and production drilling. The sound levels associated with those drilling operations have been documented to be within the hearing range of fish injury and behavioral thresholds (Popper et al. 2014). Underwater sound emitted by project construction drilling activities is not expected to produce injury to marine fauna but is likely to be audible and could elicit temporary behavioral responses.

It is unclear whether the sound emitted by marine drilling activities is likely to impact the behavior of fish. McCauley (1998) determined that any effects to fish from sounds produced by marine drilling activity would likely be temporary behavioral changes within a few hundred meters of the source. For instance, measured source levels during drilling operations reached 120 dB at 3–5 km, which may have caused fish avoidance (McCauley 1998). The available literature suggests that continuous sound produced by drilling operations may mask acoustic signals of fish that convey important environmental information (McCauley 1994, Popper et al. 2014). Recordings of planktivorous fish choruses showed that the fish were still active during drilling operations off the coast of the Timor Sea; however, it is likely that partial masking of their calls would have occurred (McCauley 1998).

There are no data to support a clear link between anthropogenic sound and permanent threshold shift or mortality in fish, particularly with non-impulsive sound sources (Popper and Hawkins 2019). Continuous sound has been linked to TTS in some species of fish; however, exposure times to these sounds were at least 12 hours (Amoser and Ladich 2003, Smith et al. 2006). The sounds emitted by marine drilling operations for wind farm construction are expected to be short-term and intermittent. It is therefore unlikely that the acoustic characteristics of this source will cause prolonged acoustic masking to fish, and the risk of impact from this activity is expected to be low.

There are very few data on the effect of sound from drilling on marine invertebrates. Sole et al. (2022) reported a decreased survival rate in cephalopod (cuttlefish) larvae exposed to drilling sound levels (167 dB re 1 μPa^2). Importantly, levels below 163 dB re 1 μPa^2 did not elicit severe damage. Evidence from research on the levels of particle motion associated with behavioral responses in blue mussels indicates that the threshold of sensitivity in this species falls within vibration levels measured near blasting, pile driving, and impact drilling (Roberts et al. 2015). Studies have indicated reception of vibration in bivalves and an associated behavioral response, which included closing syphons and, in more active mollusks, moving away from the substrate (Mosher 1972, Ellers 1995, Kastelein 2008).

Vessel Traffic

Vessel traffic associated with construction would result in temporary, transient, and continuous non-impulsive noise primarily originating from the vessel propulsion system. Sound emission from vessels, especially from vessels using dynamic positioning (DP), depends on vessel operational state and is strongly weather-dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 dB re 1 µPa for numerous vessels with varying propulsion power using DP.

Vessel noise can present a chronic impact for fish species (Popper 2003), whose communication is mainly based on low-frequency sound signals (Ladich and Myrberg 2006; Myrberg and Lugli 2006). Continuous noise greater than or equal to 158 dB root-mean-square (rms) for 12 hours can lead to behavioral disturbance, while noise above 170 dB rms for 48 hours can lead to injury (Hawkins and Popper 2017; Popper et al. 2014). Vessel noise can also cause avoidance behavior that interferes with feeding and breeding, alter schooling behaviors and migration patterns, and mask important environmental auditory cues (Barber 2017; CBD 2012). Recent studies have shown that vessel noise can induce endocrine stress response (Wysocki et al. 2006); diminish hearing ability; and mask intra-specific relevant signals in exposed fish species (Amoser et al. 2004; Codarin et al. 2009; Scholik and Yan 2002; Vasconcelos et al. 2007).

Masking communication is of concern because although fishes are generally not loud (120 dB re 1 µPa [at 1 m (3.3 ft)], with the loudest on the order of 160 dB re 1 µPa), species make unique noises that allow for individual identification (Normandeau Associates 2012). In addition, vessel noise has the capacity to provoke short-term changes in the spatial position and group structure of pelagic fish in the water column (Buerkle 1973; Handegard et al. 2003; Mitson and Knudsen 2003; Olsen et al. 1983; Ona et al. 2007; Sarà et al. 2007; Schwarz and Greer 1984; Soria et al. 1996; Vabø et al. 2002).

Fish can respond to approaching vessels by diving towards the seafloor or by moving horizontally out of a vessel's path (Berthe and Lecchini 2016; Ona et al. 2007). Nedelec et al. (2016) investigated the response of reef-associated fish by exposing them in their natural environment to playback of motorboat sounds. They found that juvenile fish increased hiding and ventilation rate after a short-term boat sound playback, but responses diminished after long-term playback, indicating habituation to sound exposure over longer durations. These results were corroborated by Holmes et al. (2017) who also observed short-term behavioral changes in juvenile reef fish after exposure to boat noise as well as desensitization over longer exposure periods.

Therefore, areas of high vessel traffic may result in habituation by localized fishes. As stated in the BOEM Environmental Assessment and the Alternative Energy Programmatic Environmental Impact Statement that were prepared for the assessment and designation of wind energy areas by BOEM, regular vessel traffic occurs throughout this area, thus implying that biological resources in the area are presumably habituated to this noise (BOEM 2007; BOEM 2014).

There is a moderate risk within tens to hundreds of meters of the source that sounds emitted by trenching, vessel operations, and cables may elicit behavioral reaction in fish without a swim bladder and those with a swim bladder not involved in hearing; at larger distances the risk is low. The risk that fish with a swim bladder involved in hearing display behavioral reactions near the sources is high, at intermediate distances, and, at greater distances, the risk is low. As stated in the BOEM Environmental Assessment and the Alternative Energy Programmatic Environmental Impact Statement that were prepared for the assessment and designation of wind energy areas by BOEM, regular vessel traffic occurs throughout this area; thus, implying that biological resources in the area are presumably habituated to this noise (BOEM 2007; BOEM 2014). In addition, the BOEM DEIS for Vineyard Wind 1 determined that short- and long-term impacts from construction noise will have minor impacts on finfish and invertebrate species (BOEM 2018b).

OECC—Phases 1 and 2

The principal noise from OECC (including the Western Muskeget Variant) installation would be from tugs and other vessels used for cable installation with the same impacts as in the SWDA. Fish in the OECC would be able to hear the vessels, but sound levels will be below those that cause injury or stress (USDOE MMS 2009). Cable installation is not expected to be a significant source of impulsive noise; if a jetting technique is used, there will be the sound of water rushing from the nozzles (USDOE MMS 2009).

6.6.2.1.6 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

The SWDA is located in the MA WEA, which was identified as suitable for wind energy development after a multi-year, multi-agency public process, partially because of its relatively low amount of important fish and invertebrate habitat, therefore reducing potential for impacts. As described in Section 2.1 of COP Volume I, the OECC was also sited taking environmental factors into consideration.

To mitigate the potential impacts of injury to fish from pile driving, New England Wind will apply a soft-start procedure to the pile driving process, which delivers initial pile drives at a lower intensity, allowing fish to move out of the activity area before the full-power pile driving begins. In addition, the Proponent expects to implement noise attenuation mitigation to reduce sound levels by a target of approximately 12 dB or greater and adhere to an anticipated time of year restriction on pile driving between January 1 and April 30 to protect North Atlantic right whales (see Section 6.7.4), which may also confer protection to fish that occur within the SWDA during that timeframe. In particular, while there have been no recorded catches of Atlantic sturgeon within the SWDA, this species is known to move offshore into water depths of 20-50 m (66–164 ft) during the winter and early spring (December to March); therefore, the anticipated time of year restriction may also benefit Atlantic sturgeon in the unlikely event that any are present within the SWDA during the winter and early spring months. Considering the implementation of mitigation measures for pile driving, the anticipated impact on fish in or near the SWDA is temporary avoidance reactions. Although vessel presence in the SWDA will be intensified, avoidance behaviors are expected to be similar to those already displayed by fish when near fishing or recreational vessels. The WTGs, and ESPs, will also be widely spaced, leaving a large portion of the SWDA undisturbed by WTG, and ESP, installation.

Immobile life stages of fishes and invertebrates in or on benthic sediment (i.e. demersal eggs) and sessile benthic organisms in the direct path of construction may experience direct mortality from physical stresses, sediment suspension, and deposition. Offshore export cable installation will avoid important habitats such as eelgrass beds and hard bottom sediments where feasible. Impacts may be minimized using mid-line buoys that are designed to minimize seabed impacts from cable sweep, if feasible and safe, and installation equipment that further minimizes installation impacts on the seabed. In nearshore areas where sensitive resources are located near the potential landfall sites, horizontal directional drilling may be used to minimize disturbance of coastal habitats by drilling underneath them instead of through them.

The Proponent is committed to fisheries science and research as it relates to offshore wind energy development. Working with SMAST, the Proponent is already collecting pre-construction fisheries data (via trawl and drop camera surveys) within New England Wind. The results of ongoing fisheries studies are published on the Proponent's website at the following link: https://www.parkcitywind.com/fisheries. The Proponent plans to develop a framework for during and post-construction fisheries studies within New England Wind. In recognition of the regional nature of fisheries science, the Proponent expects that such studies during and post-construction will involve coordination with other offshore wind energy developers in the MA WEA and RI/MA WEA. The Proponent also expects the development of the fisheries studies will be undertaken in coordination with BOEM, agencies, fisheries stakeholders, academic institutions, and other stakeholders. The Proponent is already engaging in collaboration with other developers, fishing industry representatives, and state and federal agencies through its participation in the Responsible Offshore Science Alliance and a Regional Wildlife Science Entity.

6.6.2.1.7 Summary of Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Overall, impacts to finfish and invertebrate species are expected to be short-term and localized during the construction and installation of New England Wind stemming from impacts from direct construction mortality, noise, sediment suspension and deposition, and water withdrawals. The high species richness in the SWDA may enhance recovery following any construction and installation related disturbances (MacArthur 1955). The MA WEA was selected by BOEM to exclude most sensitive fishes and invertebrate habitat and the Offshore Development Area is primarily composed of uniform sandy bottom habitat, which will likely begin recovering quickly after construction is completed relative to other habitat types. Previous research indicated that dynamic, sandy physical habitat begins to recover substantially within a few months of disturbance and can fully recover by measure of abundance within two years and recover by measure of biomass and diversity in two to four years (Dernie et al. 2003; Van Dalfsen and Essink 2001). Some alteration from unconsolidated fine habitat to structured habitat in the SWDA may change species assemblages in the SWDA and attract more structure-oriented species.

Mobile species will be able to avoid construction areas and are not expected to be substantially impacted by construction and installation. Impacts to mobile pelagic fishes and invertebrate species include localized and short-term avoidance behavior. These impacts can be minimized or offset through mitigation consisting of a "soft-start" pile driving regime, sound reduction technologies, and efficient construction practices.

Direct mortality may occur to immobile benthic organisms that are in the direct path of construction processes. Mortality of drifting pelagic egg and larval life stages in the Offshore Development Area may occur from water withdrawals by construction vessels. Although eggs and larvae may be entrained and will not survive, loss of many equivalent adults and population-scale impacts are not expected because most of these species produce millions of eggs each year and already have low adult survival rates. In addition, mortality of pelagic eggs due to increased suspended sediments is expected to be limited because sediment plumes are predicted to have low-concentrations and resettlement will occur quickly (less than six hours in the water column).

Burial and mortality of some demersal eggs and sessile organisms are also expected during cable installation in the Offshore Development Area, at locations where sediment deposition is greater than 1 mm (0.04 in) (for the most sensitive demersal eggs) or 20 mm (0.8 in) (for shellfish). However, lethal deposition levels are only expected in small, localized areas adjacent to the cable routes and sediment discharge areas. Burrowing mollusks in the area, such as quahogs, will likely be able to avoid most lethal burial depths and are only expected to be slightly impacted and exhibit short-term avoidance/feeding behavior. Overall, demersal sessile (i.e. less mobile) benthic organisms will incur the brunt of construction impacts, but since the impacted area is only a small portion of the available habitat in the region, significant population-scale impacts are highly unlikely.

6.6.2.2 Operations and Maintenance

6.6.2.2.1 Habitat Alteration (Phases 1 and 2)

SWDA—Phases 1 and 2

During the operations and maintenance (O&M) period, the introduction of up to 130 WTG and ESPs, along with any scour protection at the base of each foundation, would change habitat from non-structure oriented to a structure-oriented system. The addition of foundations and scour protection, as well as cable protection in some areas, may act as an artificial reef and provide rocky habitat previously absent from the area. Increases in biodiversity and abundance of fish have been observed around WTG foundations due to attraction of fish species to new structural habitat (Raoux et al. 2017; Riefolo et al. 2016). A recent study of the effects of wind farm structures on fish populations conducted a meta-analysis of studies that have assessed the abundance of finfish within wind farms compared to close reference sites outside of wind farms. The meta-analysis explored the overall effect size across all studies and the changes in effect size for non-structure-oriented species and structure-oriented species. The overall effect size indicated a greater abundance of finfish inside of wind farms (Methratta and Dardick 2019). Locally, cobble and boulder-type habitats are particularly important to lobsters because they serve as both nursery grounds for benthic juveniles and as home substrata for adults (Linnane et al. 1999) and addition of scour protection could attract lobsters to these artificial habitats. However, within the SWDA, the total area of impact from scour protection and cable protection is estimated to be only 1.17 km^2 (289 acres) out of the total 453 km^2 (111,939 acres).

The addition of the foundation structure throughout the water column may also alter local food web dynamics and species distribution. Foundations provide substrata for shellfish to attach; colonization by these species can change nutrient and plankton concentrations, provide a new food source, and add habitat complexity previously absent from the area (Norling and Kautsky 2007; Slavik et al. 2017). For example, biofouling by blue mussels, a filter feeder, on WTG structures in wind farms located in the North Sea notably reduced the daily net primary productivity on a regional scale. However, reduction in primary production resulted in increased production and biodiversity of higher trophic levels (Slavik et al. 2017). Raoux et al. (2017) also observed that total ecosystem activity increased and that high trophic level organisms responded positively to increased biomass near monopiles after the construction of a wind farm.

Other research on habitat changes associated with wind farms has observed that new communities of rocky-habitat fishes establish near WTG foundations while communities remain unchanged in sandy areas between the WTGs (Stenberg et al. 2015). In addition, increases in commercially important species, such as Atlantic cod and whiting, were observed near deep water wind farms (Hille Ris Lambers and ter Hofstede 2009; Løkkeborg et al. 2002). There is also evidence that WTG reef habitats and the resources they provide increase the growth and condition of juvenile Atlantic cod and whiting-pout (*Trisopterus luscus*) (Reubens et al. 2013). Although reef habitat created by WTG/ESP foundations may increase biodiversity and ecosystem production, these introduced habitats could also act as a stepping-stone for the establishment and dispersal of nonindigenous species (Glasby et al. 2007).

The presence of the WTGs in the SWDA may also alter the local ocean circulation in the region, potentially changing current plankton distribution and dispersal patterns. Hydrodynamic modeling simulating larval transport around WTGs in the MA WEA found that the presence of WTG structures would not have significant influence on southward larval transport during storm events (Chen et al. 2016).

OECC—Phases 1 and 2

While New England Wind's goal is to minimize the use of cable protection to the greatest extent possible through careful route assessment and selection of the most appropriate cable burial tool for each segment of the cable route, some cable protection may be required along the OECC in areas where target burial depths cannot be achieved. The addition of cable protection would locally alter any soft bottom habitat to hard bottom habitat. In most areas, cable protection would be placed on bottom habitat already classified as hard bottom substrate. The maximum amount of permanent bottom habitat altered by cable protection would be approximately 0.22 km^2 (54 acres) within the OECC for both Phases. If the Western Muskeget Variant is used for one or two Phase 2 export cables, the amount of permanent habitat alteration for both Phases combined from the potential installation of cable protection (if required) would be approximately 0.23-0.24 km^2 (57-60 acres). As noted above for the SWDA, the addition of hard bottom structure in these previously flat, soft sediment areas may attract different species and act as artificial reef habitat.

6.6.2.2.2 Increased Sound Exposure (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

O&M of New England Wind would introduce underwater noise from vessels or WTGs. The acoustic characteristics of vessel sounds associated with O&M are the same as those produced during construction. It is reasonable to assume that the amount of sound produced during O&M is similar to, or less than, those generated during construction due to a lower number and smaller size of vessels. Possible sound sources other than vessel operations include the WTGs themselves, which generate sound in the nacelle that is transmitted from the topside to the foundation and then radiated into the water, and subsea cable vibration.

Operational Sounds

Operation of WTGs would result in variable, mostly continuous (i.e., during power generation) non-impulsive noise. Underwater noise level is related to WTG power and wind speed, with increased wind speeds creating increased underwater sound (Wahlberg and Westerberg 2005). Operational noise from WTGs is low frequency (60–300 Hz) and at relatively low sound pressure levels near the foundation (100–151 dB re 1 µPa) and decreases to ambient within 1 km (Tougaard et al. 2009, Lindeboom et al. 2011, Dow Piniak et al. 2012; HDR 2019).

At high wind speeds, Wahlberg and Westerberg (2005) estimated permanent avoidance by fish would only occur within a range of 4 m (13 ft) of a WTG. In a study on fish near the Svante wind farm in Sweden, Atlantic cod and roach (*Rutilus rutilus*) catch rates were significantly higher near WTGs when rotors were stopped, which could indicate fish attraction to WTG structures and avoidance to generated noise (Westerberg 2000 *as cited in* Thomsen et al. 2006). Alternatively, no avoidance behavior was detected, and fish densities increased around WTG foundations of the Lillgrund offshore wind farm in Sweden (Bergström et al. 2013). In addition, ambient noise can influence how fish detect other sounds and a change in background noise could alter how fish perceive and react to biological noise stimuli (Popper and Fay 1993). Ambient noise within the 70.8–224 Hz frequency band in the MA WEA and RI/MA WEA was measured to be between 96 dB and 103 dB 50% of the time with greater sound levels 10% of the time (Kraus et al. 2016). Underwater sound radiated from operating WTGs is low-frequency and low level (Nedwell and Edwards 2004). At distances of 14 to 20 m (46 to 66 ft) from operational WTGs in Europe, underwater sound pressure levels ranged from 109 dB to 127 dB re 1µPa (Tougaard et al. 2009). Pangerc et al. (2016) recorded sound levels at ~50 m (164 ft) from two individual 3.6 megawatt (MW) WTGs monopile foundations over a 21-day operating period. Miller and Potty (2017) measured an SPL of 100 dB re 1 µPa within 50 m (164 ft) of five General Electric Haliade 150–6 MW wind turbines with a peak signal frequency of 72 Hz. At the Block Island Wind Farm off of Rhode Island, sound levels were found to be 112–120 dB re 1 µPa near the WTG when wind speeds were 2–12 m/s and the WTG sound levels declined to ambient within 1 km from the WTG (Elliott et al. 2019). Tougaard et al. (2009) found that sound level from three different WTG types in European waters was only measurable above ambient sound levels at frequencies below 500 Hz, and Thomsen et al. (2016) suggest that at approximately 500 m from operating WTGs, sound levels are expected to approach ambient levels.

Two recent meta-papers (Tougaard et al. 2020, Stöber and Thomsen 2021) assessed WTG operational sounds by extracting sound levels measured at various distances from operating WTGs from currently available reports. Both studies found sounds to generally be higher for higher powered WTGs, and thus distances to a given sound threshold are likely to be greater for higher powered WTGs. However, as Stöber and Thomsen (2021) point out, direct drive technology could reduce these distances substantially. Importantly, no measurements exist for these larger turbine sizes and few measurements have been made for direct drive turbines so the uncertainty in these estimates is large.

Overall, current literature indicates noise generated from the operation of wind farms is minor and does not cause injury or lead to permanent avoidance at distances greater than 1 km (0.6 mi) (Stenberg et al. 2015; Wahlberg and Westerberg 2005), with potential to have minimal effects at much closer distances up to within a few meters of the WTG (Bergström et al. 2013) such as masking auditory sensitivity and communication of fishes within a few tens of meters of WTGs (Zhang et al. 2021).

Subsea Cables

Previous impact assessment studies for various cable projects have concluded that sound related to subsea cable installation or cable operation is not a significant issue (Austin et al. 2005; Nedwell et al. 2003). This was based on the prediction that anticipated sound levels would not exceed existing ambient sound levels in the area, although background sound level measurements were often not presented (Meißner et al. 2006). Subsea cables are expected to produce low-frequency tonal vibration sound in the water, since Coulomb forces between the conductors cause the high voltage alternating current (HVAC) lines to vibrate at twice the frequency of the current (direct current cables do not produce a similar tonal sound because the current is not alternating). Anticipated SPLs arising from the vibration of alternating current cables during operation are significantly lower than SPLs that may occur during cable installation (Meißner et al. 2006) and may be undetectable in the ambient soundscape of the Offshore Development Area, especially after consideration of the 1.5–2.5 m (5–8 ft) target burial depth.

6.6.2.2.3 Electromagnetic Fields (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

EMFs consist of two components: electric fields and magnetic fields. A white paper review study funded by BOEM determined that electromagnetic fields (EMFs) produced by power transmission cables would result in negligible, if any, effects on bottom-dwelling commercial and recreational fish species and no negative effects on pelagic commercial and recreational fish species in the southern New England (Snyder et al. 2019).

Of species potentially present in the SWDA and OECC, electrosensitivity has been documented in elasmobranchs (sharks, skates, and rays) and some teleost fish species (ray-finned fishes). In general, elasmobranch species are present seasonally in the Offshore Development Area with varying annual abundances (NEODP 2021). The most commonly caught elasmobranchs in the Offshore Development Area include little skate and winter skate (NEODP 2021). EMFs would be generated by inter-array cables connecting WTGs in the SWDA, inter-link cables between the ESPs, and offshore export cables along the OECC. Fish use electromagnetic sense for orientation and prey detection and therefore, the function of key ecological mechanisms may be impacted by EMFs generated by the cables (Riefolo et al. 2016). Because EMFs produced by cables decrease with distance, and the target burial depth for the cables is 1.5–2.5 m (5–8 ft), the EMFs at the seabed would be expected to be weak and likely only detectable by demersal species (Normandeau et al. 2011). A BOEM-funded study funded found that although there were changes in the behavior of little skate, an elasmobranch, and American lobster in the presence of energized cables, EMFs from cables did not act as a barrier to movement in any way (Hutchison et al. 2018, 2020). In addition, research investigating habitat use around energized cables found no evidence that fishes or invertebrates were attracted to or repelled by EMFs emitted by cables (Love et al. 2017). To date, there is no evidence linking anthropogenic EMFs from WTG cables to negative responses in fish (Baruah 2016; Normandeau et al. 2011) but some evidence of attraction in a species of cancer crab when EMF strength was hundreds of times greater than expected by modeling for New England Wind (Scott et al. 2021; Gradient 2020; Gradient 2021a; 2021b). Furthermore, there are already subsea transmission cables present in the region (outside of the Offshore Development Area) with three between Martha's Vineyard and Falmouth and two more between Nantucket and Cape Cod (see Section 7.9).

Modeling of the New England Wind specific cables was conducted to assess potential effects of EMFs. As submarine offshore export cables will not produce any electric fields in the seafloor or ocean due to the shielding effect of the cable covering, modeling of potential effects from New England Wind cables was focused on magnetic fields (MFs). HVAC cables (which will be used for Phase 1 and Phase 2) were modeled. All modeling assumed cables were buried beneath 1.5 m (5 ft) of sediments. In areas where sufficient burial is not achieved and cable protection is used, the protection will serve as a physical barrier in the same manner as cable burial, preventing organisms from experiencing the full strength of the magnetic field.

Modeling of the 220 kV and 275 kV HVAC cables demonstrated that MFs at the seafloor from the buried cables decrease with distance, with a maximum MF of 84.3 mG directly above the centerline that decreases to 5.6 mG at 6 m (20 ft) from the centerline (Gradient 2020, Gradient 2021a).

These model results indicate that MFs are likely only able to be sensed, if at all, directly over the buried cable centerline. Consistent with the modeled MF levels and the findings on 60-Hz AC EMFs (Snyder et al. 2019), and because cables in the Offshore Development Area will have a minimum target burial depth of approximately 1.5 m (5 ft), it is unlikely that demersal or benthic organisms will be affected by MFs from the offshore cable system. The BOEM DEIS for Vineyard Wind 1 also determined that impacts from operational EMFs will have minor impacts on finfish and invertebrate species (BOEM 2018b).

6.6.2.2.4 Cable Maintenance (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Cable maintenance and/or repair may infrequently occur along limited segments of the offshore cables. Procedures employed to repair segments of cable in the SWDA and OECC may involve bringing the cable to the surface for repair, followed by re-installation of the cable. Impacts to fish species would be similar to those explained above for cable installation and are expected to include displacement of mobile juvenile and adult fish, injury to immobile or slower life stages or species, and temporary disturbance of benthic and pelagic habitat from suspended sediments and sediment deposition. Such impacts would be confined to the specific area of the repair(s) and, given the limited area(s) where repair(s) may occur, would be considerably less than the impacts during construction.

6.6.2.2.5 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

The mitigation measures and impacts would be broadly the same as discussed previously for construction and installation with the exception of pile driving mitigation measures because they are not expected during O&M of New England Wind.

6.6.2.2.6 Summary of Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Impacts that may occur during O&M of New England Wind include alteration of habitat, increased noise, EMFs, and maintenance activities. Limited habitat will likely be altered from unconsolidated fine substrate to structured habitat in the SWDA and may cause changes in fish assemblages in the area. Cable protection may also be used along the OECC and create hard-bottom habitat. Increased noise from the operation of the WTGs will increase background noise and, as previous research indicates, may elicit avoidance responses in some species. Required maintenance of the WTGs, ESPs, and cables may impact organisms in a similar manner as construction and installation.

In summary, impacts to finfish and invertebrates during O&M of New England Wind are expected to be localized and population-scale impacts are unlikely. Little to no direct mortality would occur, other than potentially during cable repair, which is expected to be rare and localized. The addition of hard structure habitat will add complexity to the area that did not exist before and will likely attract species that prefer structured habitat. Overall, current literature indicates noise generated from the operation of wind farms is minimal and only localized avoidance behaviors are expected; acclimation to the noise over time may occur.

The addition of EMFs from submarine cables will likely not have an impact on elasmobranchs or other electro-sensitive fish species because cables will be buried in the substrate or covered with cable protection.

6.6.2.3 Decommissioning

6.6.2.3.1 Overall Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

Decommissioning activities would include removal of WTG/ESP foundations below the mudline. Scour protection would also be removed. The offshore export cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies on the preferred approach to minimize environmental impacts. The decommissioning activities would be similar to those associated with construction (see Sections 3.3.3 and 4.3.3 of COP Volume I). Removal of the scour protection from the SWDA may result in a shift in the local finfish and invertebrate species assemblages to pre-construction, non-structure-oriented communities.

There may be effects from sound created during decommissioning. Globally, offshore wind projects are relatively new, so decommissioning is not yet a common activity. The first offshore wind energy project to be decommissioned occurred in 2016 in Sweden (Topham and McMillan 2017). The requirements of a decommissioning scheme are unique to each site and therefore the type, level, and duration of sounds emitted during decommissioning will depend on type, size, and location of the foundation. All programs for decommissioning offshore structures will include vessel operations involving normal transit and DP positioning under certain current and weather conditions. The most common approach for removal of structures embedded in the sediment involves cutting of the pile foundation. The cutting methods proposed are usually either diamond wire cutting or water jetting (with a remotely operated high-pressure water/grit tool) (Topham and McMillan 2017), a process leading to the emission of continuous broadband sound. Alternatively, impact pile driving can be used in a reverse process to remove the pile from the ground. All removed elements must be lifted and transported to shore by vessel. Until specific decommissioning approaches are agreed upon, it is reasonable to assume that sounds associated with decommissioning may be similar to or less than those produced during construction and operations.

6.6.2.3.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

The mitigation measures would be the same as discussed previously for construction and installation.

6.6.2.3.3 Summary of Impacts (Phases 1 and 2)

SWDA and OECC—Phases 1 and 2

In summary, impacts from decommissioning will be very similar to impacts from construction and are expected to be localized and short-term. Due to the long lifespan of New England Wind, it is also expected that technology will be enhanced by the time decommissioning occurs allowing for impacts to be reduced.

6.7 Marine Mammals

This section describes marine mammals that may be present within the Offshore Development Region. The Offshore Development Region is the broader offshore geographic region that could be affected by New England Wind-related activities, which includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), and the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA). Given the regional nature of marine mammal species distribution, species that are present within the Offshore Development Region are also considered likely to be present within the Offshore Development Area, which is the area where New England Wind's offshore facilities will be physically located. The Offshore Development Area includes the entirety of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (together referred to as the Southern Wind Development Area [SWDA]), as well as the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]).

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving fallback option to install one or two Phase 2 cables[76] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[77] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel. Marine mammal species that occur within the United States (US) Atlantic Exclusive Economic Zone (EEZ) are discussed generally with an evaluation of their likely occurrence in and near the SWDA, while species more likely to be present in the vicinity of New England Wind project activities are described in detail. Potential impacts are assessed for the maximum Project envelope of New England Wind assuming a full build-out of Phase 1 Phase 1, which includes Park City Wind, and Phase 2, which includes Commonwealth

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[76] It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

[77] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

Wind over multiple years, including up to 130 wind turbine generator (WTG)/electrical service platform (ESP) grid positions. Two of these grid positions may potentially have co-located ESPs (i.e. two monopile foundations installed at one grid position),[78] resulting in 132 foundations.

A discussion of the affected environment for marine mammals is followed by an evaluation of potential impact producing factors (IPFs) and a summary of monitoring and mitigation measures that the Proponent plans to implement to avoid, minimize, and mitigate potential impacts to these resources. An underwater acoustic modeling analysis was completed for New England Wind, the results of which are summarized in Section 6.7.2.2. The more detailed acoustic modeling analysis is provided in Appendix III-M.

6.7.1 Description of the Affected Environment

6.7.1.1 Marine Mammals that may Occur in the SWDA and OECC

All marine mammal species are protected under the Marine Mammal Protection Act (MMPA). Some marine mammal stocks may be designated as "strategic" under the MMPA (2015), which requires the jurisdictional agency to impose additional protection measures. A stock is considered strategic if:

- Direct human-caused mortality exceeds its Potential Biological Removal (PBR) level, which is defined as the maximum number of animals, not including natural mortality, that can be removed from the stock while allowing the stock to reach or maintain its optimum sustainable population level (the product of minimum population size, one-half the maximum productivity rate, and a recovery factor) (MMPA Section 3 of 16 U.S.C. § 1362; Wade and Angliss 1997). The recovery factor for Endangered Species Act (ESA) listed species is 0.1 and 0.5 for all other species;

- It is listed under the ESA;

- It is declining and likely to be listed under the ESA; or

- It is designated as "depleted" under the MMPA.

A depleted species or population stock is defined by the MMPA (Section 3 of 16 U.S.C. § 1362; Wade and Angliss 1997) as any case in which:

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[78] If co-located ESPs are used, each ESP's monopile foundation would be located within 76 m (250 ft) of one of the potential ESP grid locations (i.e. the monopiles would be separated by up to 152 m [500 ft]).

- The Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under MMPA Title II, determines that a species or population stock is below its optimum sustainable population;

- A State, to which authority for the conservation and management of a species or population stock is transferred under Section 109 of the MMPA, determines that such species or stock is below its optimum sustainable population; or

- A species or population stock is listed as an Endangered or Threatened species under the ESA.

Some species are further protected under the ESA (2002). Under the ESA, a species is considered Endangered if it is "in danger of extinction throughout all or a significant portion of its range." A species is considered Threatened if it "is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range" (ESA 2002). There are 17 marine mammal species that are Endangered, strategic, and/or can be reasonably expected to reside, traverse, or visit the SWDA, and thus may experience some level of exposure to sound from New England Wind construction and installation activities. The NARW, fin whale, sei whale, and sperm whale are all considered Endangered under the ESA. These four species are also considered strategic under the MMPA.

Because of their protected status and their relative sensitivity to underwater sound, marine mammals are a major focus of the environmental and acoustic impact assessment. Descriptions of marine mammals, their distribution and abundance, and Endangered species density maps are based on a review of existing published literature and, gray literature, as well as public reports (e.g. press releases), where relevant, to describe recent events not yet published. Examples of primary data sources referenced in this assessment include the following:

- **Marine Mammal Stock Assessment Reports:** National Marine Fisheries Service (NMFS) releases Stock Assessment Reports (SARs) for marine mammals that occur within the US Atlantic EEZ as required under the 1994 amendments to the MMPA. All stocks are reviewed at least every three years or as new information becomes available. Stocks that are designated as strategic are reviewed annually. Each report contains a description of a stock's geographic range, a minimum population estimate, current population trends, current and maximum net productivity rates, an estimate of the potential biological removal (i.e. maximum number of animals that may be removed from a marine mammal stock without reducing numbers below the optimum sustainable population) for each species, the status of the stock, estimates of annual human-caused mortality and serious injury by source and descriptions of other factors that may be causing a decline or impeding the recovery of strategic stocks (NOAA Fisheries 2019b).

- **The Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles:** Multiple surveys were conducted for the Massachusetts Clean Energy Center and Bureau of Ocean Energy Management (BOEM) by the Large Pelagic Survey Collaborative (comprised of the New England Aquarium, Cornell University's Bioacoustics Research Program, the University of Rhode Island and the Center for Coastal Studies) (Kraus et al. 2016). This study was designed to provide a comprehensive baseline characterization of the abundance, distribution, and temporal occurrence of marine mammals, with a focus on large, Endangered whales, and sea turtles, in the MA WEA and the RI/MA WEA and surrounding waters. Information was collected using visual line-transect aerial surveys and passive acoustic monitoring (PAM) from October 2011 to June 2015 and from December 2012 to June 2015 in in the RI/MA WEA. Seventy-six aerial surveys were conducted, and Marine Autonomous Recording Units were deployed for 1,010 calendar days, during the study period. Survey methodologies and details are described in Kraus et al. (2016).

- **Megafauna Aerial Surveys in the Wind Energy Areas of Massachusetts and Rhode Island with Emphasis on Large Whales:** Summary Report Campaign 5, 2018 – 2019: NEAq and Woods Hole Oceanographic Institution (WHOI), in coordination with the Provincetown Center for Coastal Studies, conducted oceanographic surveys to assess the physical and biological characteristics of waters used by right whales in this study area. These reports include the sightings and data information, plus analyses of effort corrected data, and includes maps of sightings per unit effort (SPUE), sighting rates, and calculations of density and abundance. This report also includes analysis of right whale prey species and oceanographic conditions near right whale aggregations during Campaigns 4 and 5 (O'Brien et al. 2020a).

- **Megafauna Aerial Surveys in the Wind Energy Areas of Massachusetts and Rhode Island with Emphasis on Large Whales: Interim Report Campaign 6A, 2020:** This report summarizes results from a subset of the ongoing Campaign 6 surveys, funded by BOEM. Campaign 6A surveys were conducted in the MA and RI/MA WEAs between March and October 2020 (with an interruption to allow for development of safety protocols related to COVID-19). Specifically, this report contains summaries of survey effort, summaries of sightings (e.g. sightings maps), and analyses of effort-corrected data, including sighting rates and calculations of density and abundance (O'Brien et al. 2020b).

- **Atlantic Marine Assessment Program for Protected Species (AMAPPS):** The AMAPPS Phase I surveys were conducted from 2010–2014 (NEFSC and SEFSC 2011a; 2011b; 2012; 2014a; 2014b), and Phase II surveys from 2015–2019 (NEFSC and SEFSC 2015; 2016; 2018; 2019; 2020). Phase III will acquire data through 2024. AMAPPS surveys include aerial and shipboard observations, biological and oceanographic sampling, satellite-telemetry, and

PAM conducted in all four seasons of the year. AMAPPS reports provide updated information on the abundance and distribution of marine mammals, sea turtles and sea birds and assess recent changes in seasonal habitat use by these species. These data can be used to quantify changing species' abundance and distributions and assess the potential impact of human activities on protected species. The abundance estimates usedby NMFS for many of the marine mammal species within the US Atlantic EEZ are based on the AMAPPS surveys (Hayes et al. 2019; Palka et al. 2017). At least one survey was conducted in the MA WEA and the RI/MA WEA in each survey year.

- **Duke University Habitat-based Cetacean Density Models for the US Atlantic:** The Duke University Habitat-Based Cetacean Density Models were originally published in 2016 for 26 cetacean species and three cetacean species guilds for US waters of the North Atlantic and northern Gulf of Mexico (Roberts et al. 2016a). Under an ongoing research agreement with the US Navy, the models were subsequently updated for the Atlantic (the East Coast [EC] models) using the same methods but incorporating additional data, including the National Oceanic and Atmospheric Administration Fisheries' (informally known as NOAA Fisheries) AMAPPS surveys, North Atlantic right whale Early Warning System (EWS) surveys, and other data (Roberts et al. 2016b). Later revisions to the EC models under this research agreement included updates to 11 cetacean taxa in 2017 and an additional 10 cetacean taxa in 2018 (Roberts et al. 2017; 2018). The 2018 update also included the addition of seals as a guild (Roberts et al. 2018). On June 20, 2022, the Duke Marine Geospatial Ecology Lab released a comprehensive new set of marine mammal density models for the U.S. east coast (Roberts et al. 2022), available at https://seamap.env.duke.edu/models/Duke/EC/. The new models result in updated density estimates for all taxa discussed in this assessment, and is a complete replacement for the Roberts et al. (2016a) models and subsequent updates.

Thirty-nine marine mammal species (whales, dolphins, porpoise, seals, and manatees) comprising 39 stocks-have been documented as present (some year-round, some seasonally, and some as occasional visitors) in the Northwest Atlantic Outer Continental Shelf (OCS) region (CeTAP 1982; USFWS 2014; Hayes et al. 2020; Hayes et al. 2022; Roberts et al. 2016a). All 39 marine mammal species identified in Appendix III-M are protected by the MMPA and some are also listed under the ESA. The five ESA-listed marine mammal species known to be present year-round, seasonally, or occasionally in southern New England waters are the sperm whale (*Physeter macrocephalus*), North Atlantic right whale (*Eubalaena glacialis*) (NARW), fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), and sei whale (*Balaenoptera borealis*). The humpback whale (*Megaptera novaeangliae*), which may occur year-round, is no longer listed as an Endangered species.

Palka et al. (2017) modeled temporal trends for several species and predicted that the abundance estimates for the period April to June were larger than that predicted for the period August to September. This pattern was observed for humpback whales, sei whales, minke whales (*Balaenoptera acutorostrata*), sperm whales, Atlantic white-sided dolphins (*Lagenorhynchus acutus*), and common dolphins (*Delphinus delphis*). In contrast, within the AMAPPS study area, some species appeared to have fairly consistent abundance estimates in all seasons (fin whales, long-finned and short-finned pilot whales [*Globicephala melaena and Globicephala macrorhynchus*], and Atlantic spotted dolphins [*Stenella frontalis*]), while others have higher abundance in US waters in late summer (Risso's dolphins [*Grampus griseus*] and harbor porpoises [*Phocoena phocoena*]).

The AMAPPS results (Palka et al. 2017) indicate that pygmy/dwarf sperm whales (*Kogia breviceps*/*Kogia sima*), beaked whales (Ziphiidae), and striped dolphins (*Stenella coeruleoalba*) are nearly always found in deep offshore waters, at least during summer. Of the species that were detected year-round, various distribution/abundance patterns were observed. For example, seasonal migrations were documented for species like sei whales that spent spring in US Atlantic waters then nearly completely disappeared in other seasons.

Southern New England waters are important feeding habitats for several species of baleen whales, including NARW, humpback, fin, and minke whales (Hayes et al. 2019) with seasonal abundance differences in New England waters (including the SWDA). These species undertake yearly migrations between their winter breeding grounds in southern latitudes and spring/summer feeding grounds in the US Atlantic. Sei whales have been sighted in summer in continental shelf waters of the Northeastern US and seem to be distributed closer to the 2,000 meter (m) (approximately 6,562 foot [ft]) depth contour than fin whales (Waring et al. 2016). Minke whales have a strong seasonal component to their distribution on both the continental shelf (spring to fall) and in deeper, off-shelf waters (fall to spring) (Hayes et al. 2019). Humpback whales can be found in New England waters throughout the year, but their numbers decrease in winter when most animals migrate to their more southerly calving and breeding grounds. Sperm whales have been observed during scientific surveys conducted in summer over the continental shelf edge, over the continental slope, and into mid-ocean regions and have occasionally been sighted in shelf waters in or near the SWDA (Halpin et al. 2009, Waring et al, 2015). Sperm whales may occur in the Offshore Development Area, though movements will vary based on prey availability and other habitat factors.

The four species of phocids (true seals) that have ranges overlapping the SWDA, are harbor seals (*Phoca vitulina*), gray seals (*Halichoerus grypus*), harp seals (*Pagophilus groenlandicus*), and hooded seals (*Cystophora cristata*) (Hayes et al. 2019). One species of sirenian, the Florida manatee (*Trichechus manatus latirostris*), is an occasional visitor to the region during summer (USFWS 2019). The manatee is listed as Threatened under the ESA and is protected under the MMPA. It is the only marine mammal in the Atlantic under the regulatory jurisdiction of the US Fish and Wildlife Service.

The expected occurrence of each species in the SWDA is described in the Sections 6.7.1.2, 6.7.1.3, and 6.7.1.4. Many of these marine mammal species do not commonly occur in this region of the Atlantic Ocean. Species categories include:

- Common: Occurring consistently in moderate to large numbers.
- Uncommon: Occurring in low numbers or on an irregular basis.
- Rare: There are limited species records for some years; range includes the SWDA but due to habitat preferences and distribution information, species are not expected to occur in the SWDA. Records may exist for adjacent waters.

The protection status, stock identification, occurrence, and abundance estimates of the species categorized as common, regular, and uncommon are listed in Appendix III-M. Species listed as rare are not considered further in this assessment. Abundance estimates, which are used to calculate the PBR for each species are based on the most recent information available, including the yearly updated SAR reports (Hayes et al. 2022). Density estimates are also used in this report to calculate the number of animals potentially exposed to threshold levels of sound (Roberts et al. 2022).

The likelihood of acoustic exposure for each species based on its presence, density, and overlap of proposed activities is described in Section 6.7.2.2. The most recent abundance estimates can be found in Appendix III-M.

The following subsections provide additional information on the biology, habitat use, abundance, distribution, and existing threats to the non-ESA-listed and ESA-listed marine mammal species that are either common, regular, or uncommon in southern New England waters (i.e. have the likelihood of occurring at least seasonally), and therefore in the Offshore Development Area. These species include the NARW, humpback whale, fin whale, sei whale, minke whale, bottlenose dolphin, short and long-finned pilot whales, Risso's dolphin, short-beaked common dolphin, sperm whales, Atlantic white-sided dolphin, Atlantic spotted dolphin, harbor porpoise, gray seal, harbor seal, and harp seal (BOEM 2014). Beaked whales are likely to occur in regions farther offshore along the continental shelf-edge but not within 74 km (40 nautical miles [NM]) of shore (Hayes et al. 2020). While the potential for interactions with pilot whales, Atlantic white-sided dolphins, Atlantic spotted dolphins, Risso's dolphins, and harp seals is low, small numbers of these species may transit the Offshore Development Area and are therefore included in this analysis. In general, the remaining non-ESA mammal species range outside the Offshore Development Area, usually in deeper water, or are so rarely sighted that their presence is unlikely, and therefore they are not described in detail in this Construction and Operations Plan (COP).

6.7.1.2 Mysticetes

6.7.1.2.1 Fin Whales

Fin whales are the second largest species of baleen whale that occur in the northern hemisphere, with a maximum length of about 22.8 m (75 ft) (NOAA Fisheries 2021e). These whales have a sleek, streamlined body with a V-shaped head that makes them fast swimmers. Fin whales have a distinctive coloration pattern: the dorsal and lateral sides of their bodies are black or dark brownish-gray while the ventral surface is white. The lower jaw is dark on the left side and white on the right side. Fin whales feed on krill (*Euphausiacea*), small schooling fish (e.g. herring [*Clupea harengus*], capelin [*Mallotus villosus*], sand lance [*Ammodytidae* spp.], and squid (*Teuthida* spp.)] by lunging into schools of prey with their mouths open (Kenney and Vigness-Raposa 2010). Fin whales are the dominant large cetacean species during all seasons from Cape Hatteras to Nova Scotia, having the largest standing stock, the largest food requirements, and therefore, the largest influence on ecosystem processes of any baleen whale species (Hain et al. 1992; Kenney et al. 1997).

Fin whales are low-frequency cetaceans producing short duration down sweep calls between 15 and 30 hertz (Hz), typically termed “20-Hz pulses,” as well as other signals up to 1 kilohertz (kHz) (Southall et al. 2019). The source level (SL) of fin whale vocalizations can reach 186 decibels (dB) re 1 µPa, making them one of the most powerful biological sounds in the ocean (Charif et al. 2002).

Distribution

Fin whales found offshore US Atlantic, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission (IWC) management scheme (Donovan 1991), which has been named the Western North Atlantic stock. The current understanding of stock boundaries, however, remains uncertain (Hayes et al. 2022).

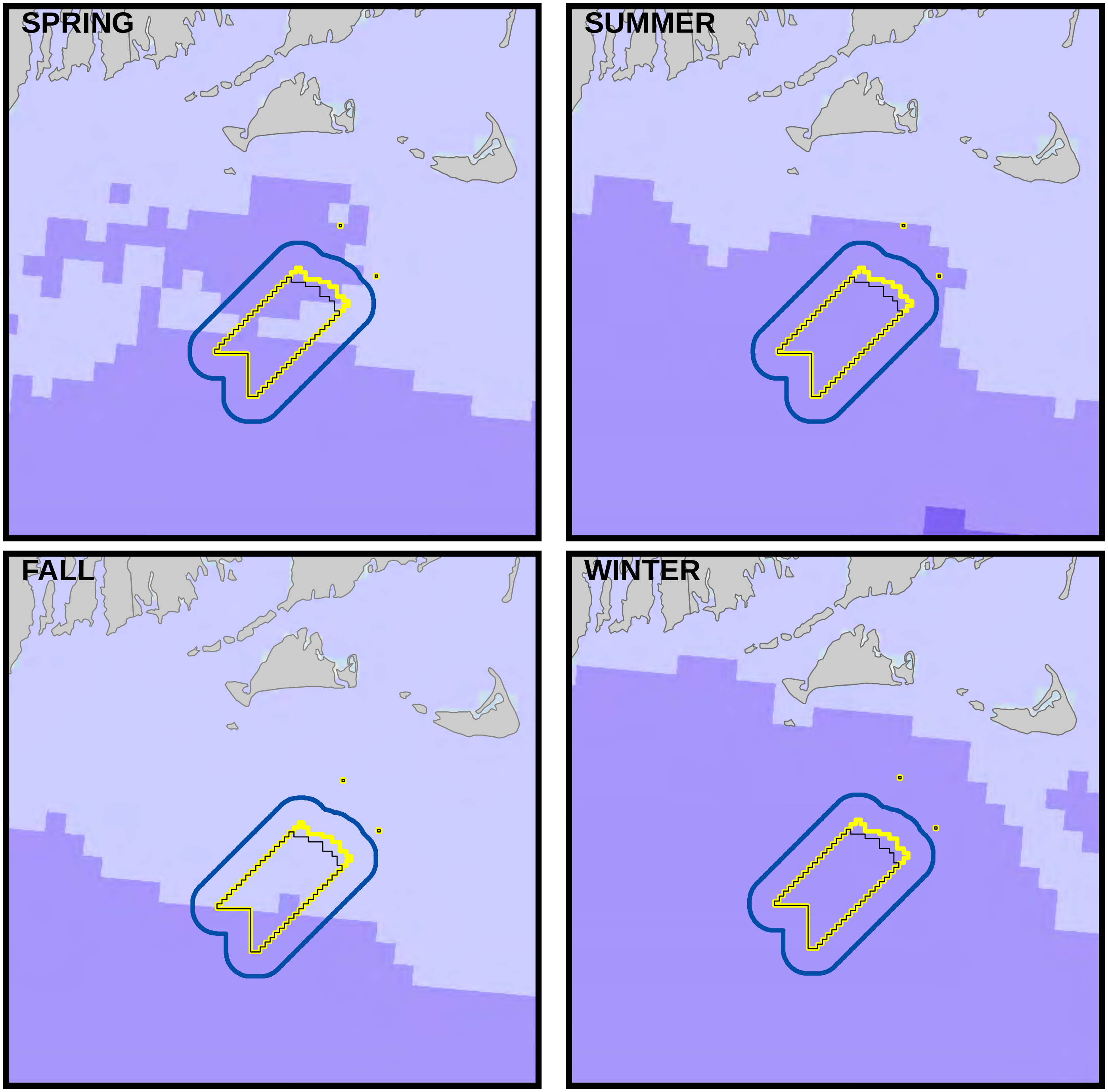
Fin whales are common in waters of the US Atlantic EEZ, principally from Cape Hatteras northward. There is evidence that fin whales are present year-round throughout much of the US EEZ north of 35° N, but the density of individuals in any one area changes seasonally (NOAA Fisheries 2021e). Fin whales are the most commonly observed large whales in continental shelf waters from the mid-Atlantic coast of the US to Nova Scotia (CeTAP 1982; Hain et al. 1992; Sergeant 1977; Sutcliffe and Brodie 1977). The range of fin whales in the Western North Atlantic extends from the Gulf of Mexico and Caribbean Sea to the southeastern coast of Newfoundland. While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, their mating and calving (and general wintering) areas are largely unknown (Hain et al. 1992; Hayes et al. 2019). Acoustic detections of fin whale singers augment and confirm these visual sighting conclusions for males. Recordings from the Atlantic Continental Shelf and deep-ocean areas have detected some level of fin whale singing year-round (Clark and Gagnon 2002; Morano et al. 2012; Watkins et al. 1987; Davis et al. 2020). These acoustic observations from both coastal and deep-ocean regions support the conclusion that male fin whales are broadly distributed throughout the Western North Atlantic for most of the year (Hayes et al. 2022). It is likely that fin whales occurring within the US Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions; however, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support (Hayes et al. 2019). Based on an analysis of neonate stranding data, Hain et al. (1992) suggest that calving occurs during October to January in latitudes of the US mid-Atlantic region.

Kraus et al. (2016) suggest that, compared to other baleen whale species, fin whales have a high multi-seasonal relative abundance in the MA and RI/MA WEAs, and surrounding areas. Fin whales were observed in the MA WEA in spring and summer. This species was observed primarily in the offshore (southern) regions of the MA and RI/MA WEAs during spring and was found closer to shore (northern areas) during summer (Kraus et al. 2016). Calves were observed three times and feeding was observed nine times during the Kraus et al. (2016) study. Although fin whales were largely absent from visual surveys in the MA and RI/MA WEAs in fall and winter (Kraus et al. 2016), acoustic data indicated that this species was present in the MA and RI/MA WEAs during all months of the year. Low-frequency vocalizing fin whales were acoustically detected in the MA WEA on 87% of survey days (889 of 1,020 days). Acoustic detection data indicated a lack of seasonal trends in fin whale abundance with slightly fewer detections from April to July (Kraus et al. 2016). As the detection range for fin whale vocalizations is more than 200 km (108 NM), detected signals may have originated from areas far outside of the MA and RI/MA WEAs; however, arrival patterns of many fin whale vocalizations indicated that received signals likely originated from within the Kraus et al. (2016) study area.

Recent continuations of the surveys in MA and RI/MA WEAs were conducted between October 2018 and August 2019 (O'Brien et al. 2020a). There were 32 sightings of 53 individual fin whales during the survey period, including both on- and off-effort data. Group sizes ranged from one to four whales. There were seasonal changes in distribution, with most fin whales sighted in May and June and no sightings in January-February, July-August, or October (O'Brien et al. 2020a). Consequently, relative abundance was highest in spring and summer, when whales clustered in the southern and eastern parts of the MA and RI/MA WEAs and was lowest in fall and winter. A continuation of these surveys occurred between March and October 2020 (O'Brien et al. 2020b). There were 11 fin whale sightings of 17 individuals during this time, with an average group size of 1.55 whales (range of one to six). Contrary to the previous surveys, fin whales were only detected in summer months, with only one whale (of 17) not detected in June (O'Brien et al. 2020b). A map of fin whale maximum seasonal density is presented in Figure 6.7-1.

Abundance

The best available abundance estimate for the Western North Atlantic fin whale stock in US waters from NMFS stock assessments is 6,802 individuals (Hayes et al. 2022). Current and maximum net productivity rates and population trends are unknown for this stock due to relatively imprecise abundance estimates and variable survey design.



LEGEND

- Lease Area OCS-A 0534
- Southern Wind Development Area
- 6.2km Buffer

Fin whale density, animals/100km²

- 0.000 - 0.242
- 0.242 - 0.760
- 0.760 - 1.382
- 1.382 - 2.212
- 2.212 - 4.407

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Scale 1:1,500,000
1 inch = 24 miles

0 30 60 Miles

0 48 96 Kilometers

New England Wind

AVANGRID RENEWABLES

Figure 6.7-1

Map of Fin Whale Maximum Seasonal Density from Roberts et al. (2016a, 2022)

Status

The status of this stock relative to its Optimum Sustainable Population (OSP) in the US Atlantic EEZ is unknown, but the North Atlantic population is listed as Endangered under the ESA and Massachusetts Endangered Species Act (MA ESA), and NMFS considers this a strategic stock under the MMPA. There are currently no critical habitat areas established for the fin whale under the ESA. The minimum population size for the Western North Atlantic fin whale stock (N_{min}) is 5,573. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.10 because the fin whale is listed as Endangered under the ESA. PBR for the Western North Atlantic fin whale stock is 11. Because uncertainties exist in stock definition and because the current N_{min} used to calculate PBR is not derived from the full range of the stock as currently defined and is derived from a negatively biased abundance estimate (i.e. not corrected for availability bias), considerable uncertainties exist in this calculated PBR (Hayes et al. 2022).

From 2015 to 2019, the minimum human-caused mortality rate was approximately two whales per year, caused by incidental fishery interactions and vessel collisions; however, this estimate is biased low due to haphazard detections of carcasses (Hayes et al. 2022). No critical habitat areas have been established for the fin whale under the ESA. Lease Area OCS-A 0534 is flanked by two Biologically Important Areas (BIAs) for feeding fin whales—the area to the northeast is considered a BIA year-round, while the area off the tip of Long Island to the southwest is a BIA from March to October (LaBrecque et al. 2015).

6.7.1.2.2 Humpback Whales

Humpback whale females are slightly larger than males and can reach lengths of up to 18 m (59 ft) (NOAA Fisheries 2021j). Humpback whale body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins, belly, and flukes. These distinct coloration patterns are used by scientists to identify individuals. This baleen whale species feeds on small prey often found in large concentrations, including krill and fish such as herring and sand lance (Kenney and Vigness-Raposa 2010). Humpback whales use unique behaviors, including bubble nets, bubble clouds, and flicking of their flukes and fins, to herd and capture prey (NMFS 1991).

Humpbacks whales are low-frequency cetaceans but have one of the most varied vocal repertoires of the baleen whales. Male humpbacks will arrange vocalizations into a complex, repetitive sequence to produce a characteristic "song." Songs are variable but typically occupy frequency bands between 300 and 3,000 Hz and last upwards of 10 minutes. Songs are predominately produced while on breeding grounds; however, they have been recorded on feeding grounds throughout the year (Clark and Clapham 2004; Vu et al. 2012). Typical feeding calls are centered at 500 Hz with some other calls and songs reaching 20 kHz. Common humpback calls also contain series of grunts between 25 and 1,900 Hz as well as strong, low-frequency pulses (with SLs up to 176 dB re 1 µPa) between 25 and 90 Hz (Clark and Clapham 2004; Vu et al. 2012).

Distribution

In the North Atlantic, six separate humpback whale sub-populations have been identified by their consistent maternally determined fidelity to different feeding areas (Clapham and Mayo 1987). These populations are found in the Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, Western Greenland, Iceland, and Norway (Hayes et al. 2020). Most humpback whales that inhabit the waters in the US Atlantic EEZ belong to the Gulf of Maine stock.

Humpback whales in the Gulf of Maine stock typically feed in the waters between the Gulf of Maine and Newfoundland during spring, summer, and fall, but have been observed feeding in other areas, such as off the coast of New York (Sieswerda et al. 2015). Humpback whales from most feeding areas, including the Gulf of Maine, migrate to the West Indies (including the Antilles, Dominican Republic, Virgin Islands, and Puerto Rico) in winter, where they mate and calve their young (Katona and Beard 1990; Palsbøll et al. 1997). There have been several wintertime humpback sightings in coastal waters of the eastern US, including 46 sightings of humpbacks in the New York-New Jersey Harbor Estuary documented between 2011 and 2016 (Brown et al. 2017). However, not all humpback whales from the Gulf of Maine stock migrate to the West Indies every winter because significant numbers of animals are observed in mid- and high-latitude regions at this time (Swingle et al. 1993).

Kraus et al. (2016) observed humpback whales in the MA and RI/MA WEA, and surrounding areas during all seasons. Humpback whales were visually observed most often during spring and summer, with a peak from April to June. Calves were observed 10 times and feeding was observed 10 times during the Kraus et al. (2016) study. That study also observed one instance of courtship behavior. Although humpback whales were rarely seen during fall and winter surveys, acoustic data indicate that this species may be present within the MA WEA year-round, with the highest rates of acoustic detections in winter and spring (Kraus et al. 2016). Humpback whales were acoustically detected in the MA WEA on 56% of survey days (566/1,020 days). Acoustic detections do not differentiate between individuals, so detections on multiple days could be the same or different individuals. The mean detection range for humpback whales using a PAM system was 30 to 36 km (16.2 to 19.4 NM). Kraus et al. (2016) estimated that 63% of acoustic detections of humpback whales represented whales within their study area.

Recent surveys (October 2018 to August 2019) in the MA and RI/MA WEAs have revealed a similar trend (O'Brien et al. 2020a). Including both on- and off-effort sightings, there were a total of 30 humpback whale sightings of 32 individuals. Humpback whales were sighted in every season, with the highest number of humpback whale sightings and the greatest relative abundance in spring and summer. The majority of sightings were on the eastern side of the MA and RI/MA WEAs, regardless of time of year (O'Brien et al. 2020a). Humpback whales were the most frequently sighted cetacean, although not the most abundant, during the most recent surveys in the MA and RI/MA WEAs from March to October 2020, accounting for 22% of all sightings (O'Brien et al. 2020b). Over the survey period, 44 individual whales were recorded during 22 sightings. Again, humpback whales were sighted in every season, with peaks in the summer. Group sizes ranged from 1–17 (average 1.9). The aggregation of 17 individuals was during a cooperative feeding event recorded in June (O'Brien et al. 2020b). Sightings during the 2020 survey were also concentrated more on the eastern side of the MA and RI/MA WEAs, and just outside the WEAs in the Nantucket Shoals area.

Abundance

The Gulf of Maine humpback whale stock consists of approximately 1,396 whales and is characterized by a positive trend in abundance with a maximum annual production rate estimate of 6.5% (Barlow and Clapham 1997; Hayes et al. 2020). The most significant anthropogenic causes of mortality to humpback whales remain incidental fishery entanglements, responsible for roughly eight whale mortalities, while vessel collisions are responsible for four mortalities, both on average annually from 2013–2017 (Hayes et al. 2020).

Status

The entire humpback whale species was previously listed as Endangered under the ESA. However, in September 2016, NOAA Fisheries identified 14 Distinct Population Segments (DPSs) of humpback whales and revised the ESA listing for this species (DoC 2016). Four DPSs were listed as Endangered, one as Threatened, and the remaining nine DPSs were deemed not warranted for listing. Humpback whales in the US Atlantic EEZ belong to the West Indies DPS, which is considered not warranted for listing under the ESA (DoC 2016).

The Gulf of Maine stock is not considered depleted because it does not coincide with any ESA-listed DPS. The detected level of US fishery-caused mortality and serious injury, derived from the available records, which is surely biased low, does not exceed the calculated PBR and, therefore, this is not a strategic stock (Hayes et al. 2020). Humpback whales in the Western North Atlantic have been experiencing an Unusual Mortality Event (UME) since January 2016 that appears to be related to a larger than usual number of vessel collisions (NOAA Fisheries 2018). In total, 88 strandings were documented between 2016–2018 (Hayes et al. 2020), as part of this event (NOAA Fisheries 2018). This most recent UME is ongoing. A BIA for humpback whales for feeding has been designated northeast of the SWDA from March through December (LaBrecque et al. 2015).

6.7.1.2.3 Minke Whales

Minke whales are a baleen whale species reaching 10 m (33 ft) in length (NOAA Fisheries 2021l). This species has a cosmopolitan distribution in temperate, tropical, and high latitude waters (Hayes et al. 2022). Common and widely distributed within the US Atlantic EEZ, these whales are the third most abundant great whale (any of the larger marine mammals of the order Cetacea) within the US Atlantic EEZ (CeTAP 1982). This species has a dark gray-to-black back and a white ventral surface (NOAA Fisheries 2021l). Its diet is comprised primarily of crustaceans, schooling fish, and copepods. Minke whales generally travel in small groups (one to three individuals), but larger groups have been observed on feeding grounds (NOAA Fisheries 2021l).

Minke whale recordings have resulted in some of the most variable and unique vocalizations of any marine mammal. Common calls for minke whales found in the North Atlantic include repetitive, low-frequency (100 to 500 Hz) pulse trains that may consist of either grunt-like pulses or thump-like pulses. The thumps are very short duration (50 to 70 milliseconds [ms]) with peak energy between 100 and 200 Hz. The grunts are slightly longer in duration (165 to 320 ms) with most energy between 80 and 140 Hz. In addition, minke whales will repeat a six to 14 minute pattern of 40 to 60 second pulse trains over several hours (Risch et al. 2013). Minke whales produce a unique sound called the "boing," which consists of a short pulse at 1.3 kHz followed by an undulating tonal call around 1.4 kHz. This call was widely recorded but unidentified for many years and had scientists widely speculating as to its source (Rankin and Barlow 2005).

Distribution

In the North Atlantic, there are four recognized populations: Canadian East Coast, West Greenland, Central North Atlantic, and Northeastern North Atlantic (Donovan 1991). Until better information is available, minke whales within the US Atlantic EEZ are considered part of the Canadian East Coast stock, which inhabits the area from the Western half of the Davis Strait (45°W) to the Gulf of Mexico. It is uncertain if separate sub-stocks exist within the Canadian East Coast stock.

Sighting data suggest that minke whale distribution is largely centered in the waters of New England and Eastern Canada (Hayes et al. 2022). Risch et al. (2013) reported a decrease in minke whale calls north of 40°N in late fall with an increase in calls between 20° and 30°N in winter and north of 35°N during spring. Mating and calving most likely take place in the winter in lower latitude wintering grounds (NOAA Fisheries 2021l).

Kraus et al. (2016) observed minke whales in the MA and RI/MA WEAs, and surrounding areas primarily from May to June. This species demonstrated a distinct seasonal habitat usage pattern that was consistent throughout the study. Minke whales were observed in spring and summer in the MA WEA. Minke whales were not observed between October and February, but acoustic data indicate the presence of this species in the Offshore Development Area in winter. Calves were observed twice, and feeding was also observed twice during the Kraus et al. (2016) study. Minke whales were acoustically detected in the MA WEA on 28% of survey days (291/1,020 days). Minke whale acoustic presence data also exhibited a distinct seasonal pattern; acoustic presence was lowest in December and January, steadily increased beginning in February, peaked in April, and exhibited a gradual decrease throughout summer (Kraus et al. 2016). Although minke whales are low-frequency cetaceans, the acoustic detection range for this species during the study was small enough that over 99% of detections were limited to within the Kraus et al. (2016) study area.

The surveys in the MA and RI/MA WEAs continued between October 2018 and August 2019 (O'Brien et al. 2020a). During this time, 115 individual minke whales were observed from 98 sightings, including both on and off-effort surveys. The average group size was 1.2 individuals (range of one to five). Most sightings occurred in June and April, resulting in the highest sighting rates during the summer and spring. Only two sightings occurred during winter, and no minke whales were observed during fall. Minkes were distributed throughout the MA and RI/MA WEAs (O'Brien et al. 2020a). Surveys conducted between March and October 2020 revealed a similar trend, with minke whales observed in all months of the survey except March and October, and distributed throughout the WEAs (O'Brien et al. 2020b).

Abundance

The best available abundance estimate for the Canadian East Coast minke whale stock is 21,968 individuals as of 2016 (Hayes et al. 2022). Current population trend and net productivity rates of minke whales in this region are unknown. The average annual human-caused mortality from 2014–2018 is approximately 11 whales per year, with nine deaths attributed to entanglement in fishing gear and approximately 2 attributed to vessel collision (Hayes et al. 2022). These records are not statistically quantifiable and may be negatively biased by focusing on strandings and entanglements. These uncertainties will have little effect on the designation of the status of the entire stock as the estimated human-caused mortality is well below the PBR calculated from the abundance estimate.

Status

Minke whales are not listed as Threatened or Endangered under the ESA and the Canadian East Coast stock is not considered strategic under the MMPA. Minke whales in the Western North Atlantic have been experiencing a UME since January 2017 with some evidence of human interactions as well as infectious disease (NOAA Fisheries 2021l). In total, 57 strandings were documented through 2018 as part of this event (Hayes et al. 2022). The most recent UME is ongoing. A BIA for minke whales for feeding has been designated east of the SWDA from March through November (LaBrecque et al. 2015).

6.7.1.2.4 North Atlantic Right Whales

NARWs are among the rarest of all marine mammal species in the Atlantic Ocean. They average approximately 15 m (50 ft) in length (NOAA Fisheries 2021m). Members of this species have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities. NARWs feed mostly on zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera (Hayes et al. 2022). They are slow-moving grazers that feed on dense concentrations of prey at or below the water's surface, as well as at depth (NOAA Fisheries 2021m).

NARWs are low-frequency cetaceans that vocalize using several distinctive call types, most of which have peak acoustic energy below 500 Hz. Most vocalizations do not go above 4 kHz (Matthews et al. 2014). One typical right whale vocalization is the "up call": a short sweep that rises from roughly 50 to 440 Hz over a period of two seconds. These up calls are characteristic of the NARW and are used by research and monitoring programs to determine species presence. A characteristic "gunshot" call is believed to be produced by male NARWs. These high-intensity broadband pulses can have SLs of 174 to 192 dB re 1 µPa m with a frequency range from 20 to 22,000 Hz (Parks et al. 2005; Parks and Tyack 2005). Other tonal calls range from 20 to 1,000 Hz and have SLs between 137 and 162 dB re 1 µPa.

Distribution

The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds, though this species has been observed feeding in winter in the mid-Atlantic region and has been recorded off the coast of New Jersey in all months of the year (Whitt et al. 2013). These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the US East Coast to their calving grounds in the waters of the southeastern US (Kenney and Vigness-Raposa 2010). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al. 2008).

Scientists separate NARWs into two separate stocks: Eastern North Atlantic and Western Atlantic. The Eastern North Atlantic stock was largely extirpated by historical whaling (Aguilar 1986). NARWs in US waters belong to the Western Atlantic stock. This stock ranges primarily from calving grounds in coastal waters of the southeastern US to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Hayes et al. 2022).

Surveys indicate that there are seven areas where NARWs congregate seasonally: the coastal waters of the southeastern US, the Great South Channel, Jordan Basin, Georges Basin along the northeastern edge of Georges Bank, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf (Hayes et al. 2022). NMFS has designated two critical habitat areas for the NARW under the ESA: the Gulf of Maine/Georges Bank region, and the southeast calving grounds from North Carolina to Florida (DoC 2016). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009). Davis et al. (2017) recently pooled together detections from several passive acoustic devices and documented broad-scale use of much more of the Atlantic Seaboard than previously believed. Further, there has been an apparent shift in habitat use patterns (Davis et al. 2017), which includes an increased use of Cape Cod Bay (Mayo et al. 2018) and decreased use of the Great South Channel. Movements within and between habitats are extensive (Hayes et al. 2022), and there is a high interannual variability in NARW use of some habitats (Pendleton et al. 2009).

New England waters are important feeding habitats for NARW who must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall NARW habitats (Kenney et al. 1986; Kenney et al. 1995). While feeding in the coastal waters off Massachusetts has been better studied than in other areas, NARW feeding has also been observed on the margins of Georges Bank, in the Great South Channel, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf (Baumgartner et al. 2007). NMFS and Center for Coastal Studies aerial surveys during spring 1999 to 2006, found NARWs along the northern edge of Georges Bank, in the Great South Channel, in Georges Basin, and in various locations in the Gulf of Maine, including Cashes Ledge, Platts Bank, and Wilkinson Basin. Analysis of the sightings data has shown that utilization of these areas has a strong seasonal component (Pace et al. 2014; Pace and Merrick 2008). In 2016, the Northeastern US Foraging Area Critical Habitat was expanded to include nearly all US waters of the Gulf of Maine (81 FR 4837, February 26, 2016). In recent years (2012–2015), surveys have detected fewer individuals in the Great South Channel and the Bay of Fundy, indicating an important shift in habitat use patterns. In addition, late winter use of a region south of Martha's Vineyard and Nantucket Islands was recently described (Leiter et al. 2017). A large increase in aerial surveys of the Gulf of St. Lawrence documented at least 36 and 117 unique individuals using the region, during the summer in 2015 and 2017, respectively (NMFS unpublished data). A poleward shift in the distribution of NARW's primary source of nutrition, the copepod species *Calanus finmarchicus* has been attributed as the impetus for the change in distribution of the NARW (Meyer-Gutbrod et al. 2018). Starting in 2012, NARW sightings in several traditional feeding habitats began to decline, causing speculation that a shift in NARW habitat usage was occurring (Pettis et al. 2017). As initially assessed in Leiter et al. (2017), and updated in Quintana-Rizzo et al. (2021), NARWs have become increasingly present in the offshore wind energy lease areas around southern New England (SNE) despite their declining population. This includes the SWDA within Bureau of Ocean Energy Management (BOEM) Lease Areas OCS-A 0534 and OCS-A 0501.

Kraus et al. (2016) observed NARWs in the MA and RI/MA WEAs in winter and spring and observed 11 instances of courtship behavior. During 436 hours of aerial surveys from October 2011 through June 2015, 93% of the NARW sightings (56 out of 60) occurred in January through April. The greatest sightings per unit effort by Kraus et al. (2016) in the MA and RI/MA WEAs took place in March, with a concentration of spring sightings in Lease Area OCS-A 0501[79] and winter sightings in the area northeast of the WEAs. Seventy-seven unique individual NARWs were observed in the MA and RI/MA WEAs over the duration of the Northeast Large Whale Pelagic Survey (October 2011 to June 2015) (Kraus et al. 2016). No calves were observed.

Kraus et al. (2016) acoustically detected NARWs with PAM within the MA WEA on 43% of survey days (443/1,020 days) and during all months of the year. During 1,020 days of acoustic recording, NARW upcalls were detected on 47% recorded days (478 out of 1,020 days, 30 out of 36 recorded months), with December through April having the highest mean monthly levels of acoustic occurrence (Kraus et al. 2016). Acoustic detections do not differentiate between individuals, so detections on multiple days could be the same or different individuals. NARWs exhibited notable seasonal variability in acoustic presence, with maximum occurrence in winter and spring (January to March), and minimum occurrence in summer (July to September). The mean detection range for NARWs using PAM was 15 to 24 km (8.1 to 13 NM), with a mean radius of 21 km (11.3 NM) (95% confidence interval of 3 km [1.6 NM]) for the PAM system.

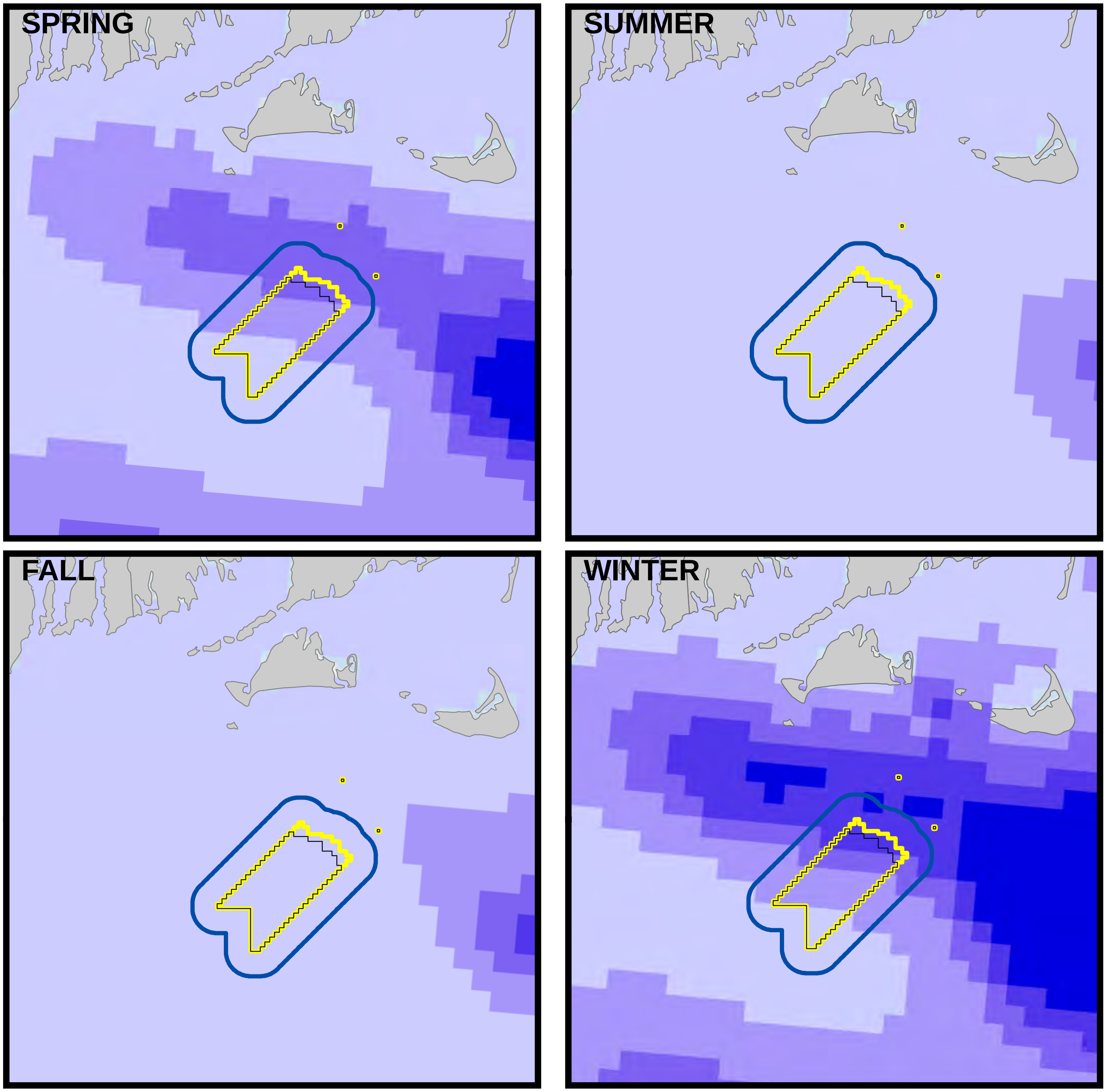
[79] This refers to Lease Area OCS-A 0501 prior to its segregation into OCS-A 0501 and OCS-A 0534.

A continuation of surveys in the MA and RI/MA WEAs between October 2018 through August 2019 revealed 164 individual right whales from 112 sightings during directed surveys. On-effort surveys resulted in a further 24 sightings of 67 right whales, and opportunistic surveys recorded three sightings of three animals (O'Brien et al. 2020a). In contrast with aerial surveys from Kraus et al. (2016), NARWs were observed in the MA and RI/MA WEAs in every season, and in nine of eleven months, with the highest number of sightings in January. No right whales were observed in June or October. Most (67%) of sightings were of single animals; however, larger feeding aggregations did occur (O'Brien et al. 2020a). NARWs were recorded predominately on the eastern side of the survey area. All sightings were within 20 NM of the MA and RI/MA WEAs; however, most were outside of the SWDA. This distribution changed seasonally, with a large aggregation of whales moving north from the southern portion of Nantucket Shoals in winter to an area 10 NM south of Nantucket in April. The aggregation moved south again back to Nantucket Shoals in late July and persisted in the area until the end of the survey period in August (O'Brien et al. 2020a). The most recent surveys in the MA and RI/MA WEAs occurred between March and October 2020 (O'Brien et al. 2020b). A total of 15 NARWs were observed from 10 sightings. Group sizes ranged from one to four, with an average of 1.5 whales. NARWs were observed in summer and fall, with no observations in the reduced spring season. No surveys were conducted in winter. Sighting rates were higher in fall than summer, and the feeding aggregations observed in previous years during summer were absent (O'Brien et al. 2020b). Similar to previous surveys, all sightings were within 15 NM of the MA and RI/MA WEAs; however, no NARWs were observed in the lease areas. A map of North Atlantic right whale maximum seasonal density is presented in Figure 6.7-2.

Abundance

The median estimate of abundance for the Western North Atlantic right whale stock is 368 (Hayes et al. 2022). This is based on a state-space model of the sighting histories of individual whales (Pace et al. 2017, 2021). This estimate does not consider that NARWs have been experiencing a UME since June 2017, with 78 documented deaths as of 2021 (NOAA Fisheries 2022). The UME appears to be driven by entanglement in fishing gear and blunt force trauma associated with ship strikes mainly in the Gulf of St. Lawrence. From 2013 to 2017, there were 28 records of mortality or serious injury involving entanglement or fishery interactions. Cause of death findings for the UME are based on seven necropsies of dead NARWs found in Canada in the Gulf of St. Lawrence (Daoust et al. 2017; NOAA Fisheries 2022) and along the Atlantic coast in US water (NOAA Fisheries 2022).

The Western North Atlantic right whale stock has been in decline since 2011 (Hayes et al. 2022). Population birth rates remain low, as the average number of calves born per year in 1990–2019 was 15 and ranged from zero to 39 per year. It appears as though that decline in NARW birth rates is continuing in more recent years, likely a result of lower female survival rate (Meyer-Gutbrod et al. 2020; Pace et al. 2017, 2021). The number of calves born in recent years has been below average (NOAA Fisheries 2022m). Additionally, the NARW consortium (NARWC) has



LEGEND

- Lease Area OCS-A 0534
- Southern Wind Development Area
- 6.2km Buffer

North Atlantic right whale density, animals/100km²

- 0.000 - 0.242
- 0.242 - 0.760
- 0.760 - 1.382
- 1.382 - 2.212
- 2.212 - 4.407

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Scale 1:1,500,000
1 inch = 24 miles

0 30 60 Miles

0 48 96 Kilometers

New England Wind
AVANGRID RENEWABLES

Figure 6.7-2

Map of NARW Maximum Seasonal Density from Roberts et al. (2016a, 2022) released the 2021 report card results predicting a NARW population of 336 for 2020 (Pettis et al. 2022) (Pettis et al. 2021 in draft). However, the consortium adjusts their estimates (Pace et al. 2017, 2021) to subtract additional mortality. This method is used in order to estimate all mortality, not just the observed mortality, therefore the (Hayes et al. 2022) SAR is used in this COP to report an unaltered output of the Pace et al. (2017, 2021) model (DoC and NOAA 2005).

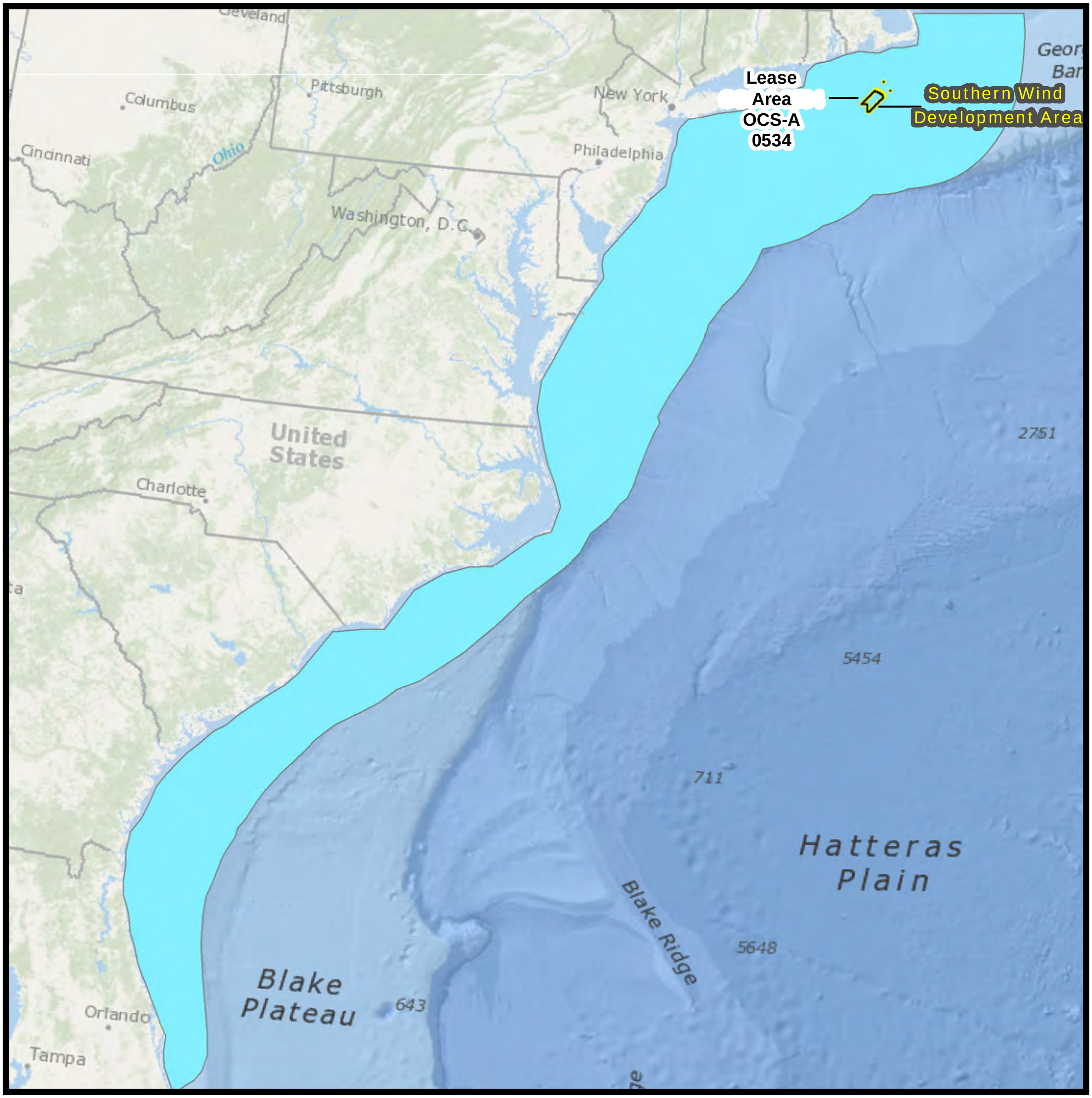
Status

The size of the Western Atlantic stock is considered extremely low relative to its OSP in the US Atlantic EEZ (Hayes et al. 2022). The Western Atlantic stock of NARWs is classified as a strategic stock under the MMPA and is listed as Endangered under the ESA and MA ESA. Although the recent draft NARWC report card estimates the population is 336 animals, the minimum population size listed in the SAR is estimated at 364 (Hayes et al. 2022). The maximum productivity rate is 0.04, the default value for cetaceans, with a recovery factor of 0.1, because this species is listed as Endangered. PBR for the Western Atlantic stock of North Atlantic right whale is 0.7 (Hayes et al. 2022).

Historically, the population suffered severely from commercial overharvesting and has more recently been threatened by incidental fishery entanglement and vessel collisions (Knowlton and Kraus 2001; Kraus et al. 2005; Pace et al. 2017). To protect this species from ship strikes, NOAA Fisheries designated Seasonal Management Areas (SMAs) in US waters in 2008 (DoC 2008). All vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 10knots (5.1 m/s) or less within these areas during specific time periods. The Block Island Sound Seasonal Management Area (SMA) overlaps with the southern portion of the SWDA and is active between November 1 and April 30 each year. The Great South Channel SMA lies to the northeast of Lease Area OCS-A 0501 and is active April 1 to July 31. NMFS may also establish Dynamic Management Areas (DMAs) when and where NARWs are sighted outside SMAs. DMAs are generally in effect for two weeks. During this time, vessels are encouraged to avoid these areas or reduce speeds to 10 knots (5.1 m/s) or less while transiting through these areas.

The SWDA is encompassed by a NARW BIA for migration from March to April and from November to December (LaBrecque et al. 2015). To determine BIAs, experts were asked to evaluate the best available information and to summarize and map areas important to cetacean species' reproduction, feeding, and migration. The purpose of identifying these areas was to help resource managers with planning and analysis. The NARW BIA for migration includes the RI/MA and MA WEAs and beyond to the continental slope, extending northward to offshore of Provincetown, Massachusetts and southward to halfway down the Florida coast (LaBrecque et al. 2015).

The SWDA is encompassed by a NARW BIA (see Figure 6.7-3) for migration from March to April and from November to December (LaBrecque et al. 2015). To determine BIAs, experts were asked to evaluate the best available information and to summarize and map areas important to cetacean species' reproduction, feeding, and migration. The purpose of identifying these areas was to help resource managers with planning and analysis. The NARW BIA for migration includes



Service Layer Credits: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Scale 1:8,000,000
1 inch = 126 miles

0 30 60 Miles
0 48 96 Kilometers

LEGEND

Lease Area OCS-A 0534
Southern Wind Development Area (SWDA)
NARW BIA for Migration

New England Wind
AVANGRID RENEWABLES

Figure 6.7-3
North Atlantic Right Whale Biologically Important Area for Migration June to September

the MA WEA and RI/MA WEA and beyond to the continental slope, extending northward to offshore of Provincetown, Massachusetts, and southward to halfway down the Florida coast (LaBrecque et al. 2015).

6.7.1.2.5 Sei Whales

Sei whales are a relatively widespread baleen whale that can reach lengths of about 12 to 18 m (39 to 59 ft). This species has a long, sleek body that is dark bluish-gray to black in color and pale underneath (NOAA Fisheries 2021o). Their diet is comprised primarily of plankton, schooling fish, and cephalopods. Sei whales generally travel in small groups (two to five individuals), but larger groups are observed on feeding grounds (NOAA Fisheries 2021o).

Like all baleen whales, sei whales are categorized as low-frequency cetacean. There are limited confirmed sei whale vocalizations; however, studies indicate that this species produces several, mainly low-frequency (<1,000 Hz) vocalizations. Calls attributed to sei whales include pulse trains up to 3 kHz, broadband “growl” and “whoosh” sounds between 100 and 600 Hz, tonal calls and upsweeps between 200 and 600 Hz, and down sweeps between 34 and 100 Hz (Baumgartner et al. 2008; McDonald et al. 2005; Rankin and Barlow 2007).

Distribution

The stock of sei whales that occurs in the US Atlantic EEZ is the Nova Scotia stock, which ranges along the continental shelf waters of the northeastern US to Newfoundland (Hayes et al. 2022). Sighting data suggest sei whale distribution is largely centered in the waters of New England and eastern Canada (Hayes et al. 2022; Roberts et al. 2018). There appears to be a strong seasonal component to sei whale distribution. Sei whales are relatively widespread and most abundant in New England waters from spring to early fall. Acoustic monitoring suggests year-round presence in Southern New England and the New York Bight (Davis et al. 2020). This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters (Hayes et al. 2020). In years of reduced predation on copepods by other predators and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (Hayes et al. 2019; Payne and Heinemann 1990). An influx of sei whales into the southern Gulf of Maine occurred in summer 1986 (Schilling et al. 1992). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide. Kraus et al. (2016) observed sei whales in the MA and RI/MA WEAs, and surrounding areas only between the months of March and June. The number of sei whale observations was less than half that of other baleen whale species in the two seasons in which sei whales were observed (spring and summer). This species demonstrated a distinct seasonal habitat use pattern that was consistent throughout the study. Calves were observed three times and feeding was observed four times during the Kraus et al. (2016) study.

Surveys between October 2018 and August 2019 revealed 28 sightings of 55 individual sei whales (O'Brien et al. 2020a). Sightings only occurred in two of the 11 months surveyed, May and June. The average group size was two whales, with a range of one to 10 individuals. Sei whales were only observed in the southern portion of the survey area, and most were outside the MA and RI/MA WEAs (O'Brien et al. 2020a). No sei whales were observed during the 2020 surveys (O'Brien et al. 2020b). Based on sighting rates in Kraus et al. (2016), and O'Brien et al. (2020a; 2020b) sei whales are expected to be present but much less common than fin whales, minke whales, humpback whales, and NARWs. A map of sei whale maximum seasonal density is presented in Figure 6.7-4.

Abundance

The best available abundance estimate for the Nova Scotia stock of sei whales from NMFS stock assessments is 6,292 individuals (Hayes et al. 2022). Current and maximum net productivity rates and population trends are unknown for this stock due to relatively imprecise abundance estimates and long survey intervals (Hayes et al. 2022).

Status

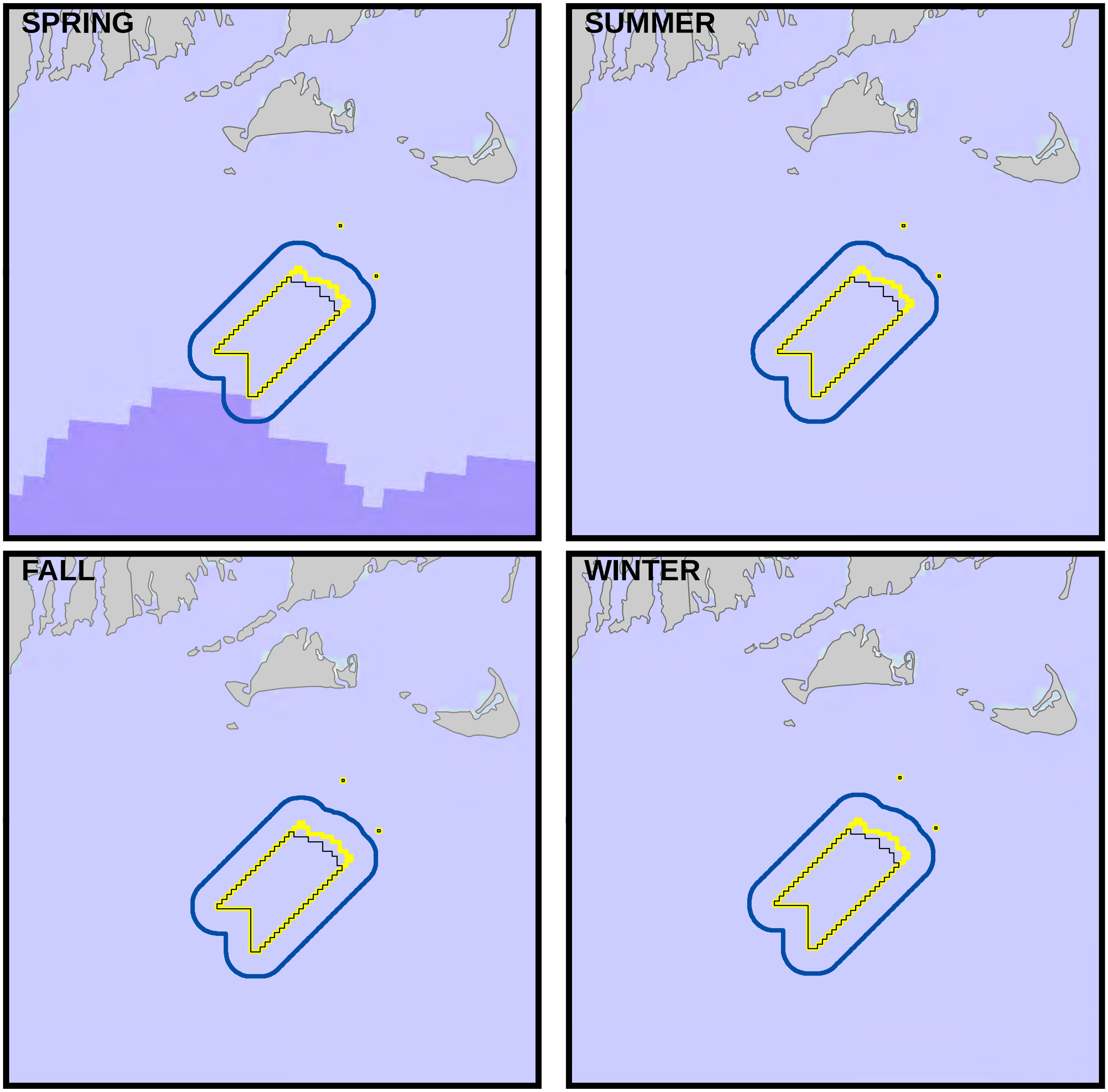
Sei whales are listed as Endangered under the ESA and MA ESA and the Nova Scotia stock is considered strategic by NMFS. The minimum population size is estimated at 3,098. The maximum productivity rate is 0.04, the default value for cetaceans, with a recovery factor of 0.1, because this species is listed as Endangered. PBR for the Nova Scotia stock of sei whales is 6.2 (Hayes et al. 2022). For the period 2013 through 2017, the minimum annual rate of human-caused mortality and serious injury to sei whales was 1.0; however, due to haphazard detections this is a minimum estimate which is almost certainly biased low (Hayes et al. 2022).

No critical habitat areas are designated for the sei whale under the ESA. A BIA for feeding for sei whales occurs east of the SWDA from May through November (LaBrecque et al. 2015).

6.7.1.3 Odontocetes

6.7.1.3.1 Atlantic Spotted Dolphins

Atlantic spotted dolphins are found in warmer temperate and tropical waters of the Atlantic Ocean (NOAA Fisheries 2021b). They are a smaller moderately slender dolphins attaining a body length of 1.5 to 2.3 m (5–7.5 ft) (Perrin 2002). They have a tall, curved dorsal fin located midway down their back (NOAA Fisheries 2021b). The Atlantic spotted dolphins' color patterns vary with age and location, with most individuals seen north of Cape Hatteras exhibiting few small dark ventral spots (Perrin 2002; Perrin et al. 1987). They form groups of varying sizes, usually less than 50 individuals, but can be seen traveling in groups of more than 200. In shallower waters, group size is typically 5–15 individuals (NOAA Fisheries 2021b). These dolphins eat small fish, invertebrates, and cephalopods such as squid or octopi (Herzing 1997).



LEGEND

Lease Area OCS-A 0534

Southern Wind Development Area

6.2km Buffer

Sei whale density, animals/100km²

0.000 - 0.242

0.242 - 0.760

0.760 - 1.382

1.382 - 2.212

2.212 - 4.407

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Scale 1:1,500,000
1 inch = 24 miles

0 30 60 Miles

0 48 96 Kilometers

New England Wind
AVANGRID RENEWABLES

Figure 6.7-4

Map of Sei Whale Maximum Seasonal Density from Roberts et al. (2016a, 2022)

Atlantic spotted dolphins are in the mid-frequency functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations, including signature whistles, range from 5 to 20 kHz (Perrin 2002). Because calls produced by many delphinid species are highly variable and overlap in frequency characteristics, they are challenging to identify to individual species (Oswald et al. 2007) during acoustic studies.

Distribution

Atlantic spotted dolphins observed off the eastern US coast are part of the Western North Atlantic stock and range from southern New England south through the Gulf of Mexico and the Caribbean (Hayes et al. 2020). Atlantic spotted dolphins regularly occur along the continental shelf, typically between 33 and 650 ft (10 to 200 m) and deeper slope waters greater than 1,640 ft (500 m) deep. Two forms of Atlantic spotted dolphin exist: one is large, heavily spotted, and usually inhabits the continental shelf, while the other is smaller in size, with fewer spots, and occurs farther offshore (Viricel and Rosel 2014). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin (*Stenella attenuata)* can be difficult to differentiate (Hayes et al. 2020). It has been suggested that this species may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966; Fritts et al. 1983). These dolphins can be expected to occur in SWDA waters, especially in the fall, spring, and summer.

Kraus et al. (2016) suggest that Atlantic spotted dolphins occur infrequently in the MA and RI/MA WEAs and surrounding areas. Effort-weighted average sighting rates for Atlantic spotted dolphins could not be calculated, because most small cetaceans sighted during the study could not be identified to species due to their size (Kraus 2016). However, during a 2020 geotechnical and geophysical survey in or adjacent to the SWDA, Atlantic spotted dolphins were observed in summer months (Vineyard Wind 2020a). It is possible that the Northeast Large Pelagic Survey may have underestimated the abundance of Atlantic spotted dolphins, as this survey was designed to target large cetaceans.

No sightings of Atlantic spotted dolphins occurred during the 2018–2019 and 2020 science surveys; however, there were some observations of small delphinids that could not be identified to species (O'Brien et al. 2020a; O'Brien et al. 2020b).

Abundance

The best available abundance estimate for the Western North Atlantic stock of Atlantic spotted dolphins is 39,921 individuals, estimated from data collected during summer surveys in 2016 covering waters from central Florida to the lower Bay of Fundy. Distinction between the two Atlantic spotted dolphin ecotypes has not regularly been made during surveys (Hayes et al. 2020).

Status

The total annual estimated human-caused mortality and serious injury to spotted dolphins between 2013 and 2017 was zero; there were no reported deaths from US fisheries observer data (Hayes et al. 2020). The Atlantic spotted dolphin is not listed as Threatened or Endangered under the ESA and the Western North Atlantic stock of Atlantic spotted dolphins is not classified as strategic.

6.7.1.3.2 Atlantic White-Sided Dolphins

Atlantic white-sided dolphins are found in cold temperate and subpolar waters of the North Atlantic (Cipriano 2002). These dolphins are robust and attain a body length of approximately 2.8 m (9 ft) (Jefferson et al. 2008). They are characterized by a strongly "keeled" tail stock and have a distinctive, white-sided color pattern (BOEM 2014). Atlantic white-sided dolphins form groups of varying sizes, ranging from a few individuals to over 500 (NOAA Fisheries 2021c). They feed mostly on small schooling fish, shrimps, and squids, and are often observed feeding in mixed-species groups with pilot whales and other dolphin species (Cipriano 2002; Jefferson et al. 2008).

Atlantic white-sided dolphins are in the mid-frequency functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations range from 6 to 15 kHz (DoN 2008). Because calls produced by many delphinid species are highly variable and overlap in frequency characteristics, they are challenging to identify to individual species (Oswald et al. 2007) during acoustic studies.

Distribution

Atlantic white-sided dolphins observed off the US Atlantic coast are part of the Western North Atlantic stock (Hayes et al. 2019). This stock inhabits waters from central West Greenland to North Carolina (about 35°N), primarily in continental shelf waters to the 100 m (328 ft) depth contour (Doksæter et al. 2008). Sighting data indicate seasonal shifts in distribution (Northridge et al. 1997). From January to May, low numbers of Atlantic white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire). From June through September, large numbers of Atlantic white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, they occur at intermediate densities from southern Georges Bank to the southern Gulf of Maine (Payne and Heinemann 1990). No critical habitat areas are designated for the Atlantic white-sided dolphin.

Kraus et al. (2016) suggest that Atlantic white-sided dolphins occur infrequently in the MA and RI/MA WEAs and surrounding areas. Effort-weighted average sighting rates for Atlantic white-sided dolphins could not be calculated, because this species was only observed on eight occasions throughout the duration of the study (October 2011 to June 2015). No Atlantic white-sided dolphins were observed during the winter months, and this species was only sighted twice in fall and three times in spring and summer. However, from 2018 to 2020, geotechnical and geophysical surveys in or adjacent to the SWDA observed Atlantic white-sided dolphins 17 times in spring and summer months. Group sizes ranged from 5 to 108 individuals (Vineyard Wind 2018; 2020a; 2020b). It is possible that the Northeast Large Pelagic Survey may have underestimated the abundance of Atlantic white-sided dolphins, as this survey was designed to target large cetaceans and most small cetaceans were not identified to species.

Surveys in the MA and RI/MA WEAs between October 2018 and August 2019 revealed no sightings of Atlantic white-sided dolphins (O'Brien et al. 2020a). Atlantic white-sided dolphins were only observed between the months of April and July, and only on the Western side of the survey area; however, the small number of sightings precludes broad assessments of distribution patterns (O'Brien et al. 2020a). Between March and October 2020, surveys in the area observed one group of 15 Atlantic white-sided dolphins (O'Brien et al. 2020b). However, as not all small delphinids could be identified to species, this may be an underestimate of abundance.

Abundance

There are insufficient data to determine seasonal abundance estimates of Atlantic white-sided dolphins off the eastern US coast or their status in the US Atlantic EEZ. The best available abundance estimate for the Western North Atlantic stock of Atlantic white-sided dolphins is 93,233 individuals, estimated from data collected during the June to September 2016 surveys that covered nearly the entire Western North Atlantic stock (Hayes et al. 2022).

Status

The Atlantic white-sided dolphin is not listed as Threatened or Endangered under the ESA and the Western North Atlantic stock of Atlantic white-sided dolphins is not classified as strategic.

6.7.1.3.3 Bottlenose Dolphins

Bottlenose dolphins are one of the most well-known and widely distributed species of marine mammals. These dolphins reach 2 to 4 m (7 to 13 ft) in length and are light gray to black in color (NOAA Fisheries 2021d). Bottlenose dolphins are commonly found in groups of two to 15 individuals, though aggregations in the hundreds are occasionally observed (NOAA Fisheries 2021d). They are considered generalist feeders and consume a wide variety of organisms, including fish, squid, shrimp, and other crustaceans (Jefferson et al. 2008).

Bottlenose dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Bottlenose dolphin vocalization frequencies range from 3.4 to 130 kHz (DoN 2008).

Distribution

The common bottlenose dolphin is a cosmopolitan species that occurs in temperate and tropical waters worldwide. Common bottlenose dolphins are found in estuarine, coastal, continental shelf, and oceanic waters of the Western North Atlantic. Bottlenose dolphins offshore New England belong to the Western North Atlantic Offshore stock, which ranges throughout the US Atlantic EEZ and into Canada (Hayes et al. 2022).

The Western North Atlantic Offshore stock inhabits the outer continental slope and shelf edge regions from Georges Bank to the Florida Keys (Hayes et al. 2017). Sightings of this stock of bottlenose dolphin occur from Cape Hatteras to the eastern end of Georges Bank (Kenney 1990). The Northeast Fisheries Science Center observed bottlenose dolphins during the AMAPPS surveys (NEFSC and SEFSC 2011a; 2011b; 2012; 2014a; 2014b; 2015; 2016; 2018; 2019).

Kraus et al. (2016) observed common bottlenose dolphins during all seasons within the MA and RI/MA WEAs. Common bottlenose dolphins were the second most observed small cetacean species and exhibited little seasonal variability in abundance. They were observed in the MA WEA in all seasons and SWDA in fall and winter. One sighting of common bottlenose dolphins in the Kraus et al. (2016) study included calves, and one sighting involved mating behavior. It is possible the Northeast Large Whale Pelagic Survey underestimated the abundance of common bottlenose dolphins, as this survey was designed to target large cetaceans and the majority of small cetaceans were not identified to species (Kraus et al. 2016).

During the 2018–2019 surveys in the MA and RI/MA WEAs, bottlenose dolphins were the second most abundant small cetacean, accounting for 15% of sightings, including periods of both on- and off-effort (O'Brien et al. 2020a). Bottlenose dolphins were only observed between April and July, but they were sighted throughout the MA and RI/MA WEAs. The March-October 2020 surveys revealed a similar trend, with sightings of bottlenose dolphins only occurring in summer. This species was again the second-most abundant small cetacean, accounting for 22% of sightings (O'Brien et al. 2020b). The 2020 survey revealed sightings only in the southern end of the MA and RI/MA WEAs, with the largest group (> 151 individuals) located on the outside edge of the lease area. Not all small delphinids could be identified to species level in either survey, so the abundance of bottlenose dolphins may have been underestimated (O'Brien et al. 2020a; O'Brien et al. 2020b).

Abundance

The best available estimate for the offshore stock abundance is 62,851 individuals (Hayes et al. 2022). Current population estimates indicate there is no significant trend in abundance. Total annual human-caused mortality is unknown. Total annual fisheries mortality and serious injury is estimated as 28 individuals for the offshore stock from 2013–2017 (Hayes et al. 2019; 2020).

Status

Bottlenose dolphins of the Western North Atlantic Offshore stock are not federally listed as Threatened or Endangered under the ESA or MA ESA and are not considered strategic.

6.7.1.3.4 Pilot Whales

Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale and the short-finned pilot whale. These species are difficult to differentiate visually and acoustically due to similarity in appearance at the surface and vocalizations that overlap in frequency range. Consequently, the two species cannot be reliably distinguished (Hayes et al. 2019; Rone and Pace 2012); unless otherwise stated, the descriptions below refer to both species. Pilot whales have bulbous heads, are dark gray, brown, or black in color, and can reach approximately 7.3 m (24 ft) in length (NOAA Fisheries 2021k). These whales form large, relatively stable aggregations that appear to be maternally determined (American Cetacean Society 2018). Pilot whales feed primarily on squid but also eat small to medium-sized fish and octopus when available (NOAA Fisheries 2021k; 2021q). Occurrence of short and long-finned pilot whales are considered uncommon in the SWDA.

Pilot whales are acoustic mid-frequency specialists with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Pilot whales echolocate and produce tonal calls. The primary tonal calls of the long-finned pilot whale range from 1 to 8 kHz with a mean duration of about one second. The calls can be varied with seven categories identified (level, falling, rising, up-down, down-up, waver, and multi-hump) and are likely associated with specific social activities (Vester et al. 2014).

Distribution

Within the US Atlantic EEZ, both species are categorized into Western North Atlantic stocks. In US Atlantic waters, pilot whales are distributed principally along the continental shelf edge off the northeastern US coast in winter and early spring (Abend and Smith 1999; CeTAP 1982; Hamazaki 2002; Payne and Heinemann 1993). In late spring, pilot whales move onto Georges Bank, into the Gulf of Maine, and into more northern waters, where they remain through late fall (CeTAP 1982; Payne and Heinemann 1993). Short-finned pilot whales are present within warm temperate to tropical waters and long-finned pilot whales occur in temperate and subpolar waters. Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Hayes et al. 2019; Payne and Heinemann 1993). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whales have stranded as far north as Massachusetts (Hayes et al. 2020). The latitudinal ranges of the two species therefore remain uncertain. However, south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of approximately 42° N, most pilot whale sightings are expected to be long-finned pilot whales Hayes et al. (2020). Based on the distributions described in Hayes et al. (2020), pilot whale sightings in the SWDA are most likely to be long-finned pilot whales.

Kraus et al. (2016) observed pilot whales infrequently in the MA and RI/MA WEAs, and surrounding areas. Effort-weighted average sighting rates for pilot whales could not be calculated. No pilot whales were observed during fall or winter, and these species were only observed 11 times in spring and three times in summer. Two of these sightings included calves.

Pilot whales were only observed off-effort between April and July in the 2018–2019 survey in the MA and RI/MA WEAs and only in the area south of Nantucket Shoals (O’Brien et al. 2020a). Based on the small number of sightings, no inferences can be made about the distribution of pilot whales in the survey area. No pilot whales were sighted during the 2020 surveys (O’Brien et al. 2020b).

As not all species of small cetacean could be identified to species level, observations of pilot whales may be underestimated during either survey (O'Brien et al. 2020a; O'Brien et al. 2020b).

Abundance

The best available abundance estimate for the Western North Atlantic stock of long-finned pilot whales is 39,215, and the best available abundance estimate for the Western North Atlantic stock of short-finned pilot whales is 28,924 (Hayes et al. 2022). Estimates of population trend or net productivity rates have not been calculated for long-finned pilot whales as abundance estimates remain highly uncertain due to long survey intervals. From 2013 to 2017, total annual observed fishery-related mortality or serious injury was 21 whales (Hayes et al. 2020). In addition to direct human-induced mortality, mass strandings of long-finned pilot whales have occurred throughout their range. Between 2013 and 2017, 16 long-finned pilot whales were found stranded between Maine and Florida. There are three available coastwide abundance estimates from summer surveys in 2004, 2011, and 2016 for short-finned pilot whales. A logistical regression model was used and indicated no significant population trend. Currently, net productivity rates are unknown for short-finned pilot whales (Hayes et al. 2020). The total annual human caused mortality between 2013–2017 is also unknown; however, the mean annual fishery- related mortality and serious injury during this time due to the pelagic long line fishery was 160 short-finned pilot whales (Hayes et al. 2020).

Status

Neither pilot whale species is listed as Threatened or Endangered under the ESA or the MA ESA, and neither Western North Atlantic stock is considered strategic under the MMPA.

6.7.1.3.5 Risso's Dolphins

Risso's dolphins occur worldwide in both tropical and temperate waters (Jefferson et al. 2008; Jefferson et al. 2014). This species of dolphin attains a body length of approximately 2.6 to 4 m (9 to 13 ft) (NOAA Fisheries 2021n), possess a narrow tailstock, and have a whitish or gray body. Risso's dolphins form groups ranging from 10 to 30 individuals (NOAA Fisheries 2021n). They feed primarily on squid as well as fish, such as anchovies, krill, and other cephalopods (NOAA Fisheries 2021n).

Risso's dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations range from 400 Hz to 65 kHz (DoN 2008).

Distribution

Risso's dolphins within the US Atlantic EEZ are part of the Western North Atlantic stock. This stock of Risso's dolphins inhabits waters from Florida to eastern Newfoundland (Baird and Stacey 1991; Leatherwood et al. 1976). During spring, summer, and fall, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank (CeTAP 1982; Payne et al. 1984). In winter, the distribution extends outward into oceanic waters (Payne et al. 1984).

The stock may contain multiple demographically independent populations that should themselves be considered stocks because the current stock spans multiple eco-regions (Longhurst 1998; Spalding et al. 2007).

Kraus et al. (2016) results suggest that Risso's dolphins occur infrequently in the MA and RI/MA WEAs and surrounding areas. Effort-weighted average sighting rates for Risso's dolphins could not be calculated. No Risso's dolphins were observed during summer, fall, or winter, and this species was only observed twice in spring. From 2018 to 2020, geotechnical and geophysical surveys in or adjacent to the SWDA observed Risso's dolphins once in early summer. Group size ranged from five to eight individuals (Kraus et al. 2016; Vineyard Wind 2018; 2020a; 2020b). It is possible that the Northeast Large Whale Pelagic Survey underestimated the abundance of Risso's dolphins, as this survey was designed to target large cetaceans and most small cetaceans were not identified to species. No Risso's dolphins were observed in either of the most recent surveys in the MA and RI/MA WEAs (O'Brien et al. 2020a; O'Brien et al. 2020b).

Abundance

The best abundance estimate for Risso's dolphins is 35,35,215 individuals, calculated from surveys conducted by Northeast Fisheries Science Center (NEFSC) and Department of Fisheries and Oceans Canada (DFO) (Hayes et al. 2022). Estimates of population trend or net productivity rates have not been calculated for Risso's dolphins. Annual average estimated human-caused mortality or serious injury from 2013 to 2017 was 54 dolphins, most of which was likely due to interactions with fisheries (Hayes et al. 2020).

Status

Risso's dolphins are not listed as Threatened or Endangered under the ESA and this stock is not considered strategic under the MMPA.

6.7.1.3.6 Short-Beaked Common Dolphins

Short-beaked common dolphins (*Delphinus delphis*) are one of the most widely distributed cetaceans and occur in temperate, tropical, and subtropical regions (Jefferson et al. 2008). Short-beaked common dolphins can reach 2.7 m (9 ft) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape (NOAA Fisheries 2021p). This species feeds on schooling fish and squid found near the surface at (NOAA Fisheries 2021p). They have been known to feed on fish escaping from fishermen's nets and fish that are discarded from boats (NOAA 1993). These dolphins can gather in schools of hundreds or thousands, although groups generally consist of 30 or fewer individuals (NOAA 1993).

Short-beaked common dolphins are in the mid-frequency functional hearing group. Their vocalizations range from 300 Hz to 44 kHz (Southall et al. 2007).

Distribution

Short-beaked common dolphins within the US Atlantic EEZ belong to the Western North Atlantic stock, generally occurring from Cape Hatteras to the Scotian Shelf (Hayes et al. 2018). Short-beaked common dolphins are a highly seasonal, migratory species. Within the US Atlantic EEZ, this species is distributed along the continental shelf between the 100 to 2,000 m (328 to 6,562 ft) isobaths and is associated with Gulf Stream features (CeTAP 1982; Hamazaki 2002; Hayes et al. 2019; Selzer and Payne 1988). Short-beaked common dolphins occur from Cape Hatteras northeast to Georges Bank (35° to 42°N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to fall (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 11°Celsius (51.8°Fahrenheit) (Gowans and Whitehead 1995; Sergeant et al. 1970). Breeding usually takes place between June and September, with females estimated to have a calving interval of two to three years (Hayes et al. 2019).

Kraus et al. (2016) suggested that short-beaked common dolphins occur year-round in the MA and RI/MA WEAs and surrounding areas. Short-beaked common dolphins were the most frequently observed small cetacean species within the Kraus et al. (2016) study area. Short-beaked common dolphins were observed in the MA and RI/MA WEAs in all seasons and observed in the SWDA in spring, summer, and fall. Short-beaked common dolphins were most frequently observed during the summer months; observations of this species peaked between June and August. Two sightings of short-beaked common dolphins in the Kraus et al. (2016) study included calves, two sightings involved feeding behavior, and three sightings involved mating behavior. Sighting data indicate that short-beaked common dolphin distribution tended to be farther offshore during the winter months than during spring, summer, and fall. Short-beaked common dolphins were the most frequently observed or detected animal during the 2016 survey in the SWDA and one was also visually observed during the 2017 geophysical and geotechnical (G&G) survey (Vineyard Wind 2016; 2017). During the 2016 G&G survey, short-beaked common dolphins were visually observed 123 times and acoustically detected 50 times. It is possible that the Northeast Large Whale Pelagic Survey underestimated the abundance of short-beaked common dolphins, because this survey was designed to target large cetaceans and the majority of small cetaceans were not identified to species (Kraus et al. 2016).

More recent aerial surveys in the MA and RI/MA WEAs took place between October 2018 and August 2019 (O'Brien et al. 2020a) and from March to October 2020 (O'Brien et al. 2020b). Common dolphins accounted for most sightings during both surveys (48% and 41% respectively). This species was observed in all seasons and throughout the MA and RI/MA WEAs during the 2018–2019 surveys; however, they were absent in the months of March and August (O'Brien et al. 2020a). They were again present in all seasons and throughout the survey area in 2020; however, no data on monthly abundance is available (O'Brien et al. 2020b). The largest aggregations of common dolphins occurred on the southern edge of the MA and RI/MA WEAs during both surveys (O'Brien et al. 2020a; O'Brien et al. 2020b).

Abundance

The best abundance estimate for the Western North Atlantic stock of common dolphins is 172,974 individuals as of 2016 (Hayes et al. 2022). Annual total human-caused mortality and serious injury are unknown; however, annual fishery-related mortality between 2013 and 2017 was 419 animals (Hayes et al. 2022).

Status

The short-beaked common dolphin is not listed as Threatened or Endangered under the ESA and the Western North Atlantic stock of the short-beaked common dolphin is not designated as a strategic under the MMPA.

6.7.1.3.7 Sperm Whales

The sperm whale is the largest of all toothed whales. Males can reach 16 m (52 ft) in length and weigh over approximately 40,800 kilograms (45 US tons), and females can attain lengths of up to 11 m (36 ft) and weigh over approximately 13,600 kilograms (15 US tons) (Whitehead 2009). Sperm whales have extremely large heads, which account for 25 to 35% of the total length of the animal. They are uniformly dark gray in color, though lighter spots may be present on the ventral surface. Sperm whales frequently dive to depths of 400 m (1,312 ft) in search of their prey, which includes large squid, fish, octopus, sharks, and skates (Whitehead 2009). This species can remain submerged for over an hour and dive to depths as great as 1,000 m (3,281 ft) (Watwood et al. 2006). Sperm whales have a global distribution in deep water and range from the equator to the edges of the polar pack ice (Whitehead 2002). Sperm whales form stable social groups and exhibit a geographic social structure-females and juveniles form mixed groups and primarily reside in tropical and subtropical waters, whereas males are more solitary and wide-ranging and occur at higher latitudes (Whitehead 2002; 2003).

The IWC recognizes only one stock of sperm whale for the North Atlantic. Reeves and Whitehead (1997), and Dufault et al. (1999) suggest that sperm whale populations lack clear geographic structure. Current threats to sperm whales include ship strikes, exposure to anthropogenic sound and toxic pollutants, and entanglement in fishing gear (though entanglement risk for sperm whales is relatively low compared to other, more coastal whale species) (NOAA Fisheries 2021r; Waring et al. 2015).

Sperm whales are in the mid-frequency hearing group, with an estimated auditory range of 150 Hz to 160 kHz (Southall et al. 2007). Sperm whales produce short-duration repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges (DoN 2008). Echolocation clicks from adult sperm whales are highly directional clicks and have a SL estimated at up to 236 dB re 1 µPa.

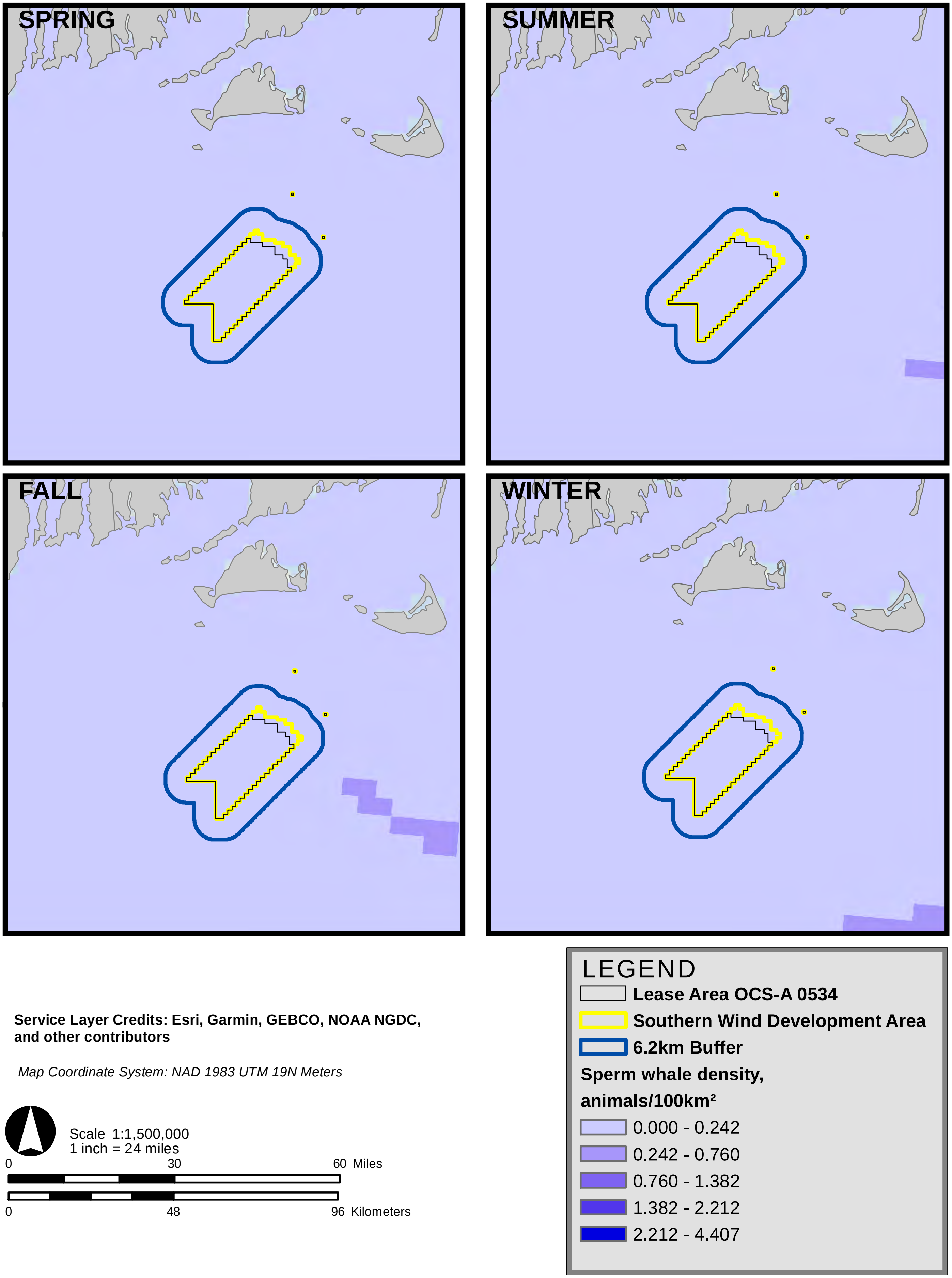
Distribution

Sperm whales mainly reside in deep-water habitats on the OCS, along the shelf edge, and in mid-ocean regions (NOAA Fisheries 2010). However, this species has also been observed in relatively high numbers in shallow continental shelf areas off the coast of southern New England (Scott and Sadove 1997). Sperm whale migratory patterns are not well-defined, and no obvious migration patterns have been observed in certain tropical and temperate areas. However, general trends suggest that most populations move poleward during summer (Waring et al. 2015). Within US Atlantic EEZ waters, sperm whales appear to exhibit seasonal movement patterns (CeTAP 1982; Scott and Sadove 1997). During winter, sperm whales are concentrated to the east and north of Cape Hatteras. This distribution shifts northward in spring, when sperm whales are most abundant in the central portion of the Mid-Atlantic Bight to the southern region of Georges Bank. In summer, this distribution continues to move northward, including the area east and north of Georges Bank and the continental shelf to the mid-Atlantic region. In fall, sperm whales are most abundant on the continental shelf to the south of New England and remain abundant along the continental shelf edge in the Mid-Atlantic Bight.

Kraus et al. (2016) observed sperm whales four times in the MA and RI/MA WEAs during summer and fall from 2011 to 2015. Sperm whales, traveling singly or in groups of three or four, were observed three times in August and September 2012, and once in June 2015. One sperm whale was observed on the northwestern border of the SWDA, and one was observed between the SWDA and Nantucket Island. The frequency of sperm whale clicks exceeded the maximum frequency of PAM equipment used in Kraus et al. (2016), so no acoustic data are available for this species from that study.

More recently, surveys in the MA and RI/MA WEAs in June and July of 2019 recorded two groups of sperm whales (O'Brien et al. 2020a). On June 12, a group of four whales was sighted, and a group of two was sighted on July 15. Photographs revealed that these were likely all different individuals. Both groups were observed in relatively shallow water close to shore, with the June 12 sighting 10 NM south of Nantucket Island and the July 15 sighting 13 NM southwest of the island. Both groups were also milling at the surface and diving, with one whale observed sleeping vertically at the surface during the June 12 sighting (O'Brien et al. 2020a). The most recent survey was conducted between March and October 2020. No sperm whales were detected during the survey period (O'Brien et al. 2020b).

From 2018 to 2020 geotechnical and geophysical surveys in or adjacent to the SWDA detected sperm whales acoustically and/or visually twice in spring and summer months. Group size ranged from one to two individuals (Vineyard Wind 2018; 2020a; 2020b). Sperm whales are expected to be present but uncommon in the SWDA based on survey sightings. A map of sperm whale maximum seasonal density is presented in Figure 6.7-5.



New England Wind

AVANGRID RENEWABLES

Figure 6.7-5

Map of Sperm Whale Maximum Seasonal Density from Roberts et al. (2016a, 2022)

Abundance

Though there is currently no reliable estimate of total sperm whale abundance in the entire Western North Atlantic, the most recent and best available population estimate for the US Atlantic EEZ is 4,349 (Hayes et al. 2020).

Status

Sperm whales are listed as Endangered under the ESA and MA ESA, and the North Atlantic stock is considered strategic by NMFS under the MMPA. The minimum population size is estimated at 3,451. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is assumed to be 0.1, because the sperm whale is listed as Endangered. PBR for the Western North Atlantic sperm whale stock is 3.9 (Hayes et al. 2020). From 2013 through 2017, there are no documented reports of fishery-related mortality or serious injury to this stock (Hayes et al. 2020). No critical habitat areas have been designated for the sperm whale under the ESA.

6.7.1.3.8 Harbor Porpoises

The harbor porpoise is abundant throughout the coastal waters of the Northern hemisphere and the only porpoise species found in the Atlantic Ocean. This species is a small, stocky cetacean with a blunt, short-beaked head, dark gray back, and white underside (NOAA Fisheries 2021g). Harbor porpoises reach a maximum length of 1.8 m (6 ft) and feed on a wide variety of small fish and cephalopods (Kenney and Vigness-Raposa 2010; Reeves and Read 2003). Most harbor porpoise groups are small, usually between five and six individuals, although they aggregate into large groups for feeding or migration (Jefferson et al. 2008).

Harbor porpoises are considered high-frequency cetaceans. The dominant component of harbor porpoise echolocation signals are narrowband, high-frequency clicks within 130 to 142 kHz (Villadsgaard et al. 2007).

Distribution

The harbor porpoise is usually found in shallow waters of the continental shelf, although they occasionally travel over deeper offshore waters. They are commonly found in bays, estuaries, harbors, and fjords less than 200 m (656 ft) deep (NOAA Fisheries 2021g). Hayes et al. (2022) report that harbor porpoises are generally concentrated along the continental shelf within the northern Gulf of Maine and southern Bay of Fundy region during summer (July to September). During fall (October to December) and spring (April to June), they are more widely dispersed from New Jersey to Maine. In winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina with lower densities found in waters off New York to New Brunswick, Canada (Hayes et al. 2022). There are four distinct populations of harbor porpoise in the Western Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Hayes et al. 2022). Harbor porpoises observed within the US Atlantic EEZ are considered part of the Gulf of Maine/Bay of Fundy stock.

Kraus et al. (2016) indicate that harbor porpoises occur within the MA and RI/MA WEAs in fall, winter, and spring. Harbor porpoises were observed in groups ranging in size from three to 15 individuals and were primarily observed in the Kraus et al. (2016) study area from November through May, with very few sightings during June through September.

During more recent surveys (October 2018-August 2019), harbor porpoises accounted for 15% of small cetacean sightings, and were seen in all seasons except fall (O'Brien et al. 2020a). They were distributed farther north in the MA and RI/MA WEAs than the other small cetacean species, and many sightings occurred outside of the lease areas. The most recent surveys between March and October 2020 only revealed two sightings of single harbor porpoises, and both observations were in summer (O'Brien et al. 2020b).

Abundance

According to data collected in 2016 by NEFSC and DFO, the best abundance estimate for harbor porpoises is 95,543 individuals NOAA Fisheries (2021). The total annual estimated human-caused mortality and serious injury is 217 harbor porpoises per year based on fisheries observer data Hayes et al. (2022).

Status

Harbor porpoises are not listed as Threatened or Endangered under the ESA or the MA ESA or designated as a strategic stock under the MMPA.

6.7.1.4 Pinnipeds

Four species of pinnipeds are known to occur or could potentially occur in the Atlantic Ocean near the SWDA: the harbor seal, gray seal, harp seal, and hooded seal. Like all pinnipeds, these animals have an amphibious lifestyle and are found nearshore (especially near their haul-out/ breeding sites) as well as in offshore waters. All four seal species are phocids, or true seals, having no external ears. Hooded seals habitat range is typically outside the SWDA, usually in deeper water, or they are so rarely sighted that their presence is unlikely and therefore they are not described further. The remaining three pinniped species are most likely to occur in the region during winter and early spring.

6.7.1.4.1 Gray Seals

Gray seals are the second most common pinniped in the US Atlantic coast (Jefferson et al. 2008). This species inhabits temperate and sub-arctic waters and lives on remote, exposed islands, shoals, and unstable sandbars (Jefferson et al. 2008). Gray seals are large, reaching 2 to 3 m (7 to 10 ft) in length, and have a silver-gray coat with scattered dark spots (NOAA Fisheries 2021f). These seals are generally gregarious and live in loose colonies while breeding (Jefferson et al. 2008). Though they spend most of their time in coastal waters, gray seals can dive to depths of 300 m (984 ft) and frequently forage on the OCS (Jefferson et al. 2008; Lesage and Hammill 2001).

These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (Bonner 1971; Jefferson et al. 2008; Reeves 1992). They often co-occur with harbor seals because their habitat and feeding preferences overlap (NOAA Fisheries 2021f).

Gray seals, as with all pinnipeds, are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 100 Hz to 3 kHz (DoN 2008).

Distribution

Gray seals range from Canada to New York; however, stranding records as far south as Cape Hatteras (Gilbert et al. 2005) have been recorded. The eastern Canadian population of gray seals ranges from New Jersey to Labrador and is centered at Sable Island, Nova Scotia (Davies 1957; Lesage and Hammill 2001; Mansfield 1966; Richardson and Rough 1993). There are three breeding concentrations in eastern Canada: Sable Island, Gulf of St. Lawrence, and along the east coast of Nova Scotia (Lavigueur and Hammill 1993). In US waters, gray seals primarily pup at four established colonies: Muskeget and Monomoy islands in Massachusetts, and Green and Seal Islands in Maine. Since 2010, pupping has also been observed at Noman's Island in Massachusetts and Wooden Ball and Matinicus Rock in Maine (Hayes et al. 2022). Although white-coated pups have stranded on eastern Long Island beaches in New York, no pupping colonies have been detected in that region. Following the breeding season, gray seals may spend several weeks ashore in late spring and early summer while undergoing a yearly molt. Gray seals are expected to occur year-round around the potential OECC route (including the Western Muskeget Variant), with seasonal occurrence in the Offshore Development Area from September to May (Hayes et al. 2022).

Kraus et al. (2016) observed gray seals in the MA and RI/MA WEAs, and surrounding areas, but this survey was designed to target large cetaceans, so locations and numbers of seal observations were not included in the study report. During the continuation of surveys in the MA and RI/MA WEAs between October 2018 and August 2019, three gray seals were observed during three sightings (O'Brien et al. 2020a). A further 77 sightings were made of 3,963 unidentified seals however, so it is likely their abundance based on this survey is underestimated. Three unidentified seals were sighted during the March to October 2020 surveys (O'Brien et al. 2020b).

Gray Seals were observed on two occasions during the 2016 G&G survey and two additional occasions in the 2017 survey in the SWDA (Vineyard Wind 2016; 2017).

Abundance

The gray seal is found on both sides of the North Atlantic, with three major populations: Northeast Atlantic, Northwest Atlantic, and Baltic Sea (Haug et al. 2013). The Western North Atlantic stock is equivalent to the Northwest Atlantic population, and ranges from New Jersey to Labrador (Katona et al. 1993; Lesage and Hammill 2001; Mansfield 1966; Scott et al. 1990). In US waters alone NOAA Fisheries (2021) estimated an abundance of 27,300.

Status

Gray seals are not listed as Threatened or Endangered under the ESA or the MA ESA, and they are not considered strategic under the MMPA.

6.7.1.4.2 Harbor Seals

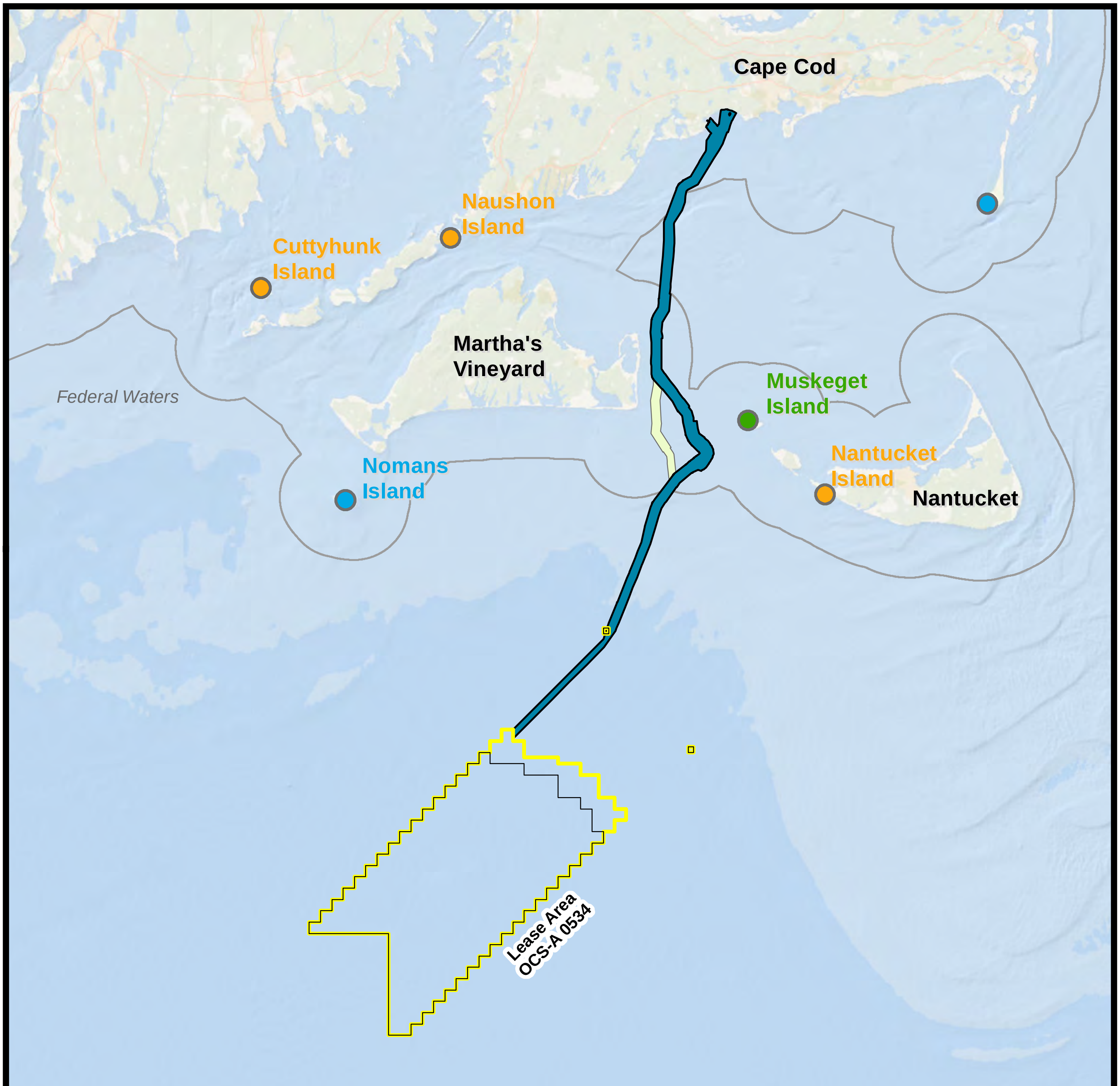
The harbor seal is found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30° N and is the most abundant pinniped within the US Atlantic EEZ (Hayes et al. 2022). This species is approximately 2 m (7 ft) in length and has a blue-gray back with light and dark speckling (NOAA Fisheries 2021h). Harbor seals complete both shallow and deep dives during hunting, depending on the availability of prey (Tollit et al. 1997). This species consumes a variety of prey, including fish, shellfish, and crustaceans (Bigg 1981; Burns 2002; Jefferson et al. 2008; Reeves 1992). Harbor seals commonly occur in coastal waters and on coastal islands, ledges, and sandbars (Jefferson et al. 2008).

Male harbor seals produce underwater vocalizations during mating season to attract females and defend territories. These calls are comprised of "growls" or "roars" with peak energy at 200 Hz (Sabinsky et al. 2017). Captive studies have shown that harbor seals have good (greater than 50%) sound detection thresholds between 0.1 and 80 kHz, with primary sound detection between 0.5 and 40 kHz (Kastelein et al. 2009).

Distribution

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Richardson and Rough 1993) and occur seasonally from southern New England to New Jersey coasts between September and late May (Barlas 1999; Schneider and Payne 1983; Schroeder 2000). In the Western North Atlantic, they are distributed from eastern Canada to southern New England and New York, and occasionally as far south as the Carolinas (Payne and Selzer 1989). A general southward movement from the Bay of Fundy to southern New England occurs in fall and early winter (Barlas 1999; Jacobs and Terhune 2000; Rosenfeld et al. 1988; Whitman and Payne 1990). A northward movement from southern New England to Maine and eastern Canada takes place prior to the pupping season, which occurs from mid-May through June along the Maine coast (Kenney 1994; Richardson 1976; Whitman and Payne 1990; Wilson 1978).

Kraus et al. (2016) observed harbor seals in the MA and RI/MA WEAs, and surrounding areas, but this survey was designed to target large cetaceans so locations and numbers of seal observations were not included in the study report (Kraus et al. 2016). Harbor seals have five major haul-out sites in and near the MA and RI/MA WEAs: Monomoy Island, the northwestern side of Nantucket Island, Nomans Land, the north side of Gosnold Island, and the southeastern side of Naushon Island (Payne and Selzer 1989) (see Figure 6.7-6**.**). Increased abundance of seals in the northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites from the Maine/New Hampshire border to eastern Long Island and New Jersey (Barlas 1999;



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Scale 1:600,000
1 inch = 9 miles

0 5 10 mi
0 8 16 km

Map Coordinate System: NAD 1983 UTM 19N Meters

LEGEND

Southern Wind Development Area (SWDA)
New England Wind Offshore Export Cable Corridor (OECC)
Phase 2 OECC Western Muskeget Variant
State/Federal Boundary

Seal Haul Out/Pupping Locations
Gray Seals
Harbor Seals
Gray Seals/Harbor Seals

New England Wind
AVANGRID RENEWABLES

Figure 6.7-6
Major Haul-Outs of Harbor Seals and Pupping Locations of Seals Near the SWDA and OECC

deHart 2002; Hoover et al. 1999; Payne and Selzer 1989; Rough 1995; Slocum et al. 1999). A total of 77 sightings were made of 3,963 unidentified seals during the surveys that occurred between October 2018 and August 2019, and three unidentified seals were sighted during the March to October 2020 surveys (O'Brien et al. 2020a; O'Brien et al. 2020b). Based on their known distribution in the MA and RI/MA WEAs and surrounding areas, it is likely that some harbor seals were included in the unidentified seal sightings.

Abundance

Although the stock structure of the Western North Atlantic population is unknown, it is thought that harbor seals found along the eastern US and Canadian coasts represent one population that is termed the Western North Atlantic stock (Andersen and Olsen 2010; Temte et al. 1991). The best estimate of abundance for harbor seals in the Western North Atlantic stock is 61,336 (Hayes et al. 2022). This estimate was derived from a coast-wide survey along the coast of Maine during May and June 2012.

Status

The Western North Atlantic stock of harbor seals is not listed as Threatened or Endangered under the ESA or the MA ESA, and it is not considered strategic under the MMPA.

6.7.1.4.3 Harp Seals

The harp seal is found throughout the North Atlantic and Arctic Oceans (Lavigne and Kovacs 1988). This species is approximately 1.7 m (5.6 ft) in length and has light gray fur with a black face and a horseshoe-shaped black saddle on its back (NOAA Fisheries 2021i). Harp seals complete shallower dives relative to other pinnipeds (Schreer and Kovacs 1997). This species consumes a variety of species of finfish and invertebrates, mainly capelin, cod (Gadidae), and krill (NOAA Fisheries 2021i).

Distribution

Harp seals are year-round inhabitants of the coastal waters off eastern Canada and occur seasonally in the northeastern US. Harp seals begin their seasonal shift south toward US waters following summer feeding in more northern Canadian waters (Lavigne and Kovacs 1988; Sergeant 1965). The most southerly point of observation for this species is New Jersey, from January through May (Harris et al. 2002). Sightings of harp seals this far south have been increasing since the early 1990s. The number of sightings and strandings from January to May have also increased off the east coast of the US (NOAA Fisheries 2021i). A total of 77 sightings were made of 3,963 unidentified seals during aerial surveys in the MA and RI/MA WEAs that occurred between October 2018 and August 2019, and three unidentified seals were sighted during the March to October 2020 surveys (O'Brien et al. 2020a; O'Brien et al. 2020b). It is possible that some harp seals were included in the unidentified seal sightings.

Abundance

The world's harp seal population is divided into three separate stocks, with the Front/Gulf stock equivalent to the Western North Atlantic stock (Bonner 1990; Lavigne and Kovacs 1988). The best estimate of abundance for harp seals in the Western North Atlantic stock is 7.6 million (Hayes et al. 2022).

Status

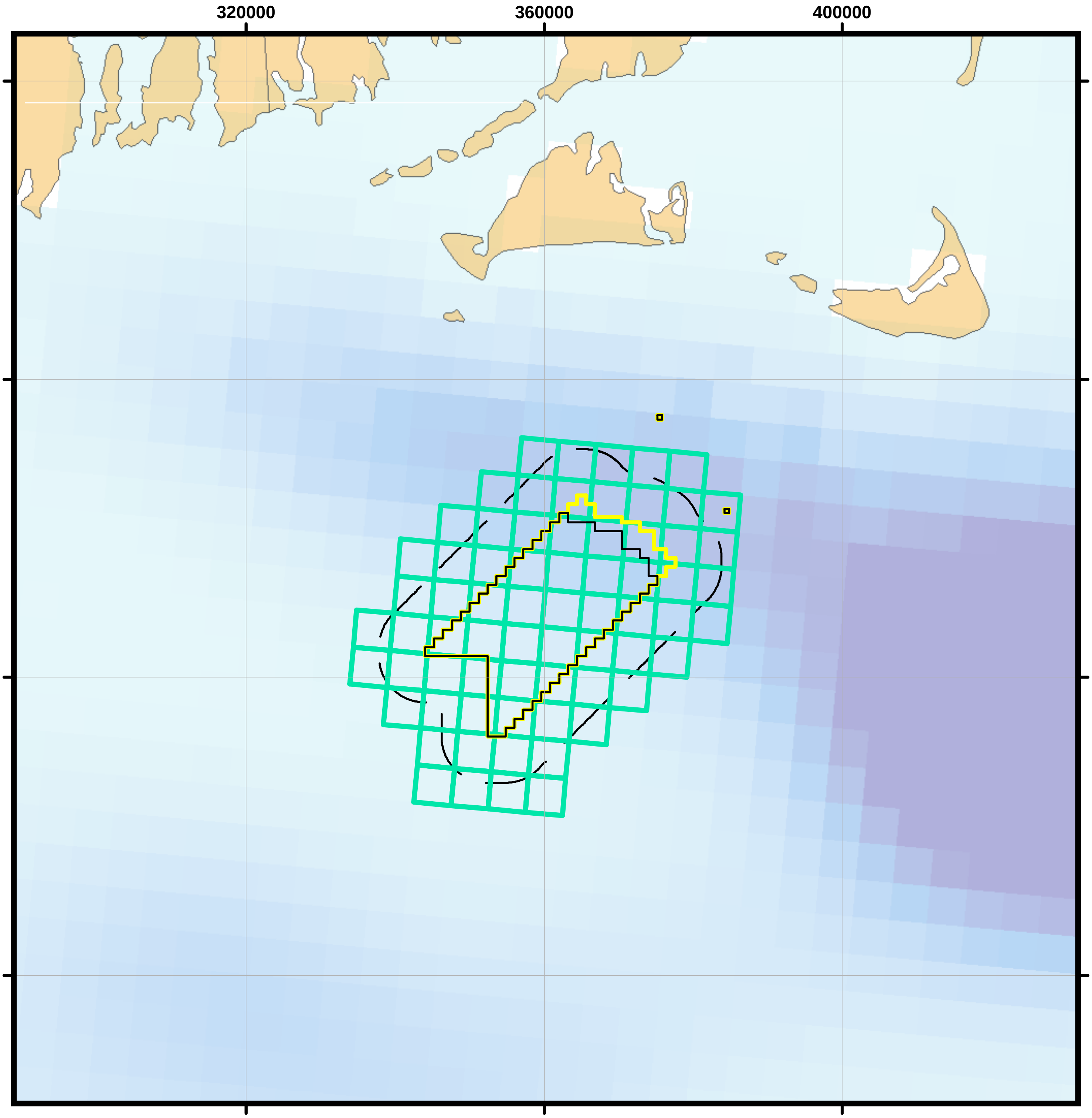
The harp seal is not considered strategic under the MMPA, not listed as Threatened or Endangered under the ESA, and not listed under the MA ESA.

6.7.1.5 Mean Monthly Marine Mammal Density Estimates

Mean monthly marine mammal density estimates (animals per 100 square kilometers [animals/100 km^2]) for all species are provided in Figure 6.7-2.. These were obtained using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016a; 2016b; 2017; 2018; 2021b) and include recently updated model results for North Atlantic right whale (NARW). The updated model includes new estimates for NARW abundance in Cape Cod Bay in December. Additionally, model predictions are summarized over three eras, 2003–2018, 2003–2009, and 2010–2018, to reflect the apparent shift in NARW distribution around 2010. The modeling conducted in this report uses the 2010–2018 density predictions.

Densities were calculated within a 6.2 km buffered polygon around the SWDA perimeter. The buffer size was selected as the largest 10 dB-attenuated exposure range over all species, scenarios, and threshold criteria, with the exception of the Wood et al. (2012) thresholds. Wood et al. (2012) exposure ranges were not considered in this estimate since they include a small subset of very long ranges for migrating mysticetes and harbor porpoise. The mean density for each month was determined by calculating the unweighted mean of all 10 × 10 km (5 × 5 km for NARW) grid cells partially or fully within the analysis polygon (Figure 6.7-7). Densities were computed for an entire year to coincide with possible planned activities. In cases where monthly densities were unavailable, annual mean densities were used instead.

Long-finned and short-finned pilot whales were modeled separately, although there is only one density model for pilot whales from Roberts et al. (2016a; 2016b; 2017). Densities were scaled for these species based on their relative abundances.



Map Coordinate System: WGS 1984 UTM Zone 19N

Scale 1:750,000
1 inch = 12 miles

0 10 20 Miles

0 10 20 Kilometers

LEGEND
Lease Area OCS-A 0534
Southern Wind Development Area
6.2km Buffer
Density Grid Cells
Marine mammal density
High
Low

New England Wind
AVANGRID RENEWABLES

Figure 6.7-7
Marine Mammal (e.g. NARW) Density Map Showing Highlighted Grid Cells Used to Calculate Mean Monthly Species Estimates Within a 6.2 km Buffer Around the SWDA (Roberts et al. 2016, 2022b)

6.7.1.5.1 Uncommon Species

Uncommon species, including sperm whales, Atlantic spotted dolphins, Risso's dolphins, short and long-finned pilot whales, and harp seals are unlikely to be exposed to sound from pile driving due to the relatively short duration of each pile driving event and these species' infrequent occurrence in the SWDA. Kraus et al. (2016) reported sightings of only one sperm whale in fall and three groups totaling eight sperm whales in summer over a five-year aerial survey study specifically focused on the MA WEA and RI/MA WEA. These sightings occurred in two different years. Only two sightings totaling two Risso's dolphins were recorded by Kraus et al. (2016) during the same period. Pilot whales were observed 11 and three times in spring and summer, respectively, during aerial surveys of the RI/MA WEA during 2011–2015 (Kraus et al. 2016).

Harp seals were not observed during any of the AMAPPS surveys. Harp seals typically breed on pack ice and migrate southward in fall to areas of Nova Scotia; however, harp seals have been observed in US waters during winter and spring (Harris et al. 2002), and harp seals have been occasionally recorded on land south of the MA WEA and RI/MA WEA, in the New York region, usually in groups of one or two individuals (CRESLI 2021). Approximately 11 individuals have been observed by the Coastal Research and Education Society of Long Island near Long Island since 2008 (CRESLI 2021). A total of 96 harp seals strandings were recorded in Massachusetts from 2007 to 2011 (Hayes et al. 2017).

Despite their infrequent occurrence, uncommon species were included in the modeling effort.

6.7.2 Potential Impacts of New England Wind

Construction and installation, operations, and maintenance (O&M), and decommissioning activities associated with New England Wind have the potential to affect marine mammals through impact producing factors (IPFs) (see Table 6.7-1). This section provides an assessment of the potential risks to marine mammal populations from New England Wind activities. Criteria used for this risk assessment are shown in Table 6.7-1. This broad assessment is supplemented with a detailed acoustic impact analysis for construction activities found in Appendix III-M.

This assessment of potential impacts considers the full buildout of Phases 1 and 2 of New England Wind. Specifically, the assessment considers the potential for up to 130 wind turbine generator (WTG)/electrical service platform (ESP) grid positions. Two of these grid positions may potentially have co-located ESPs (i.e. two monopile foundations installed at one grid position),[80] resulting in 132 foundations.[81]

To assess the potential impacts of anthropogenic sound to marine mammals, and following consultation with BOEM, the 12 m (39.4 ft]) monopiles were considered for Phase 1. The 13 m (42.7 ft) monopiles were considered for Phase 2, but it is expected that the majority of the monopiles for Phase 2 will be close to 12 m (39.4 ft) in diameter (see Appendix III-M). A modeling comparison showed minimal difference between the 12 m and 13 m monopile using a 5,000 kJ hammer. Given these similarities, the 13 m monopile was not modeled at 6,000 kJ in the acoustic assessment and the 12 m monopile with 6,000 kJ hammer energy was assumed to be a reasonable replacement in exposure calculations. The maximum jacket foundation pile size included in both Phases (4 m [13 ft]) is also assessed. Details of the acoustic modeling approach are described in Appendix III-M.

This assessment also considers potential impacts to marine mammals from installation of up to five cables within the OECC (including the Western Muskeget Variant) for both Phases of New England Wind. It should be noted that conservative assumptions were applied throughout the assessment (e.g. pile diameters may be smaller and actual hammer energies required may be lower), and animal aversion was not included in the acoustic modeling, although it is expected to occur during construction. Monitoring and mitigation of protective zones was also not included in the acoustic analysis but is considered here as an approach that may be used to reduce the risk of impacts to marine mammals from exposure to anthropogenic sound. The potential risks posed by New England Wind activities and their associated stressors are categorized as very low, low, moderate, or high based on the probability of marine mammal exposure and the vulnerability of the marine mammal species to development stressors (see Table 6.7-1). Occurrences of marine mammal species and their relationships to the established criteria were evaluated using:

- Existing literature on marine mammal distribution and habitat use in the SWDA,
- Information on the potential impacts of offshore wind farm construction and operations in both the US and globally, and

80 If co-located ESPs are used, each ESP's monopile foundation would be located within 76 m (250 ft) of one of the potential ESP grid locations (i.e. the monopiles would be separated by up to 152 m [500 ft]).

81 A total of 132 foundations are presently proposed. New England Wind previously also included one additional foundation for a potential reactive compensation station (RCS), bringing the total to 133 foundations. All hydroacoustic modeling was conducted for 133 foundations prior to the elimination of the potential RCS, which reduced the number of foundations to 132. The reduction to 132 foundations was determined to have a negligible effect on the predicted number of exposures, so the modeling was not redone.

- ♦ Studies that provide a general understanding of hearing, vessel collision risk, response to anthropogenic sound, and other factors that influence the potential impacts of offshore wind construction, operation, and decommissioning activities on marine mammals.

Based on this assessment, some of the IPFs are expected to pose little to no risk to populations of marine mammals (i.e. very low risk category). Therefore, further in-depth analysis was not conducted. These include potential impacts from marine debris, reductions in prey availability, habitat disturbance and modification, entanglement, EMFs, and sediment mobilization. Each of these is briefly described below. See Table 6.7-2 for criteria for determining an impact risk level of "very low." The remainder of this section focuses on impacts to marine mammals associated with underwater sound and vessel traffic during construction and installation (see Section 6.7.2.2), operations and maintenance (see Section 6.7.2.2.2), and decommissioning (see Section 6.7.2.4). Avoidance, minimization, and mitigation measures to reduce the effects of these IPFs during all development stages are provided in Section 6.7.4.

This risk assessment considers the definitions of harassment established by NMFS under the MMPA for the purposes of evaluating the potential impacts of sound on marine life. The MMPA defines any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild as Level A Harassment. Level B Harassment is defined as any act that has the potential to disturb marine mammals or their stock in the wild by causing a disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. New England Wind has the potential to "harass" marine mammals through sound exposure and vessel interaction, as discussed in Section 6.7.2.2. Mitigation and best management practice (BMP) measures implemented during New England Wind activities are expected to minimize the potential impacts of anthropogenic sound on marine mammals and avoid vessel collisions.

Importantly, positive impacts to marine mammals are expected to occur from New England Wind, and these positive impacts are briefly described in Section 4.1.

Table 6.7-1 Impact Producing Factors for Marine Mammals

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Underwater noise	•	•		•	•	•
Vessel collision	•	•		•	•	•
Marine debris	-	-		-	-	-
Reduction in prey abundance	-	-		-	-	-

Table 6.7-1 Impact Producing Factors for Marine Mammals (Continued)

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Habitat alteration	-	-		-	-	-
Entanglement hazard	-	-		-	-	-
Electromagnetic fields	-	-		-	-	-
Suspended sediments	-	-		-	-	-

Note:
The symbol "-" indicates an impact producing factor was assessed but is not expected to pose a risk to marine mammal populations.

Table 6.7-2 Definitions of Risk, Exposure, and Vulnerability for Marine Mammals

Risk Level	Exposure	Individual Vulnerability
Very low	No or limited observations of the species in or near the SWDA and OECC and acoustic exposure zones (low expected occurrence) *and/or* Species tends to occur mainly in other habitat (e.g. deeper water or at lower/higher latitudes) *and/or* No indication that SWDA has regional importance	Literature and/or research suggest the affected species and timing of the stressor are not likely to overlap *and/or* Literature suggests limited sensitivity to the stressor *and/or* Little or no evidence of impacts from the stressor in the literature
Low	Few observations of the species in or near the SWDA and OECC and noise exposure zones (occasional occurrence) *and/or* Seasonal pattern of occurrence in or near the SWDA and OECC and acoustic exposure zones	Literature and/or research suggest the affected species and timing of the stressor may overlap *and/or* Literature suggests some low sensitivity to the stressor *and/or* Literature suggests impacts are typically short-term (end within days or weeks of exposure) *and* Literature describes mitigation/BMPs that reduce risk

Table 6.7-2 Definitions of Risk, Exposure, and Vulnerability for Marine Mammals (Continued)

Risk Level	Exposure	Individual Vulnerability
Moderate	Moderate year-round use of the SWDA and OECC and acoustic exposure zones *and/or* Evidence of preference for near-shore habitats and shallow waters in the literature	Literature and/or research suggest the affected species and timing of the stressor are likely to overlap. *and/or* Literature and/or research suggest a moderate susceptibility to the stressor exists in the region and/or from similar activities elsewhere. *and* Literature does not describe mitigation/BMPs that reduce risk
High	Significant year-round use of the SWDA and OECC and acoustic exposure zones	Literature and/or research suggest the affected species and timing of the stressor will overlap *and* Literature suggests significant use of SWDA and OECC and acoustic exposure zones for feeding, breeding, or migration *and* Literature does not describe mitigation/BMPs that reduce risk

6.7.2.1 IPFs Not Expected to Pose a Risk to Marine Mammal Populations

6.7.2.1.1 Reductions in Prey Abundance

As demonstrated in Sections 6.5 and 6.6, potential impacts to benthic and finfish resources from substrate (habitat) disturbance, noise, and increased suspended sediments will be localized and short-term; therefore, risk of declining prey availability is not anticipated. Increased substrate and reef effects are likely to increase prey availability for some species in operating wind farms (Bergström et al. 2014; Russell et al. 2014). Bergstrom et al. (2014) assessed windfarms in the North Sea and Baltic Sea and found that disturbance associated with underwater sound during construction was lower for commercial demersal fish species (e.g. wrasses, cod, sculpins) than for marine mammals, suggesting that fish would not be temporarily displaced further than marine mammals during pile driving events, and therefore fish would remain available as prey for marine mammals. Bergström et al. (2013) found increased densities of some fish species close to operating WTGs, but no large-scale effects on fish diversity or abundance. With respect to suspended sediments, sediment modeling tends to be conservative and sampling conducted for the Block Island Wind Farm did not show measurable impacts compared to modeling results (Elliot et al. 2017). Therefore, it is not expected that New England Wind activities will reduce prey availability to marine mammals.

6.7.2.1.2 Habitat Alteration

The presence of WTG/ESP foundations and offshore export cables are not expected to significantly modify marine mammal habitat. Habitat alterations will include the creation of hard substrate around WTG and ESP foundations and the loss of habitat from the footprint of the installations as well as the introduction of structures into the water column. These structures are intended to remain in place throughout the approximately 30-year operational life of the project. For the SWDA, WTGs/ESPs will be oriented in an east-west, north-south grid pattern with one nautical mile (NM) (1.85 km) spacing between WTG/ESP positions. Such large distances between WTGs/ESPs will minimize the extent of habitat modification that could potentially impact marine mammals and make it unlikely that these structures would impede marine mammal movement. With few notable exceptions, the majority of studies indicate that marine mammals are likely to use the area after the WTGs are installed, as demonstrated by the continued use of areas where other structures have been built in marine environments. For example, Delefosse et al. (2018) evaluated sightings of marine mammals around 25 fixed oil and gas installations in the North Sea. Observations of harbor porpoises, minke whales, killer whales (*Orcinus orca*), white-beaked dolphins (*Lagenorhynchus albirostris*), pilot whales, harbor seals, and gray seals reflected the general expectation for marine mammal abundance and diversity in the area. Additionally, while a study in the Baltic Sea documented 89% fewer harbor porpoises inside a wind farm during construction and 71% fewer 10 years later compared to baseline levels (Teilmann and Carstensen 2012), a similar study found a significant increase of 160% in harbor porpoise presence within an operating wind farm in the Dutch North Sea (Scheidat et al. 2011). Barriers to activities, including migration, are not anticipated from modification of the water column habitat.

6.7.2.1.3 Entanglement Hazard

New England Wind activities are not expected to pose an entanglement risk to marine mammals. Steel anchor cables used on construction vessels are typically five to seven centimeters (cm) (2–3 inches [in]) in diameter, and these cables are under tension while deployed, eliminating the potential for entanglement. Similarly, tow lines for cable installation and taut lines for metocean buoys (described in Sections 3.3.1.11 and 4.3.1.11 of COP Volume I) are expected to be under constant tension and should not present an entanglement risk for marine mammals. Second, as reported in Inger et al. (2009), WTGs are unlikely to be a significant risk for entanglement of marine mammals given the large, static nature of the structures. Lost fishing gear and other marine debris could possibly catch on WTGs and present a secondary entanglement hazard to marine mammals; however, WTG/ESP foundations have large monopile diameters (up to 12 m [39 ft] or 13 m [43 ft]) or jacket diameters (up to 4 m [13 ft]) without protrusions on which lost fishing gear or other marine debris could become snagged. As such, it is unlikely that secondary entanglement of marine mammals in such debris would occur. New England Wind maintenance activities during the construction and operation of WTGs provide an opportunity to remove debris that would otherwise remain in the ocean, reducing debris entanglement risks. Finally, all undersea cables have large diameters and will be buried in the seabed at depths of up to 1.5–2.5 m (5–8 ft). Where target burial depths cannot be achieved, the cables would be covered with concrete mattresses or similar protective measures that would preclude any risk of entanglement.

6.7.2.1.4 Marine Debris

The Clean Water Act and other applicable federal and international regulations will be followed to prevent the release of substances into the ocean during construction, operation, and decommissioning of New England Wind. Any items that could become marine debris will be appropriately discarded ashore. Thus, activities occurring in the SWDA are not expected to produce marine debris and therefore would not pose a risk to marine mammals.

6.7.2.1.5 Electromagnetic Fields

The offshore cable system for New England Wind will generate EMFs. However, the intensity of any generated EMFs will be minimized by cable burial into the seafloor at depths of 1.5–2.5 m (5–8 ft). EMFs are a natural occurrence that certain marine mammals are capable of detecting (Bauer et al. 1985; Czech-Damal et al. 2013; Kirschvink 1990; Kirschvink et al. 1986; Walker et al. 2003; 1992).

There is limited research into the impacts of EMF on marine mammals (Slater et al. 2010). Behavioral disturbances, such as temporary changes in swim direction or longer detours during migrations, are possible, as studies have demonstrated statistical increases in strandings near naturally occurring, slightly weakened, magnetic fields (Kirschvink 1990). However, studies that examined the reaction of harbor porpoises to operating subsea cable EMFs did not detect changes in behavior (Gill et al. 2005; Slater et al. 2010; Walker 2001). While it has been suggested that species that feed near the benthos are at greater risk than those that feed in the water column (Normandeau Associates et al. 2011), none of the common species of marine mammals in the SWDA are benthic foragers. Several reviews of existing studies have determined that, due to the lack of documented evidence of marine mammal interactions with subsea cables, cetaceans would likely not be affected by subsea cable EMFs, as the area of influence would be too small to alter their behavior (Copping et al. 2016; Gill et al. 2014; Normandeau Associates et al. 2011). Therefore, EMFs associated with New England Wind's offshore cable system are not expected to pose a risk to marine mammals.

6.7.2.1.6 Suspended Sediments

Suspended sediments caused by disturbance of the seafloor would be limited to an area near the construction or maintenance activity and be short-term. Field verification of sediment plume modeling for cable installation during Block Island Wind Farm indicated that the actual sediment plume was less than the modeled plume, without any evidence of the jet plow causing a sediment plume in the water column (Elliot et al. 2017).

Sediment plumes are dependent on sediment type and, therefore, mobilization of sediments would be expected to vary from region to region. Sediments in the SWDA and along the OECC in water depths greater than 30 m (98.4 ft) are predominately fine sand with some silt, fining in the offshore direction. Heading north through Muskeget Channel, median grain size increases, with sand and gravel dominant, along with coarser deposits (cobbles and boulders) locally. Continuing north into the main body of Nantucket Sound, sand still dominates the seabed, with coarser deposits concentrated around shoals and in high current areas, with finer grained sediments occupying deeper water and/or more quiescent flow areas. These sandy sediments would be expected to settle quickly. A Sediment Transport Modeling Study provided in Appendix III-A predicts that suspended sediments from cable installation activities in the SWDA and along the OECC (including the Western Muskeget Variant) would settle out within approximately six hours or less at any given location. Marine mammals are also expected to avoid areas very close to pile driving, dredging, or offshore export cable installation, thereby avoiding areas where most temporarily suspended sediments may occur before settling back to the bottom. Therefore, based on the limited mobilization of sediment into the water column, New England Wind activities are not expected to pose a risk to marine mammals.

The above potential risk producing factors that are not expected to impact, or are deemed **very low** risk to marine mammal populations-reduction in prey availability, habitat disturbance and modification, marine debris, EMFs, entanglement, and sediments (see Table 6.7-1) are not addressed further in this analysis.

The remaining IPFs are underwater sound and vessel interaction. These will be described in detail in the following sections.

6.7.2.2 Construction and Installation

6.7.2.2.1 Underwater Noise (Phases 1 and 2)

Marine mammals use sound, either by actively producing or passively listening to sounds, for basic life functions such as communicating, navigating, foraging, detecting predators and maintaining social networks. Toothed whales (odontocetes) have been documented to produce echolocation sounds to image their surroundings and find prey and some research suggests that baleen whales may also have echo ranging function (Beamish and Mitchell 1971; Clark and Ellison 2004; Mercado 2018). Additionally, marine mammals passively listen to sounds to learn about their environment by gathering information from other marine mammals, prey species, and physical phenomena such as wind, waves, rain, and seismic activity (Richardson et al. 1995). Scientific knowledge of how anthropogenic sound sources could potentially affect marine mammals is rapidly evolving, with significant research investment by industry, government, and academia into improving the understanding of the impacts of sound from pile driving and other industrial operations on marine mammals, as well as the potential to reduce these impacts through mitigation procedures.

Potential noise-induced impacts on marine mammals include physical effects (such as auditory and non-auditory impairment), behavioral disruption, acoustic masking, and physiological responses (stress) as well as secondary effects (e.g. mediated through noise-induced effects on prey species). The likelihood of a potential impact from an anthropogenic activity is dependent upon the spatial and temporal co-occurrence of animals and the activity. The severity of any noise-induced effect on marine mammals depends on the characteristics of received sounds (received level, frequency band, duration, rise time, duty cycle, etc.), the distance over which the sound travels, the biological context within which it occurs, the sound propagation environment, and the activity of the animal under consideration (Ellison et al. 2016; Ellison et al. 2012; Ellison et al. 2018). Marine mammals exposed to anthropogenic sound may experience impacts ranging in severity from minor disturbance to non-auditory injury (NMFS 2018; Southall et al. 2007; 2019; Wood et al. 2012).

Exposure to intense levels of anthropogenic sound can lead to an increase in hearing threshold in marine mammals (Finneran 2015). This increase in hearing threshold is called a threshold shift (TS), which means that the hearing becomes less sensitive (i.e. poorer). If this effect is reversable and the hearing threshold returns to its normal sensitivity, the TS is called a temporary threshold shift (TTS). If the threshold shift remains and does not return completely to normal, the residual TS is called a permanent threshold shift (PTS). TS can be caused by exposure to intense sound of short duration, as well as exposure to lower level sounds over longer time periods (Houser et al. 2017). The metrics commonly used to assess the risk of impairment or injury to the hearing system are peak pressure (PK) and sound exposure level (SEL), which considers the sound level and duration of the exposure signal (see Appendix III-M for more detail).

6.7.2.2.1.1 Impact Pile Driving

The most likely potential impact on marine mammals from underwater sound exposure from pile driving is the elicitation of behavioral responses. To cause behavioral reactions, sound must be audible, (i.e. it must exceed the animal's hearing threshold, and it must be detectable above background noise). The nature and extent of behavioral responses differs between species, as well as between individuals of the same species. The severity of behavioral responses of marine mammals to sound exposure can vary widely, from subtle responses, which may be difficult to observe and have limited implication for the affected animal, to obvious responses, such as avoidance or panic reactions (Southall et al. 2007). The National Research Council (2005) noted that an action or activity (or lack thereof) is biologically significant to an individual animal when it affects its ability to grow, survive, and reproduce (i.e. basic life functions), which can lead to population-level consequences and affect the viability of the species. The hearing threshold for perceiving or detecting a signal of interest can be reduced by the simultaneous presence of another sound through a process called auditory or acoustic masking (Clark et al. 2009; Erbe 2008; Erbe and Farmer 1998; Erbe et al. 2016b; Hatch et al. 2012). Masking from a single noise source occurs under conditions when the received noise level overlaps the signal of interest in time and frequency content and has a sound level high enough that the signal of interest cannot be detected or recognized by the receiving animal. Directional overlap between the noise source and signal of interest also plays a role. The greater the coincidence between the arrival directions of the noise and the signal of interest, the greater the risk of masking. Some amount of auditory masking is expected to occur in localized areas of the SWDA under conditions when an animal is in proximity to noise generating activities such as pile driving that meet the criteria above.

Acoustic Thresholds Used to Evaluate Potential Impacts on Marine Mammals

To assess the potential impacts of anthropogenic sound from New England Wind, it is necessary to first establish acoustic exposure criteria for the various species included in this assessment. The thresholds used in the assessment are relevant for both Phases of New England Wind, and for all stages of the offshore development (e.g. construction, O&M, and decommissioning). There are several auditory similarities between phylogenetically closely related species, but also significant differences between species' groups among the marine mammals. Southall et al. (2007) assigned the extant marine mammal species to functional hearing groups based on their hearing capabilities and sound production and other biological functions. This division into broad categories was intended to provide a realistic number of categories for which individual sound exposure criteria were developed. These groups were revised by NMFS (2018) (see Table 6.7-3) but the categorization has proven to be a scientifically justified and useful approach in developing auditory weighting functions and deriving noise exposure criteria for the different marine mammal groups. Southall et al. (2019) published an updated set of Level A sound exposure criteria (i.e. for onset of temporary threshold shift (TTS) and PTS in marine mammals). While the authors propose a new nomenclature and classification for the marine mammal functional hearing groups, the proposed thresholds and weighting functions do not differ in effect from those proposed by NMFS (2018).

Table 6.7-3 Marine Mammal Hearing Groups[1]

Hearing Group	Generalized Hearing Range[2]
Low-frequency (LF) cetaceans (mysticetes or baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (odontocetes: delphinids, beaked whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (other odontocetes)	275 Hz to 160 kHz
Phocid pinnipeds underwater (PW)	50 Hz to 86 kHz
Phocid pinnipeds in air[3]	50 Hz to 36 kHz

Notes:
1. NMFS (2018); Sills et al. (2014).
2. The generalized hearing range is for all species within a group. Individual hearing will vary.
3. Based on the distance from shore (37.7 km [20 NM] from Martha's Vineyard and Nantucket), sound will not reach NOAA behavioral disturbance thresholds for seals in air (90 dB sound pressure level (SPL) re 20 µPa for harbor seals and 100 dB SPL re 20 µPa for all other seal species) at land-based sites where seals may spend time out of the water. Thus in-air hearing is not considered further.

Marine Mammal Auditory Weighting Functions

The potential for anthropogenic sounds to impact marine mammals is largely dependent on whether the sound occurs in frequency ranges within which a species can hear well, unless the sound pressure level is so high that it can cause physical tissue damage regardless of frequency. Auditory (frequency) weighting functions are intended to represent a species' ability to hear a sound (Nedwell and Turnpenny 1998; Nedwell et al. 2007).

Auditory weighting functions have been proposed for marine mammals, specifically associated with PTS and TTS thresholds expressed in metrics that consider what is known about marine mammal hearing (e.g. SEL [L_E]) (Erbe et al. 2016a; Finneran 2016; Southall et al. 2007). Marine mammal auditory weighting functions published by Finneran (2016) are included in the NMFS (2018) Technical Guidance for use in conjunction with corresponding PTS (injury) onset acoustic criteria (see Table 6.7-4).

Marine Mammals Auditory Injury Exposure Criteria

Table 6.7-4 Summary of Relevant PTS Onset Acoustic Thresholds (Received Level; dB) for Marine Mammal Hearing Groups[1]

Hearing Group	Impulsive Signals[2]		Non-Impulsive Signals
	Unweighted PK (L_{pk}, dB re 1 µPa)[4]	Frequency Weighted SEL, 24hr ($L_{E,24h}$, dB re 1 µPa^{2}s)[3]	Frequency Weighted SEL, 24hr ($L_{E,24h}$, dB re 1 µPa^{2}s)[3]
LF cetaceans	219	183	199
MF cetaceans	230	185	198
HF cetaceans	202	155	173
PW	218	185	201

Notes:
1. NMFS (2018).
2. Dual metric acoustic thresholds for impulsive sounds: The largest isopleth of the two criteria is used to calculate PTS onset. If a non-impulsive sound exceeds the PK threshold associated with impulsive sounds, these thresholds are also considered.
3. $L_{E,24h}$ = sound exposure level (dB re 1 µPa^2·s).
4. L_{pk} = peak sound pressure (dB re 1 µPa).

Marine Mammals Behavioral Response Exposure Criteria

Numerous studies on marine mammal behavioral responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioral reactions. However, it is recognized that the context in which the sound is received affects the nature and extent of responses to a stimulus (Ellison et al. 2012; Southall et al. 2007). Because of the complexity and variability of marine mammal behavioral responses to acoustic exposure, NMFS has not yet released technical guidance on behavior thresholds for use in calculating animal exposures (NMFS 2018). For impulsive sounds, NMFS is currently using an unweighted sound pressure level (SPL) of 160 dB re 1 µPa and 120 dB re 1 µPa for non-impulsive sounds as behavioral response thresholds for all cetacean species (NMFS and NOAA 2005) (see Table 6.7-5). These criteria were derived from the High Energy Seismic Survey (HESS) Review Process (1999) report. This report took information on the responses of migrating gray whales (*Eschrichtius robustus*) to air gun sounds from Malme et al. (1983; 1984) and extended this to all species and contexts. The HESS team recognized that behavioral responses to sound may occur at lower levels, but substantial responses were only likely to occur above a SPL of 140 dB re 1 µPa. An extensive review of behavioral responses to sound was undertaken by Southall et al. (2007, their Appendix B). Southall et al. (2007) found varying responses for most marine mammals between an SPL of 140 and 180 dB re 1 µPa, consistent with the HESS (1999) report, but lack of convergence in the data prevented them from suggesting explicit dose-response functions. Absence of controls, precise measurements, appropriate metrics, and context dependency of responses (including the activity state of the animal) all contributed to variability. NMFS (2013) specified a set of thresholds for onset for behavioral disturbance in marine mammals (see Table 6.7-5).

Table 6.7-5 Threshold Criteria for Onset of Behavioral Disturbance in Marine Mammals for Impulsive and Non-impulsive Sound from NOAA (2018)

Hearing Group	Impulsive	Non-Impulsive
	Unweighted SPL (L_p; dB re 1 µPa)[1]	
LF cetaceans	160	120
MF cetaceans		
HF cetaceans		

Note:
1. L_p = root mean square sound pressure (dB re 1 µPa).

Impact (Impulsive) Hammer Pile Installation

Impact pile driving is the primary source of sound expected to occur during New England Wind construction. Potential impacts are assessed for the maximum Project envelope of New England Wind South assuming a full build-out of Phase 1, which includes Park City Wind and Phase 2, which includes Commonwealth Wind, over multiple years including up to 132 wind turbine generator (WTG)/electrical service platform (ESP) positions. Two foundation positions potentially have co-located ESPs (i.e. two monopile foundations installed at one grid position[82]). Over the course of construction of both Phases of New England Wind, there will be days where no pile driving occurs, resulting in periods without impulsive pile driving sounds. Impact pile driving is carried out using an impact hammer, which consists of a falling ram that repeatedly strikes the top of a pile and drives it into the ground. When the hammer strikes the pile, the impact creates stress waves traveling down the length of the pile, which couple with the surrounding medium, radiating

[82] If co-located ESPs are used, each ESP's monopile foundation would be located within 76 m (250 ft) of one of the potential ESP grid locations (i.e. the monopiles would be separated by up to 152 m [500 ft]).

acoustic energy into the water. Pile driving also generates vibration waves in the sediment, which can radiate acoustic energy back into the water from the seabed. The sound from impact pile driving is transient, repetitive, and discontinuous (McPherson et al. 2017; Reinhall and Dahl 2011). A typical strike interval for pile driving activities is 1.5 to 2 seconds.

The sound levels produced are the result of several interdependent factors such as pile size, hammer strike energy, and seabed type. Field measurements of pile driving show that source, or near-source levels are typically in the range of 210 to 250 dB re 1 µPa (Bailey et al. 2010; McHugh 2005; Tougaard et al. 2009a) and frequency is predominantly less than 1 kHz (Robinson et al. 2007; Tougaard et al. 2009a), although they can extend to much higher frequencies (MacGillivray 2018) including at least 100 kHz (Tougaard et al. 2009a). Deep and shallow-water conductor driving generate similar sound pressures; however, in deep water the pile is much longer so the ensonified area is greater (MacGillivray 2018).

Illingworth & Rodkin (2007) measured an unattenuated sound pressure within 10 m (33 ft) at a peak of 220 dB re 1 µPa for a 2.4 m (96 in) steel pile driven by an impact hammer. Studies of underwater pile driving indicate that most acoustic energy is below 1,000–2,000 Hz, with broader band sound energy (40 Hz to greater than 40 kHz) near the source, and only lower frequency (less than 400 Hz) at long ranges (Erbe 2009; Illingworth & Rodkin 2007). Brandt et al. (2011) found that for a pile driven in a wind farm in the Danish North Sea, the maximum PK level at 720 m (2,362 ft) from the source was 196 dB re 1 µPa.

To address behavioral dose responses, Wood et al. (2012) developed a probabilistic step function for which 10, 50, and 90% of individuals exposed to different dose levels of sound would be expected to exhibit behavioral responses dependent on received sound levels. This approach is discussed and applied to analyses in BOEM's Programmatic Environmental Impact Statement for Geological and Geophysical surveys in the Gulf of Mexico (BOEM 2016).

The risk to marine mammals from pile driving noise must be assessed in the context of site-specific existing ambient sound levels. Kraus et al. (2016) recorded ambient sound in the frequency range of 71–224 Hz, with sound levels ranging from 96 to 103 dB re 1 µPa during 50% of recording time in the RI/MA WEA from 2011 to 2015. Sound pressure levels were 95 dB re 1 µPa or less 40% of the time and greater than 104 dB re 1 µPa 10% of the time.

Noise from pile driving can cause temporary, localized displacement of marine mammals. For example, during construction of wind farms, harbor seals have demonstrated displacement during pile driving of up to 25 km (13.5 NM) from the center of the wind farm (Russell et al. 2016). Harbor porpoises have also demonstrated displacement of up to 20 km (10.8 NM) from pile driving for wind farms (Dähne et al. 2013), as well as documented sensitivity to temporary threshold shift (TTS) from simulated pile driving sounds (Kastelein et al. 2015; 2016).

Some habituation and/or adaptation to pile driving sound may occur as this has been observed with impulsive sound elsewhere. For example, sperm whales in the Gulf of Mexico, where seismic surveys have been conducted nearly continuously for decades, were found to maintain their behavior state when subjected to seismic sound sources, suggesting habituation to this relatively loud sound source (Miller et al. 2009). Similar results have been observed in the Arctic, where no changes were recorded in typical sperm whale vocal patterns during feeding dives in proximity to seismic survey noise (Madsen et al. 2002).

Species for which there is increased concern related to pile driving noise impacts include the NARW, other baleen whales, harbor porpoises, and seals. Pile driving produces impulsive sounds within the hearing range of baleen whales and seals (Finneran 2016; Kastelein et al. 2013), and harbor porpoises are known to avoid pile driving sounds (Brandt et al. 2016). NARWs have been documented to modify the amplitude of their calls during periods of increased ambient sound, suggesting some flexibility in adapting to temporarily noisy environments (Parks et al. 2011). NARWs may experience chronic stress associated with relatively constant anthropogenic sounds already existing in their environment (Rolland et al. 2012).

NARWs are of particular concern for potential impacts within the SWDA because of their critically Endangered status due to a continuing population decline (Pace et al. 2017), an ongoing UME (NOAA Fisheries 2021a), and a range that is limited to US and Canadian east coasts, without distribution across the North Atlantic like other baleen whale species. Further, Kraus et al. (2016) identified 77 individual NARWs in the MA and RI/MA WEAs and observed courtship behavior on multiple occasions. The BIA for NARW migration overlaps the SWDA (LaBrecque et al. 2015); however, this migration BIA extends well beyond the SWDA, suggesting suitable areas for migration are extensive (see Figure 6.7-2). Monitoring and mitigation measures proposed by New England Wind (see Section 6.7.4) are expected to reduce risk to NARWs.

Harbor porpoises are known to have high metabolic demands (Read and Hohn 1995) and have been observed to respond to anthropogenic sounds with aversion and disruptions of foraging. High-resolution movement from tagging data suggest that harbor porpoises have ultra-high foraging rates, which suggests disruption to foraging could put some individuals at risk (Wiśniewska et al. 2016). Other studies (Hoekendijk et al. 2018) caution that the feeding behaviors recorded by Wiśniewska et al. (2016) are not representative of normal behaviors, and could not be sustained over long periods of time. Adjusting their feeding behavior may suggest a resilience strategy of harbor porpoises to disruptions in their environment. Although the daily feeding rate of non-lactating adult harbor porpoises is only about 3.5% of body weight, this rate can increase to 6.3% (an increase of 80%) for lactating females in summer months, resulting in about five additional hours of foraging per day at that time (Yasui and Gaskin 1986). Studies by Dähne et al. (2013) and Brandt et al. (2011) demonstrated avoidance of offshore pile driving activities by harbor porpoises over a distance of 20 km (10.8 NM). Interruption to feeding may occur during pile driving if harbor porpoises are present in the SWDA during construction. However, except for winter, the largest densities for this species occur outside the RI/MA WEA (Halpin et al. 2009; Roberts et al. 2016a), suggesting better foraging habitat occurs outside the SWDA.

Species' distribution plays a significant role in assessing marine mammal exposure to pile driving sounds. While gray seals are present in low numbers year-round in the SWDA and harbor seals may also be present, the risk of injury to these species is low since both species mainly occur farther north than the SWDA (Hayes et al. 2017), thereby limiting the number of individuals available for exposure to pile driving relative to their populations. In addition, gray seals spend periods of time on land at haul-outs and breeding sites in the region where they are not exposed to underwater sound in the SWDA. Likewise, harbor seals are not exposed to underwater sound while on land.

The risk of behavioral disturbance is difficult to quantify, but sound exposure may cause temporary displacement and/or some decline in foraging activity in the SWDA. Species ranges for gray seals, harbor seals, and harbor porpoises extend well beyond the SWDA, and cetacean density estimates from Roberts et al. (2016a; 2016b; 2017; 2018; 2021b) suggest that numbers of baleen whales are low in the SWDA relative to preferred foraging habitats outside the area (LaBrecque et al. 2015).

The potential risk to marine mammals from exposure to impact pile driving sound is specific to hearing groups and species and may range from low to moderate without mitigation. Overall, the risk is considered low when mitigation and BMPs are implemented. Monitoring and mitigation to reduce the risk of impact of sound to marine mammals is described in more detail in Section 6.7.4.

Marine Mammal Exposure Estimates

Animal movement modeling was used to sample the sound fields generated during New England Wind pile driving by incorporating real animal movement using species-typical behavioral parameters derived from animal observations. Animal movement models integrate the modeled sound fields with biologically meaningful movement rules for each marine mammal species. The result of animal movement modeling is a sound exposure history for each animal in the model, from which the probability of exposure can be calculated. The modeled exposure probabilities are then scaled by the density of real-world animals and duration of construction to get an estimate of the number of individuals expected to receive threshold levels of sound. Key to this estimation are the modeled species' monthly densities (see Appendix III-M for more information on the calculated monthly density estimates) and the proposed construction and installation schedule. For this analysis, the exposure estimates are based on the maximum total buildout of 132 foundations for both Phases 1 and 2 of New England Wind.

For the purposes of estimating marine mammal and sea turtle exposures, New England Wind developed two approximate pile installation schedules based on weather factors and potential construction vessel sequencing:

- ♦ Construction Schedule A assumes that the majority of Phase 1 and Phase 2 foundations are monopiles and that foundations are installed over a two-year period. Construction schedule A assumes that foundations for all of Phase 1 (which includes Park City Wind) and a portion of Phase 2 (which includes Commonwealth Wind) are installed in year 1, and that the remaining Phase 2 foundations are installed in year 2.

- ♦ Construction Schedule B assumes that most of the Phase 1 and Phase 2 foundations are jackets[83] and that foundations are installed over a three-year period. Construction schedule B assumes that foundations for all of Phase 1 (which includes Park City Wind) are installed in year 1 and that the Phase 2 (which includes Commonwealth Wind) foundations are installed in years 2 and 3.

Seasonal increases in species' densities within the SWDA (see Section 3.2 of Appendix III-M) increase the risk of exposure to sound levels associated with injury or behavioral response. To reduce the potential impact of sound exposure on the critically Endangered NARW, time of year restrictions for construction are expected from January 1 through April 30. Therefore, for both Construction Schedules A and B, pile driving activity was distributed from May through December (see Appendix III-M for more information on the construction schedules). No concurrent pile driving is assumed in the model. For more detail on the modeling scope and assumptions, see Section 1.2 of Appendix III-M.

A maximum of up to one jacket foundation (four 4 m [13 ft] piles) and one or two monopile foundations installed in one day are considered in the exposure modeling. The estimated piling construction schedules assume that a combination of different hammer energies will be used during the installation of each pile. Exposure estimates based on the construction schedules and monthly species density models are presented in Appendix III-M for various criteria and attenuation levels.

Given the temporal overlap of piling installation with various marine mammal species, the risk of exposure to sounds above regulatory threshold levels is expected to be moderate without mitigation. However, it is important to note that there are conservative assumptions in the NMFS (2018) acoustic guidance such as no hearing recovery between pile strikes. With the expected implementation of monitoring and mitigation, including a time of year restriction for NARW and noise attenuation systems, the risk to marine mammals from sound exposure is considered low.

Effect of Aversion

Some marine mammals, such as harbor porpoises, are well known to avoid loud anthropogenic sounds. The exposure estimates, however, do not account for aversion or the implementation of

[83] Jackets are assumed because they are the most conservative and therefore provide an envelope for an up to 13 m monopile installed with a 5,000 or 6,000 kJ hammer.

mitigation measures other than sound attenuation (e.g. clearance zones, pile driving shutdown, or power down). The Wood et al. (2012) step function includes a probability of response that is based primarily on observed aversive behavior in field studies. Additional exposure estimates that included aversion in the animal movement model, based on the Wood et al. (2012) response probabilities, were calculated for both the harbor porpoise and the NARW for New England Wind Phases 1 and 2. For more detail and information regarding aversion, see Appendix III-M.

Modeled Range to Marine Mammal Acoustic Thresholds

Appendix III-M provides a detailed acoustic impact assessment with modeled ranges to regulatorily defined threshold levels of sound produced by impact pile driving of various pile diameters and hammer energies. Radial distances to acoustic thresholds using species-specific exposure information from the animal movement modeling, referred to as exposure-based ranges, were calculated for use in suggesting monitoring and mitigation zones. Exposure-based ranges to the dual criteria injury thresholds for all marine mammals can be found in Appendix III-M.

Airborne Noise from Pile Driving

Airborne noise could potentially impact seals hauled-out near pile driving activities. Van Renterghem et al. (2014) evaluated airborne sound propagation over the Belgian North Sea during wind farm pile driving activities. Though airborne sound is expected to propagate differently depending on variables such as type of equipment, wind speed, sea state, etc., this study is informative for assessing the distance from land where offshore pile driving activities sound levels would be high enough to exceed behavioral disturbance criteria thresholds. Van Renterghem et al. (2014) found that, at distances over 10 km (5.4 NM), noise impact was expected to be very low. The closest major seal haul-out site to the SWDA where pile driving would take place is on the northwestern side of Nantucket Island (Payne and Selzer 1989) (see Figure 6.7-6). This haul-out is 29.6 km (16 NM) from the SWDA. Given this distance, risk from airborne noise from pile driving would be very low and would not reach NOAA thresholds for Level B disturbance of seals at major haul-out sites. Thus, airborne noise will not be considered further.

6.7.2.2.1.2 Vibratory Pile Setting

The sound levels produced during vibratory pile driving relative to impact hammer piling are low; however, because vibratory driving is considered a continuous sound, the acoustic threshold for behavioral impact is much lower (SPL 120 dB versus 160 dB). Additional information and the potential effects of vibratory pile installation are provided in Appendix III-M and in a request for a Letter of Authorization submitted to NMFS.

The noise resulting from vibratory piling activities has been demonstrated to impact the echolocation abilities of bottlenose dolphins. When dolphins were exposed to playbacks of vibratory piling, they significantly reduced the number of echolocation clicks on a target compared to periods with no exposure to noise. However, they increased the rate of echolocation after the initial trial, indicating that the dolphins were able to acclimate to the piling noise (Branstetter et al. 2018). Vibratory piling activity has also been associated with a decrease in the probability of occurrence in bottlenose dolphins and harbor porpoises, and with a reduction in the time spent in the area of vibratory piling for bottlenose dolphins (Graham et al. 2017). These responses were observed at predicted received single-pulse SEL values of between 98.8 and 131.7 dB re 1 lPa2 s. However, neither species was excluded from the area, and both continued to be present during vibratory piling activities.

Although bottlenose dolphins exposed to playbacks of noise from vibratory piling eventually increased their echolocation rates, there was no evidence that this was due to masking (Branstetter et al. 2018). The communicative whistles of some species, however, may be more susceptible to masking due to their lower peak frequencies. For example, the echolocation clicks of Indo-pacific humpback dolphins have a peak frequency of 43.5 to 142.1 kHz, while their whistles range from 520 Hz to 33 kHz (Wang et al. 2014). As the dominant frequency of the vibratory hammer measured during that study was below 10 kHz, the authors concluded that the echolocation clicks of this species would be largely unaffected, the whistles in this species could be susceptible to masking.

There are no direct studies on the impact of vibratory pile driving on hearing impairment in marine mammals. However, based on the source levels measured near a vibratory hammer, (Wang et al. 2014) concluded that TTS or PTS could be exceeded under certain conditions (e.g. prolonged exposure) for Indo-pacific humpback dolphins. This study was conducted based on the world's largest vibratory hammer, however, and may not be applicable to all vibratory piling activities.

Risk of impacts to marine mammals from vibratory piling sounds may cause minor effects on behavior and potential masking. Therefore, the potential risk is considered low. Appendix III-M provides further assessment of the potential effects of vibratory pile setting and a description of the mitigation measures that will be utilized.

6.7.2.2.1.3 Drilling

Drilling may be required in certain locations during pile installation to remove boulders and in cases of pile refusal. The sound levels associated with those drilling operations have been documented to be within the hearing range of marine mammals and above the recommended marine mammal behavioral thresholds (NOAA 2005, NMFS 2018) The underwater sounds from those drilling activities are non-impulsive, low frequency (20 -1000 Hz), and of varying levels ranging from an SPL of 117 to 184 dB re 1 µPa (Greene 1987, Blackwell et al. 2004a, Dow Piniak et al. 2012). However, the types of drilling likely to be used during construction of New England Wind are of a smaller scale and are unlikely to produce the maximum sounds reported for oil drilling.

Impacts to marine mammals from underwater sound from drilling depend on the species, distance from the source and type of drilling activity (Awbrey and Stewart 1983, Richardson et al. 1990a, Richardson et al. 1990b, Miller et al. 2005, Blackwell et al. 2017). Observed responses can include changes in migratory pathways, avoidance, changes in calling behavior, altered diving and feeding patterns, and/or displacement from an area (Richardson et al. 1990b, Miller et al. 2005, Blackwell et al. 2017). However, these responses are expected only when underwater sounds associated with drilling activities are above marine mammal behavioral thresholds (NOAA 2005).

Research suggests that not all marine mammals respond negatively to drilling operations and any reactions to this source are short-term (Blackwell et al. 2004b, Todd et al. 2009). Received sound levels of drilling from construction operations were found to be within the hearing range of phocid seals (<100 Hz); however, no aversion to sound was observed for ringed seals (Blackwell et al. 2004b).

While underwater drilling sounds can have a negative effect on some species (bowhead and beluga whales), others (ringed seals and harbor porpoises) have been documented to be far more tolerant to drilling activities (Moulton et al. 2003, Todd et al. 2009). Further, there are individual differences in the reactions to drilling even within species. Awbrey and Stewart (1983) demonstrated that some beluga whales responded to playbacks of drilling noise up to 3.5 km (1.9 NM) from the source while others approached to within 15 m (49 ft). In the North Sea, high frequency odontocete species, such as harbor porpoises, have been found feeding around offshore drilling rigs and platforms during routine drilling and production operations at relatively low sound pressure levels (120 dB re 1 µPa) (Todd et al. 2009)

While some impacts on marine mammals have been reported, most have been reported in response to oil production drilling, whereas drilling operations associated with wind farm construction activities would be of a much smaller magnitude. Underwater sound produced by drilling activities are expected to cause minor impacts to marine mammals. The potential risk is considered low. Appendix III-M provides further assessment of the potential effects of drilling and a description of the mitigation measures that will be utilized.

6.7.2.2.2 HRG Surveys (Phases 1 and 2)

Many high-resolution geophysical (HRG) sources operate at frequencies (>200 kHz) above the hearing range of marine mammals so are not expected to result in impacts. Research suggests that sound levels produced by HRG sources operating within the hearing range of marine mammals are unlikely to cause injury but could result in temporary behavioral responses.

While Varghese et al. (2020) found no consistent changes in Cuvier's beaked whale foraging behavior during multibeam echosounder surveys, analogous studies assessing mid-frequency active sonar on beaked whale foraging found that individuals would stop echolocating and leave the area. Other studies have focused on the responses of marine mammals exposed to sonar. For example, minke whales (*Balaenoptera acutorostrata*) demonstrated strong avoidance to mid-frequency sonar at 146 dB re 1 µPa (Sivle et al. 2015, Kvadsheim et al. 2017) and Wensveen et al. (2019) showed northern bottlenose whales (*Hyperoodon ampullatus*) had a greater response to (military) sonar signals. Surface-feeding blue whales showed no changes in behavior to mid-frequency sonar, but blue whales (*Balaenoptera musculus*) feeding at deeper depths and nonfeeding whales displayed temporary reactions to the source; including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter et al. 2013, Goldbogen et al. 2013, Sivle et al. 2015). Several behavioral reactions were seen in beaked whale species in response to mid-frequency sonar sounds (12-400 kHz and 230 dB re 1 µPa) including cessation of clicking, termination of foraging dives, changes in direction to avoid the sound source, slower ascent rates to the surface, longer deep and shallow dive durations, and other atypical dive behavior (Tyack et al. 2011, DeRuiter et al. 2013, Stimpert et al. 2014, Miller et al. 2015, Cholewiak et al. 2017). Exposure to mid-frequency sonar at various sound levels (125–185 dB re 1 µPa) caused behavioral responses in California sea lions (*Zalophus californianus*), including a refusal to participate in trials, hauling out, an increase in respiration rate, and an increase in the time spent submerged (Houser et al., 2013). Hooded seals (*Cystophora cristata*) showed initial avoidance behavior to 1–7 kHz sonar signals at levels between 160 and 170 dB re 1 µPa, but these animals did adapt to the sound and stopped avoiding the source (Kvadsheim et al. 2010).

There are limited data on the masking effects of pulsed sounds on marine mammal calls, and there are no direct studies on the impact of HRG surveys on masking in marine mammals. Data from seismic surveys, another impulsive sound source, shows that the detection rates of some cetacean calls are reduced in the presence of seismic pulses (Clark and Gagnon 2006, Nieukirk et al. 2012). However, it is often unclear if this is the result of masking or a cessation of calling activity. For the smaller odontocetes, the masking effects of low frequency, impulsive noise are expected to be insignificant because the calls of these species occur predominantly at much higher frequencies.

There are no direct studies on the impact of HRG surveys on hearing impairment in marine mammals. Although impulsive sounds have been shown to cause TTS in both beluga whales (Finneran et al. 2002) and harbor porpoises (Lucke et al. 2009), other studies have failed to elicit TTS in response to impulsive sounds (Finneran et al. 2000, Finneran et al. 2003, Finneran et al. 2015). Appendix III-M provides further assessment of the potential effects of HRG surveys and a description of the mitigation measures that will be utilized.

6.7.2.2.3 UXO Detonation (Phases 1 and 2)

In instances where avoidance, physical removal of unexploded ordnance (UXO), or deflagration is not feasible due to layout restrictions or personnel safety, UXO may need to be detonated in situ. The potential effects of UXO detonation (if required) are described in Appendix III-M and in a request for a Letter of Authorization submitted to NMFS.

There is limited data on the masking effects of pulsed sounds on marine mammal calls, and there are no direct studies on the impact of UXO detonation on masking in marine mammals. Data from seismic surveys, another impulsive sound source, shows that the detection rates of some cetacean calls are reduced in the presence of seismic pulses (Clark and Gagnon 2006, Nieukirk et al. 2012). However, it is often unclear if this is the result of masking or a cessation of calling activity. For the smaller odontocetes, the masking effects of low frequency, impulsive noise are expected to be insignificant because the calls of these species occur predominantly at much higher frequencies.

There are no direct studies on the impact of UXO detonation on hearing impairment in marine mammals. However, a recent acoustic modeling study assessed auditory system injury zones using SEL based on TTS and PTS onset (Hannay and Zykov 2022). Appendix III-M provides further assessment of the potential effects of UXO detonation and a description of the mitigation measures that will be utilized.

6.7.2.2.4 Vessel Sounds (Phases 1 and 2)

Ship engines and vessel hulls emit broadband, continuous sound, which overlap with the assumed or known hearing frequency ranges for all marine mammals (NSF 2011). Researchers have reported a change in the distribution and behavior of marine mammals in areas experiencing increased vessel traffic, particularly associated with whale watching, likely due to increases in ambient noise from concentrated vessel activity (Erbe 2002; Nowacek et al. 2004). Kraus et al. (2016) recorded ambient noise in the MA and RI/MA WEAs from November 2011 through March 2015, in the 71 to 224 Hz frequency band for all PAM sites with SPLs that varied between 96 dB and 103 dB re 1 µPa during 50% of the recording time. Analyses of behavioral observations made during the Behavioral Response of Australian Humpback whales to Seismic Surveys (BRAHSS) study, Dunlop et al. (2016a; 2015; 2016b; 2017a; 2018; 2017b) found only minor and temporary changes in the migratory behavior of humpback whales in response to exposure to vessel and seismic air gun sounds. Increased proximity of vessels, however, led to aversive reactions (Dunlop et al. 2017b) and to reduced social interactions between migrating humpback whales (Dunlop et al. 2020).

Vessel sounds arise from propulsion and engines produced during transit to and from multiple ports as well as during construction at the SWDA. Dynamic positioning thrusters may also be used during construction that contribute to the overall sound output of vessel noise. Vessel traffic associated with both Phases of New England Wind is expected to originate from one or more port facilities and construction staging areas in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey, though it is not anticipated that all ports under consideration will be used (see Sections 3.2.2.5 and 4.2.2.5 of COP Volume I for a discussion of potential port facilities). In addition, some components, materials, and vessels will come from Canadian and European ports. Possible effects of increased vessel noise on marine mammals are variable and depend on such factors as the marine mammal species, the marine mammal's location and activity, the novelty of the sound, ambient noise levels, and vessel behavior.

Marine mammals in the Offshore Development Region are regularly subjected to commercial shipping and other vessel traffic and may be habituated to vessel noise (BOEM 2014). Although received levels of sound may, at times, be above the continuous sound threshold for Level B Harassment (120 dB SPL), NARWs have been known to continue to feed in Cape Cod Bay despite disturbance from passing vessels (Brown et al. 2000). In another study, NARWs showed no behavioral response to ship sounds at all, or at least not to received levels of 132–142 dB re 1 µPa from large ships passing within 1.85 km (1 NM) distance, nor to received levels of 129–139 dB re 1 µPa (main energy between 50 and 500 Hz) to playback of ship noise (Nowacek et al. 2004).

Humpback whales migrating off the Australian east coast exhibited great variation in behavioral responses to seismic survey vessels with their air guns turned off. While no behavioral change was seen in some trials, others revealed a decrease in dive duration, travel speed, and the number of breaches (Dunlop 2016; Dunlop et al. 2015; 2017a; 2018; 2017b). Overall, their results showed that both vessel proximity and received sound level from the air gun impulses affected the behavior of the humpback whales. In contrast, most humpback whales did not respond to sonar vessels with the sonar turned off (Sivle et al. 2016; Wensveen et al. 2017). Tsujii et al. (2018) found that humpback whales moved away from large vessels, while others noted changes in respiratory behavior (Baker and Herman 1989; Frankel and Clark 2002) and a cessation of foraging activities (Blair et al. 2016). The large number of studies on humpback whales and the resulting variety of documented responses demonstrate that context affects behavior.

Studies conducted in various parts of the world suggested that mid-frequency cetaceans respond to vessel sounds. Groups of Pacific humpback dolphins (*Sousa chinensis*) offshore eastern Australia that included mother-calf pairs increased their rate of whistling after a boat transited the area (Van Parijs and Corkeron 2001). The authors postulated that vessel sounds disrupted group cohesion, especially between mother-calf pairs, requiring re-establishment of vocal contact after boat noise masked their communication. Lesage et al. (1999) revealed that belugas reduced their overall call rate in the presence of vessels but increased the emission and repetition of specific calls and shifted to higher frequency bands. In response to high levels of boat traffic, killer whales increased the duration (Foote et al. 2004) or the amplitude (Holt et al. 2009) of their calls. Other studies of killer whales showed changes in behavior in response to vessel noise (i.e. less foraging and increased surface-active behavior), respiration, swim speed, and direction occurred at received levels above 130 dB re 1 µPa (0.01–50 kHz) (Lusseau et al. 2009; Noren et al. 2009; Williams et al. 2014; 2002). Marley et al. (2017) found that Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in Fremantle Inner Harbour (Australia) significantly increased their average movement speed in the presence of high vessel densities but only for some activity states. Behavioral budgets also changed in the presence of vessels, with animals spending more time travelling and less time resting or socializing.

A study using acoustic tags that record sound and behavior concurrently showed that harbor and grey seals were exposed to vessel noise 2.2–20.5% of their time at sea (Mikkelsen et al. 2019). In response to vessel noise, a tagged seal changed its diving behavior, switching quickly from a dive ascent to descent (Mikkelsen et al. 2019). This observation agrees with descriptions of changes in diving reported from juvenile northern elephant seals (*Mirounga angustirostris*) (Burgess et al. 1998; Fletcher et al. 1996).

Studies conducted in the Bay of Fundy, (Polacheck and Thorpe 1990) noted that high-frequency harbor porpoises tended to swim away from approaching vessels. Off the Western coast of North America, Barlow (1988) observed that harbor porpoises within 1 km (0.5 NM) of a survey vessel moved rapidly out of its path. Cuvier's beaked whales (*Ziphius cavirostris*) responded to ship sounds by decreasing their vocalizations when they attempted to catch prey (Aguilar Soto et al. 2006), and foraging changes were observed in Blainville's beaked whales (*Mesoplodon densirostris*) when they were exposed to vessel noise (Pirotta et al. 2012). Both harbor porpoises and beaked whale species are known to avert from relatively low levels of anthropogenic sound and are therefore categorized as sensitive species (Wood et al. 2012 criteria, see Table 6.7-5.

Vessel traffic associated with construction is likely to emit underwater sound with acoustic characteristics and levels comparable to transiting vessels that are unrelated to the construction; emitted levels may even be lower than average vessel sound levels if construction vessels are traveling at slow speed. However, additive effects due to increased volume of vessel operations in the SWDA may result in additional risk of impacts to marine mammals from vessel noise. Stationary construction vessels are expected to produce low sound levels unless dynamic positioning is used, which can result in significantly raised sound levels. Therefore, the potential risk is considered very low to low and is not considered further.

6.7.2.2.5 Vessel Collision (Phases 1 and 2)

Vessel collisions with marine mammals can result in serious injury or death. Laist et al. (2001) reviewed 407 stranding deaths of seven large whale species from 1975 to 1996 along the US East Coast from Maine to Florida. The review indicated that 67% of sei whale, 33% of fin whale, 33% of NARW, 8% of humpback whale, 5% of minke whale, and zero sperm and Bryde's whale (*Balaenoptera edeni*) stranding deaths included signs of vessel collision (Laist et al. 2001). A humpback whale US Atlantic coast UME was declared from 2016–2018, with necropsies performed on approximately half of the strandings that occurred between January 15, 2016, and April 2017. Of the 20 cases examined, 10 had injuries consistent with vessel collision (NOAA 2019). Based on these data, vessel collision risk for individuals would be highest for sei whales, fin whales, NARWs, and humpback whales.

Research indicates that most vessel collisions with whales resulting in serious injury or death occur when a ship is traveling over speeds of 7.2 m (14 knots) (Laist et al. 2001). Thus, the highest risk for vessel strike would most likely occur during transit to and from the SWDA if vessels travel at increased speeds. However, construction vessels are large and travel at relatively low speeds. In addition, NOAA has issued guidance to avoid such collisions, which will be followed during all stages of New England Wind to reduce risk (see Table 6.7-7 for monitoring and mitigation).

Several studies have reported a shift in the distribution and behavior of marine mammals in high traffic areas (Erbe 2002; Jelinski et al. 2002; Nowacek et al. 2004). Therefore, increased vessel activity associated with construction could result in marine mammals avoiding the area, which would reduce the risk of collision with oncoming vessels, but the potential for vessel collision may increase if whales are displaced into higher shipping traffic areas (such as commercial shipping corridors) by sound from impact pile driving. Given the distance (at least 40 km [22 NM]) to the nearest shipping lane and New England Wind activities, risks resulting from marine species moving into the shipping lane are low and will be further evaluated in the context of mitigation and BMPs.

Existing marine vessels in the area also adhere to vessel collision avoidance measures that include vessel speed limits. Reductions in vessel speed have been shown to reduce the risk of collision-related mortality for NARWs (Conn and Silber 2013) and is also inherently protective of other marine mammals. Risk of collision with vessels along the OECC (including the Western Muskeget Variant) is expected to be similar to the risk experienced with construction activities in the SWDA. However, since the OECC is closer to shore, vessel transit times would decrease, thereby reducing the risk of vessel collision.

6.7.2.3 Operations and Maintenance

6.7.2.3.1 Underwater Noise (Phases 1 and 2)

Impact pile driving is not expected to occur during the O&M stage of New England Wind. Sound sources that are present in all stages of the development, such as vessel traffic, are relevant during each Phase of New England Wind. The acoustic characteristics of vessel sounds associated with O&M are the same as those produced during construction and installation (see Section 6.7.2.2.1). Therefore, the potential impacts of this anthropogenic sound on marine mammals are expected to be similar to, or less than, those generated during construction due to a lower number and smaller size of vessels. Possible sound sources other than vessel operations include the WTGs themselves, which generate sound in the nacelle that is transmitted from the topside to the foundation and then radiated into the water, and subsea cable vibration.

Operational noise of from WTG is generally low with sound pressure levels of around 151 dB and frequency ranges of 60 to 300 Hz (Dow Piniak et al. 2012). Measurements at the Block Island Wind Farm found sound would likely decline to ambient levels at a distance of 1 km (0.5 NM) from the WTGs and average sound level was recorded to be between 112–120 dB re 1 µPa when wind speed was 2–12 m/s (6.5–39.4 feet per second) (HDR 2019). Closer to operational WTGs in Europe, sound pressure levels ranged from 109 dB to 127 dB at 14 to 20 m (46 to 66 ft) (Tougaard et al. 2009b). WTG design was found to make a difference in sound pressure level at further distances with a steel monopile WTG observed producing louder sounds (133 dB with peak frequency of 50 and 140 Hz) at 150 m (492 feet) than a jacket foundation WTG (122 dB with peak frequency of 50 Hz and secondary peaks at 150, 400, 500, and 1,200 Hz). However, at a closer distance of 131 ft (40 m) sound pressure levels were comparable between the steel monopile (135 dB) and jacket foundation WTGs (137 dB) (Thomsen et al. 2016 {Thomsen, 2016 #26048}).

Underwater noise level is also related to WTG power and wind speed, with increased wind speeds creating increased underwater sound (Wahlberg and Westerberg 2005). Ambient noise within the 71–224 Hz frequency band in the MA WEA and RI/MA WEA was measured to be between 96 dB and 103 dB 50% of the time with greater sound levels 10% of the time (Kraus et al. 2016). Overall, current literature indicates noise generated from the operation of wind farms is minor and does not cause injury or lead to permanent avoidance at distances greater than 1 km (0.5 NM) for the species studied (e.g. harbor porpoise, seals, and fish) (Wahlberg and Westerberg 2005), with potential to have minimal effects at much closer distances up to within a few meters of the WTG (Bergström et al. 2013).

Subsea cables are expected to produce low-frequency tonal vibration sound in the water, since Coulomb forces between the conductors cause the high-voltage alternating current lines to vibrate at twice the frequency of the current (direct current cables do not produce a similar tonal sound because the current is not alternating). Low level tonal sound from an existing 138 kilovolt transmission line was measured in the Trincomali Channel, offshore of Vancouver Island, British Columbia, during a very low ambient noise condition. The broadband SPL at approximately 100 m (328 ft) from the cable was below 80 dB. Assuming cylindrical spreading of sound, the source level of the submarine cable was approximately 100 dB SPL (Austin et al. 2005). Anticipated SPL arising from the vibration of alternating current cables during operation are significantly lower than SPL that may occur during cable installation (Meißner et al. 2006) and may be undetectable in the ambient soundscape of the Offshore Development Area, especially after consideration of the 1.5–2.5 m (5–8 ft) target burial depth.

These sound sources and potential for impact are considered very low risk.

6.7.2.3.2 Vessel Collision (Phases 1 and 2)

As described in Section 6.7.2.2.2, collisions between marine mammals and ships that result in serious injury or death can occur. Research indicates that most vessel collisions with whales resulting in serious injury or death occur when a ship is traveling over speeds of 7.2 m (14 knots) (Laist et al. 2001). Thus, the highest risk for vessel strike would most likely occur during transit to and from the SWDA if vessels travel at increased speeds. Reductions in vessel speed have been shown to reduce the risk of collision-related mortality for NARWs (Conn and Silber 2013) and is also inherently protective of other marine mammals. Fewer vessels are required for O&M of New England Wind than are expected during construction and installation. NOAA has issued guidance to avoid such collisions, which will be followed during all stages of New England Wind to reduce risk (see Section 6.7.4 for monitoring and mitigation). Adherence to vessel speed restrictions and the incorporation of BMPs for vessels in the area will reduce the individual and population level collision risk from vessel traffic.

6.7.2.4 Decommissioning

Decommissioning of the offshore components includes removal of WTG/ESP foundations below the mudline. Scour protection would also be removed. The offshore export cables, inter-array cables, and inter-link cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies and stakeholders on the preferred approach to minimize environmental impacts.

Anthropogenic sound associated with decommissioning the WTGs and ESPs are expected to be unique for each site and dependent on the method chosen for structure decommissioning. Until specific decommissioning approaches are agreed, it is reasonable to assume that sounds associated with decommissioning may be similar to, or less than, those produced during construction and operations.

Similarly, the acoustic characteristics of vessel sounds associated with decommissioning are expected to be the same as those produced during construction and operations (see Section 6.7.2.2), and therefore the impacts are likely to be similar, with the risk assessed as very low.

Vessel traffic rates during decommissioning are expected to be similar to traffic rates during the construction and installation (see Section 6.7.2.2.2). Consequently, the risk from vessel collisions on marine mammals during decommissioning are anticipated to be similar to those during construction. The offshore export cables may be retired in place to minimize environmental impact; in this instance, no vessels would be required for offshore export cable removal, so there would be no risk of vessel collision from cable decommissioning. If offshore export cable removal is required, the cables would be removed from their embedded position in the seabed and reeled up onto barges. Collision risk from removing the cables would be short-term, localized to the OECC route, and similar to those experienced during cable installation, as described in Section 6.7.2.2.2.

6.7.3 Conclusions

Of the 39 marine mammal species known to inhabit the offshore Atlantic region, 17 are most likely to be present in the vicinity of the SWDA during construction and installation, O&M, and decommissioning of New England Wind. Six of these species–sperm whale, Risso's dolphin, long and short-finned pilot whale, Atlantic spotted dolphin, and harp seal–are considered uncommon and, thus, have low exposure probability (see Appendix III-M). The potential exists for small numbers of marine mammals to experience sound levels at regulatory thresholds associated with Level A and Level B harassment from pile driving activities. Effects from noise associated with New England Wind vessels and other sources of sound are considered very low risk relative to pile driving.

Common and regular species (see Appendix III-M) are likely to have individuals exposed to noise and increased vessel traffic. Species' vulnerability to these IPFs varies, but it is unlikely that population level impacts will occur for ESA- and non-ESA-listed species. Mid-frequency cetaceans such as bottlenose dolphins (*Tursiops truncatus*), short-beaked common dolphins, and Atlantic white-sided dolphins-appear to have low sensitivity to pile driving and similar low-frequency dominated noise sources (Finneran 2016). The modeled injury-level acoustic exposures for this hearing group can be found in Appendix III-M.

For species listed as Endangered under the ESA, modeled results suggest that there is a probability that some injurious level exposures could potentially occur during construction and installation of both Phases 1 and 2 over a minimum of two construction seasons without monitoring and mitigation measures beyond seasonal restrictions and noise abatement systems (see Appendix III-M for more detail. The model also predicts behavioral level exposures. Behavioral responses for Endangered species are likely limited to short-term disruption of behavior or displacement related to construction noise (i.e. pile driving). Monitoring and mitigation measures proposed by New England Wind are expected to reduce the likelihood for exposure to threshold sound levels for all species and to eliminate injurious sound exposure for the NARW. Similarly, the risk of vessel collision may also be reduced with the implementation of monitoring and mitigation measures.

Even within a particular hearing group, the exposure modeling results vary substantially between species due to differences in estimated local species density, modeled monthly construction schedule, and modeled swimming and diving behavior. The proposed pile installation schedule was developed with a variety of factors including anticipated time of year restrictions to protect NARW and anticipated weather days. Time of year restrictions are expected to preclude foundation installation in the periods with the greatest presence of NARW. The construction schedule and modeling align with the predicted weather conditions resulting in greater construction activity over the summer months when NARW densities are at their lowest. Fewer weather delays and longer daylight will allow greater construction productivity (see Appendix III-M).

In some cases, particularly for low frequency cetaceans, the simulations predicted similar exposure estimates and ranges for Level A and Level B criteria. This stems from the different threshold metrics that are used when assessing Level A (SEL) and Level B (SPL) thresholds. Level B exposures are based on the loudest single sound pressure level experienced by an animat (model animal) and are similar across different species within a particular hearing group. In contrast, Level A exposures for most of the species considered in this assessment are dominated by the cumulative sound exposure metric, which is more sensitive to the way animats move through and "sample" the sound field and to the total number of strikes and hammer energy levels. Species definitions used in the animal movement modeling are based on the most recent available literature on behavioral parameters such as speed, dive depth, dive reversals, surface intervals, and directionality.

NARWs are Endangered under the ESA and are declining (Pace et al. 2017); therefore, they are potentially more vulnerable to population level impacts than other marine mammals in the region. NARWs have been experiencing a UME since June 2017, with 78 documented deaths as of 2021 (NOAA Fisheries 2022). NARWs can potentially adapt to underwater sound by modifying their calls in noisy environments (Hotchkin and Parks 2013; Parks et al. 2011) but may reduce their calls when experiencing chronic stress associated with aggregate noise from commercial shipping traffic (Rolland et al. 2012). Unlike commercial vessel traffic noise, which is ubiquitous in the NE region, pile driving noise from New England Wind will be limited to a small portion of the NARW range and is for short lengths of time (e.g. approximately 3 hours per monopile) allowing NARWs to avoid sound in the SWDA. Pile driving activities are subject to a time of year restriction and noise arising from piling will also only typically occur in less than approximately three-hour increments with hours or days in between (see Section 6.7.2.2.1 in this document and Section 1.2.8. in Appendix III-M for estimated piling construction schedule), providing recovery time from cumulative sound exposure and returning noise to baseline levels for most of the construction period. For the individuals that may be present during the period of construction, masking may result from pile driving noise, but the duration and intensity would be likely short-term and localized, and habituation over the duration of the construction activities could reduce behavioral response over time. Monitoring and mitigation planned for construction and installation are expected to reduce the risk of population level impacts to low.

The area surrounding the SWDA is biologically productive and used by many species for foraging and migrating. This increases the likelihood of some sound exposure during construction and installation and from increased vessel presence. After construction is complete, WTGs will have sufficient distance between them (1.85 km [1 NM]) so that NARWs and other species will not be impeded from using the habitat. Further, mitigation will reduce the risk of impact associated with New England Wind O&M and decommissioning activities. NARWs are vulnerable to vessel collisions (Laist et al. 2001), but mitigation, such as decreased vessel speeds, Protected Species Observers (PSOs) visually monitoring for whales, and vessel strike avoidance guidance recommendations (NMFS 2008), are expected to result in avoidance of vessels.

Harbor porpoise are the only high-frequency cetaceans known to occur within areas of the SWDA. Pile driving emits primarily low-frequency sound, however, there are high-frequency components to the sound emission. This high-frequency sound will attenuate rapidly in the marine environment but may still cause behavioral responses in this sensitive species (Finneran 2016). Feeding disruption of harbor porpoises could be an important response to noise, due to the energetic requirements of lactating females, in particular (Yasui and Gaskin 1986). Given the use of this habitat for foraging, the installation of in-water structures may cause a decline in harbor porpoise foraging activity in the area. However, feeding can occur in nearby areas if harbor porpoises are temporarily displaced. Predictions of occurrence (Roberts et al. 2016a; 2016b; 2017) suggest nearby habitat is suitable and potentially preferred relative to the SWDA. Further, as with NARWs, monitoring and mitigation measures during pile driving are expected to minimize the risk to harbor porpoises.

Harbor and gray seals are considered low-frequency specialists (Kastak and Schusterman 1999; Kastelein et al. 2009; Reichmuth et al. 2013; Sills et al. 2014; 2015). Gray seals are present year-round in the SWDA and spend periods of time on land at haul-outs and breeding sites where they would not be subject to stressors from New England Wind activities. Likewise, harbor seals are not subject to exposure to underwater sound while on land. Both harbor seals and gray seals primarily occur farther north than the SWDA (Hayes et al. 2022) limiting the numbers of individuals that may be exposed to pile driving sound relative to their populations. Implications of behavioral disturbance are similar to those described above, and impacts can be minimized or offset through similar mitigation.

In summary, the expected type of impact for species commonly found in the SWDA is disturbance of individuals, mainly from pile driving sound. Exposure probability is low for uncommon species but probable for individuals of common and regular species in months when they are present. The duration of the impact is expected to be short-term and spread out over a minimum of two construction seasons with breaks in between activities, likely leading to recovery and behavioral restoration, and potentially some habituation and adaptation to sound sources associated with

New England Wind. The two most vulnerable species are NARWs and harbor porpoises for the reasons described above. Density models suggest that both species are seasonal in the SWDA and predicted to occur in higher densities outside of the SWDA, indicating suitable habitat is available for any displaced individuals. Further, New England Wind is proposing an estimated construction schedule that minimizes risk to the critically Endangered NARW.

Individual exposure numbers are also considered in the context of species' abundance. As with individual exposure estimates, the model-predicted numbers for injurious exposures as a percentage of species' abundance are very low or low for all marine mammal species, with or without attenuation. With sound attenuation planned for New England Wind, the injury and behavioral response impact rating for mid- and high-frequency marine mammal species is very low.

For all species, impacts resulting from sound exposure may affect individuals but have only a very low to low risk of impact on marine mammal stocks or populations. The potential impact on the population will depend on both the effect on the individual and the size of the species' population and the localized activity. As the piling activity will be moving around the SWDA during construction seasons, masking effects are expected to be negligible and not contribute significantly to the existing ambient sound levels in the region.

Not all marine mammal species are uniformly affected by the potential impacts resulting from vessel strikes. Some species face a higher risk of collision given their size, mobility, and surface behavior. Baleen whales, harbor porpoises, and harbor seals all have a seasonal component to their occurrence in the SWDA and along the OECC (including the Western Muskeget Variant). Based on Kraus et al. (2016), AMAPPS surveys (NEFSC and SEFSC 2011a; 2011b; 2012; 2014a; 2014b; 2015; 2016; 2018; 2019), and density estimates by (Roberts et al. 2022), NARWs are mainly present in the SWDA in the spring, with another smaller peak in the winter, and range elsewhere for their main feeding and breeding/calving activities as a species. Humpback, fin, and minke whales are mainly present in the spring and summer. Sei whales are also mainly present in the spring and summer but are less common than the other baleen whales. Harbor porpoises and harbor seals tend to move out of the Offshore Development Area in the summer. There will be a risk of short-term, localized, behavioral disturbance to these species during some seasons. The implications of behavioral disturbance are hard to quantify, but sufficient disturbance may result in temporary displacement.

Risk can be minimized or offset through mitigation consisting of vessel collision guidance and noise reduction through technology and real-time observation and mitigation actions. Due to the low population estimates for Endangered whale species, vessel strikes that result in injury or mortality could have more severe impacts, particularly for NARWs where any impacts resulting in injury or mortality are more likely to have population-level effects. ESA-listed species with more stable or increasing stocks and non-ESA listed populations have a greater capacity to absorb and recover from potential impacts without incurring population-level effects. Therefore, in the unlikely event a strike occurred that resulted in mortality or serious injury impacts to the most vulnerable ESA-listed species (e.g. NARW), this risk would be considered high; and impacts to less vulnerable ESA-listed species and non-ESA listed species would be considered moderate. However, with the implementation of the environmental mitigation measures outlined in Section 6.7.4 and the nominal addition to existing vessel traffic expected, there is an overall low risk of vessel strikes to marine mammals.

Mitigation and BMPs are expected to be implemented to reduce risks associated with underwater sound and vessel collision to levels that meet regulatory requirements under the ESA, MMPA, and other applicable laws. Further, benefits of New England Wind to marine mammals post-construction include the potential for increased prey availability resulting from reef effects and fish aggregation, and decreased impacts to species from climate change as greenhouse gas production is reduced by use of offshore wind power, as further described in the benefits discussion included in Section 4.1.

6.7.4 Avoidance, Minimization, and Mitigation Measures

Working collaboratively with BOEM and NOAA, the Proponent will develop monitoring and mitigation measures that are expected to effectively avoid and minimize the risk of impacts to marine mammals from underwater sound and vessel collision during construction, operations, and decommissioning. New England Wind is using acoustic modeling (see Appendix III-M) as a tool to inform approaches to mitigation and address sensitive receptors to IPFs. Modeling, as part of permitting and regulatory processes, will be used to evaluate potential risks and specific mitigation and BMP options.

Mitigation and BMPs must consider both practicability for a large-scale development and effectiveness at avoiding and minimizing impacts to marine mammals. Practicability includes safety, logistical ability, project integrity, environmental impacts, and the potential to extend the New England Wind construction duration, which may have secondary impacts on other resources. Options will be modeled and weighed against biological value and effectiveness relative to practicability. NOAA and BOEM will be engaged in this iterative and adaptive process that may also incorporate lessons learned from Vineyard Wind 1 and other offshore wind farm development in the MA WEA and RI/MA WEA.

In addition to monitoring and mitigation specific to New England Wind, the Proponent is establishing the Offshore Wind Protected Marine Species Mitigation Fund as part of Phase 1 of New England Wind. The Proponent has committed to provide up to $2.5 million to the Mystic Aquarium in Connecticut to study underwater noise generated by offshore wind farms and the potential impacts on cetacean and pinniped behavior, hearing, and physiology. In addition, this fund will further the investigation of best practices and advance technologies to reduce potential sound impacts and collision threats from offshore wind project development.

The core menu of potential monitoring and mitigation measures for marine mammals is described below and summarized in Table 6.7-7. These core measures include the establishment of clearance, exclusion, and/or monitoring zones, pile driving soft-start procedures, vessel strike avoidance measures, noise attenuation technology, and the use of PSO/PAM, among others.

Given the duration of the permitting process and timeline for offshore construction (particularly for Phase 2), New England Wind has identified core measures, but must retain some flexibility so the measures can be adapted to incorporate lessons learned from other offshore wind projects and to allow for new technologies and techniques. As noted above, New England Wind expects to further refine these core mitigation and monitoring measures in coordination with agencies and stakeholders. The core mitigation and monitoring measures include, but are not limited to the following:

Siting

The Lease Area is in the MA WEA, which was sited pursuant to a public process. Selecting an appropriate site was the first step to minimize and avoid impacts to marine mammals and other resources and habitats. The Massachusetts Request for Interest Area was determined by BOEM in collaboration with the Massachusetts Renewable Energy Task Force. Based on public input on the Request for Interest Area, BOEM selected a MA WEA. BOEM then modified the planning area and published a Call for Information and Nominations to identify areas where there was interest in commercial leases. After considering comments on the Call for Information and Nominations, BOEM further modified the MA WEA to exclude some areas of important habitat and fisheries value. BOEM conducted an Environmental Assessment of Commercial Wind Leasing and Site Assessment Activities (BOEM 2014), which resulted in a Finding of No Significant Impact.

Foundations will be oriented in an east-west, north-south grid pattern with approximately 1.85 km (1 NM) spacing between WTG/ESP positions. The layout of foundations within the SWDA is expected to provide adequate spacing for marine fauna.

Seasonal Restrictions on Pile Driving

Historical and anticipated NARW presence will be used to inform a time of year restriction on pile driving, which would minimize the amount of pile driving that occurs when the migratory NARW is likely to be in the Offshore Development Area and would thus limit sound exposure and vessel collision risk for this Endangered species. New England Wind expects to establish a restriction on pile driving between January 1 and April 30. The seasonal restriction would also have a protective effect for other marine mammal species.

Pile Driving Noise Abatement Systems

Pile driving sound attenuation technology under consideration for New England Wind includes piling equipment that is optimized for sound reduction (e.g. Integrated Pile Installer), underwater noise abatement systems (e.g. AdBm encapsulated bubble sleeve), and/or bubble curtains. Various studies have demonstrated that these mitigation measures are capable of attenuating sounds during pile driving by approximately 10 to 23 dB (Bellmann 2014; Christopherson and Lundberg 2013; Reinhall et al. 2015). Attenuation levels vary by equipment type, frequency band, and location. A California Department of Transportation study tested several sound reduction systems and found that they resulted in 10–15 dB of attenuation in good conditions (Buehler et al. 2015). In a study conducted by Dähne et al. (2017), two big bubble curtains were shown to attenuate pile driving sounds between 7-10 dB when used independently and up to 12 dB when used concurrently.

Various levels of attenuation, ranging from 6–12 dB, were modeled for New England Wind (see Appendix III-M) to illustrate the effect of sound attenuating technology on acoustic exposure radii calculations for pile driving. While impacts to marine species were conservatively assessed based on 10 dB of noise attenuation, New England Wind expects to implement noise attenuation technology to reduce sound levels by a target of approximately 12 dB or greater.

Sound Field Verification

To assess the efficacy of mitigation measures and to determine the distance to pre-defined acoustic thresholds, New England Wind proposes to conduct sound field verification (SFV) when construction commences. Sound levels are expected to be recorded for one of each of the pile types for comparison with model results.

Establishment of Protective Zones During Pile Driving

As practicable, monitoring, clearance, and/or exclusion zones will be established to minimize and avoid potential impacts of underwater sound on marine mammals during pile driving.

Clearance zones are typically zones in which observations for marine mammals are made for a specified period of time prior to starting pile driving. The duration and distance of the clearance zone may vary by species group. If a marine mammal is observed entering or within the relevant species-specific clearance zone prior to initiating pile driving, pile driving will be delayed, and the observed animal will be allowed to leave the clearance zone of their own volition.

An exclusion zone is a shutdown or power-down area surrounding pile driving activities that may be defined relative to Level A Harassment zones (as defined in NMFS 2018) or based on other criteria as appropriate. The size of Level A Harassment zones is based on environmental conditions and marine mammal hearing types (see Table 6.7-3), and biologically appropriate and practicable zones vary by species and situation. If a marine mammal is observed entering or within the relevant species-specific exclusion zone after pile driving has commenced, pile driving will be shutdown, when technically feasible. If New England Wind determines that a shutdown is not technically feasible due to human safety concerns or to maintain installation stability, reduced hammer energy will be used if the lead engineer determines it is technically feasible. Pile driving will only be reinitiated after a shutdown once the clearance zones are confirmed to be clear of marine mammals for the minimum species-specific time periods.

In addition, a monitoring zone may be established during impact pile driving to monitor and record marine mammal occurrence and behavior. Monitoring zones are monitored for marine mammals, but marine mammal presence does not necessarily trigger shutdown or other actions.

These monitoring zones are useful for observing potential approach by marine mammals to exclusion zones and can inform understanding of and adaptive management for potential behavioral disturbance.

Monitoring of clearance, exclusion, and/or monitoring zones during pile driving will be conducted by NMFS-approved PSOs and the final requirements and data sharing will be determined in collaboration with BOEM and NMFS.

Pile Driving Ramp-Up/Soft-Start Procedures

As practicable, a ramp-up (i.e. soft-start) will be used at the commencement of a pile driving activity to provide additional protection to marine mammals potentially located near the construction effort. A soft-start allows marine mammals to become aware of noise at low levels and avert from the area prior to the commencement of full energy pile driving activities. A soft-start utilizes an initial set of very low energy strikes from the impact hammer, followed by a waiting period. Additional strike sets gradually increase energy to what is needed to install the pile, which is usually less than hammer capability.

Establishment of Protective Zones During HRG Surveys

As practicable, monitoring, clearance, and/or exclusion zones may be established during certain high resolution geophysical (HRG) survey activities for sources operating below specified frequencies (i.e. based on species' hearing ranges), to minimize and avoid potential impacts of underwater sound on marine mammals.

Vessel Strike Avoidance Measures

The Proponent will adhere to legally mandated vessel speeds, approach limits, and other vessel strike avoidance measures to reduce the risk of impact to NARWs as a result of New England Wind activities in the SWDA. For example, federal regulations require that vessels maintain a separation distance of 457 m (1,500 ft) from an observed NARW (see 50 CFR 224.103 (c)). As safe and practicable, New England Wind's vessels will also follow NOAA guidelines for vessel strike avoidance, including vessel speed restrictions and separation distances, that are applicable at the time of construction and operations. During appropriate time periods, New England Wind-related vessels traveling to/from Salem Harbor will transit at 18.4 km per hour (10 knots) or less within NOAA-designated NARW critical habitat and outside critical habitat.

Regardless of the guidance in effect at the time of construction, vessel operators and crew will maintain a vigilant watch for marine mammals, and will slow down or maneuver their vessels, as appropriate, to avoid a potential interaction with a marine mammal. Vessels will also maintain required separation distances, which will be monitored by trained observers or PSOs. New England Wind personnel will check the NMFS' NARW reporting systems on a daily basis. Additionally, it is expected that vessel captains will monitor USCG VHF Channel 16 throughout the day to receive notifications of any sightings. This information would be used to alert the team to the presence of a NARW in the area and to implement mitigation measures as appropriate. Whenever multiple New England Wind vessels are operating, all sightings of listed species will be communicated between vessels to all PSOs.

Protected Species Observers and Trained Observers

As noted above, New England Wind will use NMFS-approved PSOs or dedicated, trained observers to monitor clearance, exclusion, and/or monitoring zones during pile driving and vessel transits. PSOs will use visual aids (e.g. range finders, binoculars, night vision devices, IR/Thermal camera), when necessary. PSOs will have no tasks other than to conduct observations, collect and report data, and communicate with and instruct relevant vessel crew regarding the presence of marine mammals and mitigation requirements.

Equipment and Technology

New England Wind will consider the best commercially available equipment and technology for minimizing and avoiding impacts to marine mammals during construction and installation. This includes a variety of marine mammal detection and sound mitigation methodologies. Examples of potential technologies include PAM recorders, thermal cameras, and sound dampening devices. New England Wind may collaborate with BOEM and NOAA to integrate practicable technology choices in equipment, mitigation, and monitoring to meet the necessary standards for permitting and successful consultations.

Environmental Training

New England Wind personnel working offshore will receive environmental training, which will stress individual responsibility for marine mammal awareness and reporting as well as marine debris awareness.

Reporting of Marine Mammal Impacts

New England Wind will report impacts to marine mammals to jurisdictional/interested agencies, as required. These agencies include, but are not limited to, NMFS and BOEM. New England Wind is expected to provide notification of commencement and completion of construction activities and provide all required documentation and reports for permitted activities to the jurisdictional agencies.

Summary of Monitoring and Mitigation Measures

Table 6.7-6 is a summary of the acoustic and non-acoustic monitoring and mitigation measures currently proposed for Phases 1 and 2 of New England Wind to be implemented if applicable. The table does not include standard compliance or mitigation measures that may be stipulated by BOEM or NOAA in permit conditions. While protection of marine fauna is a top priority, environmental and human health and safety is the very highest priority in working in the offshore environment; therefore, exceptions to mitigation may be made under certain circumstances.

Table 6.7-6 Proposed Monitoring and Mitigation Measures for New England Wind

Monitoring & Mitigation Measure	Description
Seasonal Restrictions on Pile Driving1	New England Wind expects to establish a restriction on pile driving between January 1 and April 30.
Pile Driving Sound Reduction Technology	New England Wind expects to implement noise attenuation technology to reduce sound levels by a target of approximately 12 dB or greater.
Sound Field Verification	Sound levels are expected to be recorded for one of each of the pile types for comparison with model results.
Pile Driving Soft-Start	Soft-start will be implemented during pile driving.
Protective Zones (radius from pile center/survey vessel)	Clearance, exclusion, and/or monitoring zones will be established for pile driving and may be established for certain HRG survey activities in consultation with regulatory agencies.
Shutdowns and Reduced Hammer Energy	Pile driving shutdown and reduced hammer energy protocols will be established in consultation with regulatory agencies, recognizing technical and health and safety constraints.
Protected Species Observers (PSOs)	NMFS-approved PSOs will monitor before and during piling activities and certain HRG survey activities, utilizing visual aids when necessary.
Passive Acoustic Monitoring	A PAM system is expected to be utilized; the system will be identified prior to construction and in consultation with BOEM and NMFS.
Vessel Strike Avoidance	As safe and practicable, New England Wind will adhere to NOAA guidelines for vessel strike avoidance, including vessel speed restrictions and separation distances, that are applicable at the time of construction and operations. All NMFS speed restrictions with respect to NARW will be followed.
Monitoring for the Presence of NARW	New England Wind personnel/vessel captains will monitor NMFS' NARW reporting systems and USCG VHF Channel 16 for notifications of any NARW sightings.
Environmental Training	All New England Wind personnel working offshore will receive environmental training, which will stress individual responsibility for marine mammal awareness and reporting as well as marine debris awareness.
Reporting of Marine Mammal Impacts	New England Wind will report impacts to marine mammals to jurisdictional/interested agencies, including NMFS and BOEM, as required.
NARW Specific Monitoring and Mitigation	New England Wind expects to develop additional monitoring and mitigation measures for NARW protection in consultation with regulatory agencies and interested stakeholders.

This restriction is intended to minimize the amount of pile driving that occurs when the migratory NARW is likely to be in the Offshore Development Area and thus limit sound exposure for this Endangered species. Density data from Roberts et al. (2016a; 2021b) and survey data (both visual and acoustic) from Kraus et al. (2016) suggest that the highest density of NARWs in the SWDA occurs annually during March and April.

6.8 Sea Turtles

This section describes sea turtles that may be present within the Offshore Development Region. The Offshore Development Region is the broader offshore geographic region that could be affected by New England Wind-related activities, which includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), and the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA). The range of several sea turtle species overlaps with the Offshore Development Region. Given the regional nature of sea turtle species distribution, species that are present within the Offshore Development Region are also considered likely to be present within the Offshore Development Area, which is the offshore area where New England Wind's offshore facilities are physically located. The Offshore Development Area includes the entirety of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (together referred to as the Southern Wind Development Area [SWDA]), as well as the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]).

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables[84] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[85] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

Sea turtle species that occur within the United States (US) Atlantic Exclusive Economic Zone (EEZ) are discussed generally with an evaluation of their likely occurrence in and near the SWDA, while species more likely to be present in the vicinity of New England Wind project activities are described in detail. Potential impacts are assessed for the maximum Project envelope of New England Wind, assuming a full build-out of Phase 1, which includes Park City Wind, and Phase 2, which includes Commonwealth Wind, over multiple years, including up to 130 wind turbine

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84 It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

85 The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

generator (WTG)/electrical service platform (ESP) grid positions. Two of these grid positions may potentially have co-located ESPs (i.e. two monopile foundations installed at one grid position[86]), resulting in 132 foundations.

A discussion of the affected environment for sea turtles is followed by an evaluation of potential impact producing factors (IPFs) and a summary of monitoring and mitigation measures that the Proponent plans to implement to avoid, minimize, and mitigate potential impacts to these resources. An underwater acoustic modeling analysis was completed for New England Wind, the results of which are summarized in Section 6.8.2.2. The more detailed acoustic modeling analysis is provided in Appendix III-M.

6.8.1 Description of the Affected Environment

The description of the affected environment of sea turtles within the SWDA, including documentation of regional occurrences and impact evaluation, is based on several studies listed below:

- **Northeast Large Pelagic Survey:** The Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles were conducted for the Massachusetts Clean Energy Center and Bureau of Ocean Energy Management (BOEM) by the Large Pelagic Survey Collaborative (comprised of the New England Aquarium, Cornell University's Bioacoustics Research Program, the University of Rhode Island, and the Center for Coastal Studies) (Kraus et al. 2016). This study was designed to provide a comprehensive baseline characterization of the abundance, distribution, and temporal occurrence of marine life, with a focus on large whales and sea turtles, in the MA WEA and RI/MA WEA and surrounding waters. Information was collected using line-transect aerial surveys and passive acoustic monitoring from October 2011 to June 2015 in the MA WEA, and from December 2012 to June 2015 in the RI/MA WEA. Seventy-six aerial surveys were conducted, and Marine Autonomous Recording Units were deployed for 1,010 calendar days during the study period. For survey methodologies and details, please refer to Kraus et al. (2016).

- **The National Oceanic and Atmospheric Administration's Fisheries Sea Turtle Stranding and Salvage Network:** The National Oceanic and Atmospheric Administration (NOAA) established the Sea Turtle Stranding and Salvage Network (STSSN) in response to the need to better understand threats faced by sea turtles in the marine environment, to provide aid to stranded sea turtles, and to salvage deceased sea turtles for scientific and educational purposes (NEFSC and SEFSC 2018). In the northeast region, there is an active

[86] If co-located ESPs are used, each ESP's monopile foundation would be located within 76 m (250 ft) of one of the potential ESP grid locations (i.e. the monopiles would be separated by up to 152 m [500 ft]).

network organization that supports and participates in the STSSN, and collected data are stored in the national STSSN database, which is maintained by NOAA's Southeast Fisheries Science Center.

- **North Atlantic Right Whale Consortium Database:** Since the late 1970s, the North Atlantic Right Whale Consortium (NARWC) has archived much of the existing aerial and shipboard survey data for marine mammals and sea turtles in southern New England waters. The NARWC database is managed and continually updated at the University of Rhode Island's Graduate School of Oceanography. Kenney and Vigness-Raposa (2010) have modeled the relative seasonal abundance of sea turtles from data gathered from 1974 to 2008.

- **Atlantic Marine Assessment Program for Protected Species (AMAPPS):** The AMAPPS Phase I surveys were conducted from 2010–2014 (NEFSC and SEFSC 2011a; 2011b; 2012; 2014a; 2014b), and Phase II surveys from 2015–2019 (NEFSC and SEFSC 2015; 2016; 2018; 2019; 2020). Phase III will acquire data through 2024. AMAPPS surveys include aerial and shipboard observations, biological and oceanographic sampling, satellite-telemetry, and passive acoustic monitoring (PAM) conducted in all four seasons of the year. AMAPPS reports provide updated information on the abundance and distribution of marine mammals, sea turtles and sea birds and assess recent changes in seasonal habitat use by these species. These data can be used to quantify changing species' abundance and distributions and assess the potential impact of human activities on protected species. The abundance estimates used by National Marine Fisheries Service (NMFS) for many of the marine animal species within the US Atlantic Exclusive Economic Zone are based on the AMAPPS surveys (Hayes et al. 2019; Palka et al. 2017). At least one survey was conducted in the RI/MA WEA in each survey year.

- **Navy Operations Area Density Estimates (NODEs):** NODEs for the Northeast Navy Operations Area -Boston, Narragansett Bay, and Atlantic City provide area-specific marine mammal and sea turtle density information estimates (DoN 2007). These data were prepared for the US Navy Fleet Forces Command to meet its requirements established through the National Environmental Policy Act (NEPA), Marine Mammal Protection Act (MMPA), and Endangered Species Act (ESA) compliance processes. Though these data have been superseded by more up-to-date abundance information for most species, this report provides general distribution information for sea turtles.

- **Northeast Ocean Data Portal:** In response to the US National Ocean Policy call for regional ocean planning supported by a robust data management system, the Northeast Ocean Data Portal (NortheastOceanData.org) was created to bring together key data types. Data products are developed in association with the Northeast Regional Planning Body and the Northeast Regional Ocean Council. Currently, the portal contains information on loggerhead and leatherback sea turtle sightings in the Northeast for spring and summer.

- **OBIS-SEAMAP:** The Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) (seamap.env.duke.edu) is an effort led by Duke University aimed at augmenting our understanding of the distribution and ecology of marine mammals, sea turtles, seabirds, rays, and sharks. Data are collected from various providers world-wide and archived online in a spatially and temporally interactive format for distribution, abundance, and modeling efforts.

6.8.1.1 Sea Turtles that May Occur in the SWDA and OECC

There are seven species of sea turtles worldwide, six of which can be found in US waters. All six species are listed as threatened or endangered under the ESA. Of these species, five have been known to occur within, or in the vicinity of, the SWDA and/or OECC (including the Western Muskeget Variant). All five species that may be present are also listed under the Massachusetts Endangered Species Act (MA ESA). Only four are likely to occur in these areas: the loggerhead sea turtle *(Caretta caretta)*, Kemp's ridley sea turtle (*Lepidochelys kempii*), the green sea turtle (*Chelonia mydas*), and the leatherback sea turtle (*Dermochelys coriacea).* The protection status, stock identification, distinct population segments (DPSs), occurrence, and abundance estimates of the five species of sea turtle that may occur within, or in the vicinity of, the SWDA and OECC (including the Western Muskeget Variant) aredescribed in more detail in Appendix III-M.. Only those that are categorized as common, regular, and uncommon, are discussed in this document

Many sea turtle species prefer coastal waters; however, both the loggerhead and leatherback sea turtles are known to also occupy deep-water habitats and are considered common during summer and fall in the SWDA. Kemp's ridley sea turtles are thought to be regular visitors to the SWDA during those seasons. The green sea turtle (*Chelonia mydas*), generally prefers tropical and subtropical habitats, and they also may be present during those seasons.

The official range of a fifth species, the hawksbill sea turtle (*Eretmochelys imbricata*), extends into the Offshore Development Region; however, this range is based on an historical stranding record in Massachusetts in 1968 (Lazell 1980; McAlpine 2018) and an historical stranding record in New York in 1938 (Morreale et al. 1992). There are no recent recorded sightings of this species in the area. Because the potential presence of this species is low, and no impacts to the species are expected, hawksbill sea turtles are not considered further in this analysis.

Sea turtle presence in the SWDA is primarily limited to summer and fall months when waters in this region are warmer (DoN 2007; Dodge et al. 2014; Hawkes et al. 2007; Milton and Lutz 2003). Figure 6.8-1 through Figure 6.8-3 show sea turtle densites from DoN (2017). In the SWDA, the densities are all low relative to the range of densities modeled for the entire region. Based on historical data, no nesting sites are expected near the landfall sites for New England Wind (NMFS and USFWS 1991; 1992a; 1992b; 1993; 2008); therefore, the evaluation of impacts to sea turtles will only be described and assessed based on their anticipated offshore distributions. The STSSN database was consulted for seasonal relative abundance patterns of sea turtles in the region (Kenney and Vigness-Raposa 2010), and strandings within this zone over the past 10 years (2007 to 2017) as a relative indication of each species' presence in the area (see Appendix II-M for density and abundance information).) Sighting per unit effort results from the Northeast Large Pelagic Survey (Kraus et al. 2016) were reviewed to confirm the presence/absence of sea turtle species in the SWDA. Sightings information from surveys reported in BOEM [BOEM] Bureau of Ocean Energy Management (2014b) have also been integrated into the species-specific discussions below.

6.8.1.1.1 Green Sea Turtles

The green sea turtle is the largest hard-shelled sea turtle with carapace lengths (CLs) reaching 122 centimeters (cm) (48 inches [in]). This species' shell is dark brown, grey, or olive colored and has five scutes running down the middle and four scutes on each side (NMFS 1991, NOAA Fisheries 2022). The underside is a much lighter yellow-to white color. Green sea turtles have a distinctive serrated beak on the lower jaws and two large scales between the eyes. Green turtles are largely herbivorous in their benthic juvenile and adult stages, their diet mainly consisting of seagrass and macroalgae (Gilbert et al. 2008; Holloway-Adkins 2006). Hatchlings and some populations of juveniles and adults have been known to feed on plants and marine invertebrates (NMFS 2022, USFWS 2022).

Distribution

Green sea turtles are found worldwide primarily in subtropical and, less frequently, temperate regions. In the U.S. Atlantic and Gulf of Mexico waters, they are found inshore and nearshore waters from Texas to Maine. They occupy different habitat types, depending on life stage. Green turtles nest in over 80 countries and in the U.S. Atlantic, nesting occurs annually from North Carolina south to Texas (Waring et al 2012, NMFS 2022). Most juveniles spend their time in offshore pelagic habitats, specifically in and around sargassum mats, while adult turtles move into benthic feeding grounds and spend most of their lives in shallow coastal waters (Waring et al 2012, Carballo et al. 2002). Although uncommon, individual green turtles can be found as far north as Maine in the summer and fall when water temperatures are highest. Most return to warmer waters during the winter or can succumb to cold-stunning (McMichael et al. 2006).

Abundance

Kraus et al. (2016) did not observe any green sea turtles in the RI/MA WEA. During AMAPPS surveys conducted between 2010-2013, green sea turtles were observed outside of the RI/MEA WEA and as far north as Maine, although sightings mainly occurred from New Jersey to Florida (NEFSC and SEFSC 2011a; 2011b; 2012; 2014a; 2014b; 2015; 2016; 2018; 2019). In 2005, a confirmed green turtle sighting occurred in the RI Special Area Management Plan area, south of Long Island (Kenney and Vigness-Raposa 2010). Nawojchik and St. Aubin (2003) reported only two strandings in Connecticut and Rhode Island during 1987–2001, but the specific dates and locations are unknown. However, like Kemp's ridleys, juvenile green turtles are known to be present in shallow waters around eastern Long Island and Cape Cod, although data suggests they are relatively more common around Long Island than they are in Massachusetts (Kenney and Vigness-Raposa 2010)

Status

The green turtle was listed under the ESA on July 28, 1978 (43 Fed. Reg. 32800 [1978]). Two of the 11 distinct population segments are listed as endangered- the breeding populations in Florida and Mexico's Pacific coast. Elsewhere, including the North Atlantic, the species is listed as threatened. The main threats facing green sea turtles include bycatch in commercial and recreational fishing gear, vessel strikes, loss of nesting habitat from coastal development, and climate related changes.

6.8.1.1.2 Kemp's Ridley Sea Turtles

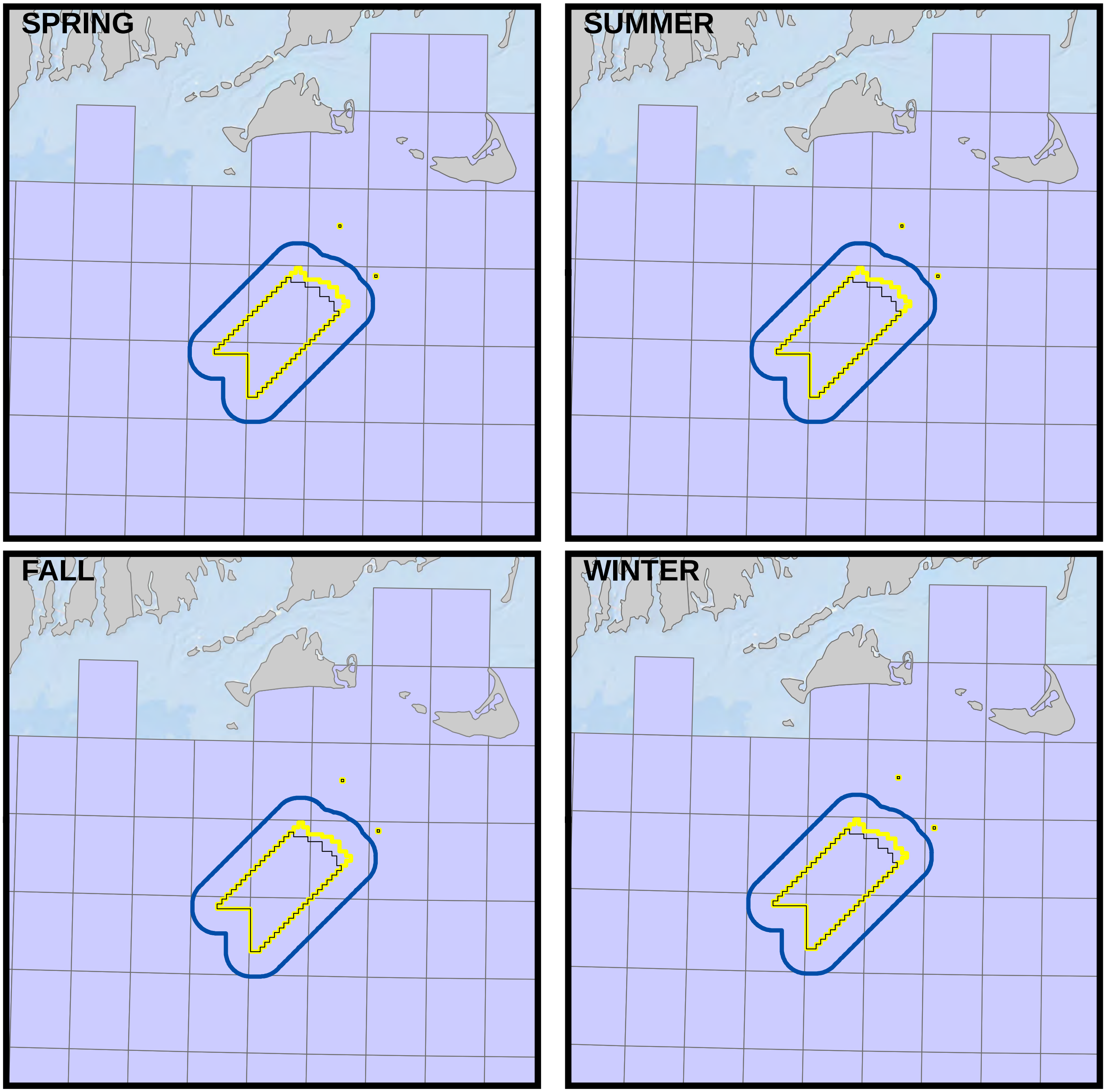
Kemp's ridley sea turtles are the smallest of the Chelonidae species, with carapace lengths (CLs) reaching 65 centimeters (cm) (25.6 inches [in]). This species' nearly circular-shaped carapace is almost as wide as it is long and is olive-gray in color. Integument coloration is olive-gray dorsally and light yellow ventrally. The plastron (bottom shell) is a light cream-white (NMFS, USFWS and SEMARNAT 2011). When in pelagic habitats, juvenile Kemp's ridleys feed on small invertebrates associated with sargassum (a brown seaweed that can form large floating masses), such as mollusks and crabs (Bjorndal 1997). Once they recruit to nearshore habitats, their diet is primarily composed of crabs. Kemp's ridleys spend approximately 11% of their time at the surface and are otherwise submerged, foraging, or resting (Renaud 1995).

Distribution

Kemp's ridley sea turtles are distributed throughout the Gulf of Mexico and along the US Atlantic seaboard as far north as Nova Scotia; their range encompasses the SWDA (see Figure 6.8-1.). Although Kemp's ridley sea turtles are expected to regularly occur within the Offshore Development Area, their abundance may be biased due to several factors: (1) most individuals are too small to be detected during surveys; (2) historically, shallow bays and estuaries utilized by Kemp's ridleys in the region have been excluded from survey designs, including Kraus et al. (2016); and (3) Kemp's ridleys may be overrepresented in stranding reports due to cold-stun events (i.e. a hypothermic effect that occurs from prolonged exposure to cold water temperatures) (Kenney and Vigness-Raposa 2010).

Abundance

In the Kraus et al. (2016) surveys of the MA WEA and RI/MA WEA, the only confirmed sightings of Kemp's ridley sea turtles occurred within a four-week span in 2012 (one on August 23, four on September 12, and one on September 17, 2012). Modeling from the NARWC database show that Kemp's ridley sea turtles are present in the RI/MA WEA, with over 85% of records in summer



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Scale 1:1,500,000
1 inch = 24 miles

0 30 60 Miles

0 48 96 Kilometers

LEGEND

Lease Area OCS-A 0534

Southern Wind Development Area

6.2km Buffer

Kemps ridley turtle density, animals/km²

0.000 - 0.023

0.023 - 0.087

0.087 - 0.200

0.200 - 0.354

0.354 - 2.046

Figure 6.8-1

Map of Kemp's Ridley Sea Turtle Maximum Seasonal Density from DoN (2017) months; however, this species is sighted at much lower numbers than other species (Kenney and Vigness-Raposa 2010). The AMAPPS surveys did not detect Kemp's ridley sea turtles near the SWDA (NEFSC and SEFSC 2011a; 2011b; 2012; 2014a; 2014b; 2015; 2016; 2018; 2019). The STSSN records indicate that Kemp's ridleys are the most common species to be found stranded within or near the Offshore Development Area; however, this does not necessarily indicate that they are the most common species, as noted above for their overrepresentation in stranding data. Cold stun events are relatively common in Cape Cod (Dodge et al. 2007), and 50 to 200 turtles are expected to be found cold-stunned each year and reported as strandings in the STSSN. Kemp's ridleys are the most common cold-stunned stranding turtle species recovered (Dodge et al. 2007).

Status

The Kemp's ridley sea turtle was listed as endangered in 1970 (35 Fed. Reg. 18,319 [1970]). There is only one population of Kemp's ridley sea turtles, and all nesting occurs in the western Gulf of Mexico. Nesting primarily occurs at Rancho Nuevo, Mexico, but nesting within the US (primarily on South Padre Island in Texas) has been increasing (Valdivia et al. 2019). Kemp's ridley sea turtles and the closely related Olive ridley sea turtles (*Lepidochelys olivacea*) are the only turtle species to exhibit a synchronized mass nesting behavior where large numbers of females gather offshore and then come to shore as a group to nest in an arribada.

Historically, the primary threat to Kemp's ridleys was the harvest of both eggs and turtles. Small levels of harvesting still occur on nesting beaches in Mexico, but it has dramatically decreased from historical levels (NMFS, USFWS, and SEMARNAT 2011). Current threats include vehicles on beaches and coastal development in terrestrial habitats, oils spills, and bycatch in fisheries, especially the shrimp trawl fishery (NMFS, USFWS, and SEMARNAT 2011).

6.8.1.1.3 Leatherback Sea Turtles

Leatherback sea turtles are the only remaining species of the family Dermochelyidae and are characterized by an extreme reduction of the bones of the carapace and plastron and a lack of scutes (i.e. bony plates) (Pritchard 1997). They are the largest of the sea turtles, reaching over 180 cm (71 in) carapace length (CL). They are black in coloration on their dorsal surfaces with varying patterns of white spotting; ventrally they are mottled pinkish-white and black (NMFS and USFWS 1992b). The carapace has seven longitudinal ridges that taper to a blunt point. Their diet primarily consists of jellyfish and salps. Mean dive duration for leatherback sea turtles is approximately 10 minutes with mean surface interval time of five minutes, suggesting they spend about one third of their time at the surface (Eckert et al. 1989).

Distribution

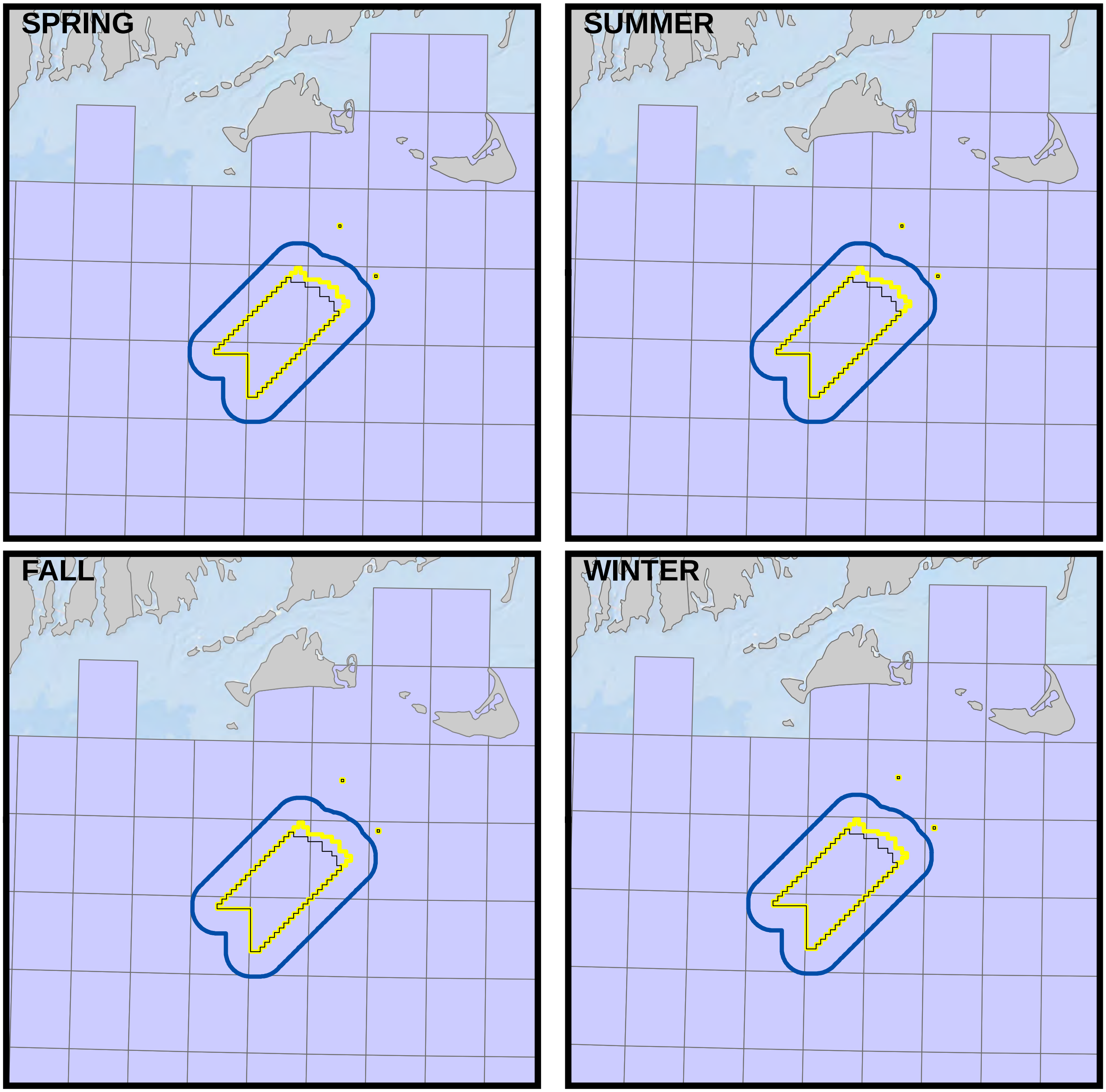
Leatherback sea turtles have thermoregulatory adaptations, including counter-current heat exchange systems, a high oil content, and large body size that allow them to have the widest geographical distribution of all sea turtles (Spotila et al. 1997). While primarily found in tropical and temperate waters, they occur as far north as British Columbia, Newfoundland, and the British Isles in the Northern Hemisphere. This range includes the SWDA (see Figure 6.8-2). Primary nesting beaches for Atlantic leatherbacks are Gabon, Africa, and French Guiana, though substantial nesting also occurs in the US, Puerto Rico, US Virgin Islands, and Trinidad, and Tobago. Nesting trends for these areas are generally stable or increasing (TEWG 2007).

Abundance

Modeled seasonal abundance patterns of leatherback sea turtles suggest that they are present in the SWDA during fall and remain south of the Offshore Development Area during the summer months (Kenney and Vigness-Raposa 2010). A recent survey of the RI/MA WEA differed from this conclusion and reported that leatherbacks were widespread throughout the region during both summer and fall months (98.7% of sightings), with the highest abundances located within the OECC (including the Western Muskeget Variant) and to the east of the SWDA (Kraus et al. 2016). Three leatherback sea turtles (one live sighting and two deceased animals) were identified in October 2016 in the SWDA during high resolution geophysical surveys (Vineyard Wind 2016); and 14 leatherbacks and four unknown species were identified during 2017 surveys. Only two leatherback sea turtles were detected outside of summer and winter for RI/MA WEA surveys (both in the spring), and these sightings occurred south and southeast of the SWDA (Kraus et al. 2016). AMAPPS surveys sighted leatherback sea turtles only during summer surveys (shipboard and aerial) in 2011 and 2016 (NEFSC and SEFSC 2011b; 2016). A lack of spring and winter survey sightings are consistent with previous modeling efforts that suggest leatherback sea turtles are not expected to be present during these seasons (Kenney and Vigness-Raposa 2010). Data from the STSSN also support the conclusion that leatherback sea turtles are relatively common within the Offshore Development Area during the summer and fall months.

Status

The leatherback sea turtle was listed as endangered in 1970 (35 Fed. Reg. 8,491 [1970]). Notably, the Atlantic leatherback nesting populations within US jurisdiction have also experienced a considerable rebound, and the combined number of nests across Florida, Puerto Rico, and the Virgin Islands, significantly increased after ESA listing (Valdivia et al. 2019). Leatherbacks primarily use pelagic habitats, except when nesting. Harvesting of eggs and meat continues to be a threat throughout parts of the leatherback's nesting range. Terrestrial threats to nesting habitats are similar to those of other sea turtle species and include coastal development, erosion, erosion control, and recreational activities. Leatherbacks are also vulnerable to bycatch in fishing gear, such as longline, gillnets, trawls, traps, and dredges.



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Scale 1:1,500,000
1 inch = 24 miles

0 30 60 Miles

0 48 96 Kilometers

LEGEND

- Lease Area OCS-A 0534
- Southern Wind Development Area
- 6.2km Buffer

Leatherback turtle density, animals/km²

- 0.000 - 0.006
- 0.006 - 0.019
- 0.019 - 0.041
- 0.041 - 0.074
- 0.074 - 0.141

New England Wind
AVANGRID RENEWABLES

Figure 6.8-2

Map of Leatherback Sea Turtle Maximum Seasonal Density from DoN (2017)

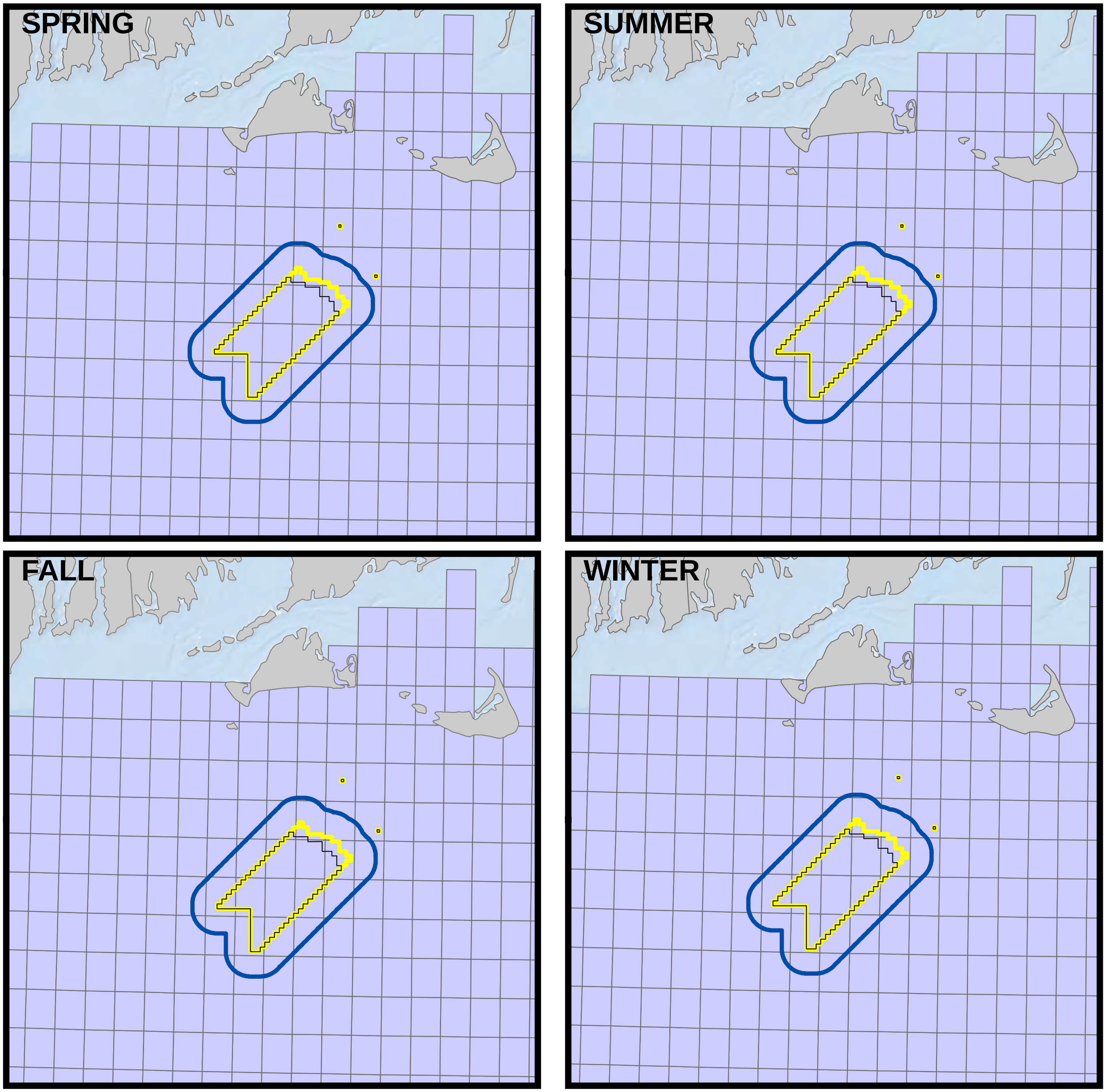
6.8.1.1.4 Loggerhead Sea Turtles

Loggerhead sea turtles are among the largest of the hard-shelled Cheloniidae sea turtles, with CLs reaching 120 cm (47 in) (TEWG 2007). They have a reddish-brown carapace, with a dull brown integument (outer protective layer) dorsally and a light-to-medium yellow integument ventrally (Conant et al. 2009). When in pelagic habitats, juvenile loggerheads feed on invertebrates associated with sargassum as well as salps and jellyfish (Bjorndal 1997). Once they reach a size of 40–60 cm (16–24 in) CL, they recruit to coastal inshore and waters of the continental shelf throughout the US Atlantic to feed on a wide range of benthic and suspended animals including crabs, mollusks, jellyfish, and vegetation at or near the surface (NMFS, NOAA, DoC 2002). Loggerhead sea turtles spend approximately 3.8% of the time (or 2.3 minutes per hour) at the surface and are otherwise submerged, foraging, or resting (Thompson 1988).

Distribution

Globally, loggerheads occur throughout the temperate and tropical regions of all ocean basins (Dodd 1988). The range of the Northwest Atlantic DPS is within the Atlantic Ocean, north of the equator, south of 60° N, and west of 40° W, which includes the SWDA (see Figure 6.8-3). Nesting for this DPS is concentrated along the Florida coast, with lower levels of nesting occurring on Gulf of Mexico beaches and up the Atlantic coast as far north as Virginia, far south of potential New England Wind cable landfall sites.

Kraus et al. (2016) surveys of the MA WEA and RI/MA WEA found that loggerhead sea turtles occur throughout the region, with the most sightings occurring during the summer and fall months (over 92% of sightings occurred in August and September) (see Figure 6.8-3). One loggerhead sea turtle in Lease Area OCS-A 0501 was also identified during high resolution geophysical surveys (Vineyard Wind 2016); four unidentified species were sighted in 2017. Loggerheads tend to be absent during the winter months and are rare during the spring months, although sightings in spring were found within the Offshore Development Area (Kraus et al. 2016). These findings regarding loggerhead sea turtle spatial and temporal distributions are consistent with prior studies in the region; AMAPPS surveys have also spotted loggerheads near the SWDA in the summer and fall months during surveys in 2010, 2012, 2013, 2016, 2017, and 2018 (NEFSC and SEFSC 2011a; 2011b; 2012; 2014a; 2014b; 2015; 2016; 2018; 2019). Data from the NARWC database report a majority of loggerhead sightings in the region (99.6%) during the summer and fall months with a lower likelihood of occurrence in nearshore waters (e.g. the OECC, including the Western Muskeget Variant) (Kenney and Vigness-Raposa 2010). Nearshore areas should not be discounted, however, as juveniles present in more coastal areas or embayments may be too small to be detected during surveys (Kenney and Vigness-Raposa 2010). STSSN data also indicate that loggerhead sea turtles are relatively common within the region during the summer and fall. Additional studies consistent with loggerhead sea turtle distributions reported here include the Cetacean and Turtle Assessment Program (CeTAP 1982) and Shoop and Kenney (1992).



LEGEND

- Lease Area OCS-A 0534
- Southern Wind Development Area
- 6.2km Buffer

Loggerhead turtle density, animals/km²

- 0.000 - 0.020
- 0.020 - 0.065
- 0.065 - 0.117
- 0.117 - 0.170
- 0.170 - 0.301

Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Map Coordinate System: NAD 1983 UTM 19N Meters

Scale 1:1,500,000
1 inch = 24 miles

0 30 60 Miles

0 48 96 Kilometers

New England Wind

AVANGRID RENEWABLES

Figure 6.8-3

Map of Loggerhead Sea Turtle Maximum Seasonal Density from DoN (2017)

Abundance

The most common way to census sea turtle populations is to count nests on nesting beaches. In 2019, the loggerhead nest count for Florida core index beaches was 53,000 (FFWCC 2020). This value represents approximately 70% of all nesting that occurs in Florida. Females will lay three to four nests in a year, but will not nest every year; therefore, converting the nest count to a population count requires assumptions, thus nest trends are typically used as a proxy for population trends. Overall, trends in nesting numbers for this DPS have been increasing since 2007.

Status

Loggerhead sea turtles were listed as threatened in 1978 (43 Fed. Reg. 32,800 [1978]). In 2011, the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service issued a final rule concluding that, globally, the loggerhead sea turtle is comprised of nine DPSs, identifying four as threatened and five as endangered (76 Fed. Reg. 58,868 [2011]). Only the Northwest Atlantic DPS is likely to occur in the SWDA.

Historically, the primary threat to loggerheads was the harvest of both eggs and turtles. Current threats include incidental capture in fishing gear (primarily longline and gill nets, trawls, traps, and dredges), and destruction and modification of nesting habitat from coastal construction, coastal erosion, and placement of erosion control structures (Conant et al. 2009).

The Northeast Fisheries Science Center and Southeast Fisheries Science Center (NEFSC and SEFSC 2011c) estimated that the loggerhead turtle population in the northeast Atlantic Ocean is approximately 588,000 when only positively identified loggerhead turtles are considered in abundance estimates, and as high as 801,000 when a proportion of unidentified sea turtles in surveys is considered in estimates.

6.8.1.2 Seasonal Sea Turtle Density Estimates

The SWDA is on the northernmost border of the Mid-Atlantic North region defined in NEFSC and SEFSC (2011c) for sea turtle distribution and therefore, the presence of sea turtles in the SWDA is seasonal and limited mainly to time periods when waters are warmer (DoN 2017; Dodge et al. 2014; Hawkes et al. 2007). There are no known sea turtle nesting areas north of the Carolinas (Kot et al. 2018). During surveys of the MA WEA and RI/MA WEAs, Kraus et al. (2016) observed sea turtles in the summer and fall; however, sea turtles were absent in winter and nearly absent in spring. Leatherback and loggerhead sea turtles were the most commonly observed turtle species during the surveys by Kraus et al. (2016). Kemp's ridley sea turtles were also observed, though in much smaller numbers. South of the MA WEA, in the New York Bight, Normandeau Associates Inc. and APEM (2016; 2018) conducted aerial surveys for sea turtles in 2016 and 2017 using high-resolution photography to aid in species identification. In that region, loggerhead sea turtle numbers were higher than other species by an order of magnitude.

For this analysis, sea turtle densities were obtained from the US Navy Operating Area Density Estimate (NODE) database on the Strategic Environmental Research and Development Program Spatial Decision Support System (SERDP-SDSS) portal (DoN, 2012; 2017) and from the Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles (Kraus et al. 2016). These data are summarized seasonally (winter, spring, summer, and fall). Since the results from Kraus et al. (2016) use data that were collected more recently, those were used preferentially where possible.

Sea turtles were most commonly observed in summer and fall, absent in winter, and nearly absent in spring during the Kraus et al. (2016) surveys of the MA WEA and RI/MA WEAs. Because of this, the more conservative winter and spring densities from SERDP-SDSS are used for all species. It should be noted that SERDP-SDSS densities are provided as a range, where the maximum density will always exceed zero, even though turtles are unlikely to be present in winter. As a result, winter and spring sea turtle densities in the lease area, while low, are likely still overestimated.

For summer and fall, the more recent leatherback and loggerhead densities extracted from Kraus et al. (2016) were used. These species were the most commonly observed sea turtle species during aerial surveys by Kraus et al. (2016) in the MA/RI and MA WEAs. However, Kraus et al. (2016) reported seasonal densities for leatherback sea turtles only, so the loggerhead densities were calculated for summer and fall by scaling the averaged leatherback densities from Kraus et al. (2016) by the ratio of the seasonal sighting rates of the two species during the surveys. The Kraus et al. (2016) estimates of loggerhead sea turtle density for summer and fall are slightly higher than the SERDP-SDSS densities, and thus more conservative.

Kraus et al. (2016) reported only six total Kemp's ridley sea turtle sightings, so the estimates from SERDP-SDSS were used for all seasons. Green sea turtles are rare in this area and there are no density data available for this species, so the Kemp's ridley sea turtle density is used as a surrogate to provide a conservative estimate.

For more information on sea turtle densities used in exposure estimates, see Appendix III-M.

6.8.2 Potential Impacts of New England Wind

Construction and installation, operations and maintenance (O&M), and decommissioning activities associated with New England Wind have the potential to affect sea turtles through IPFs including underwater sound, vessel interactions, marine debris, reductions in prey availability, habitat alteration, and entanglement (Table 6.8-1). This section provides an assessment of the potential risks to sea turtles populations (stocks or DPSs) from New England Wind activities. Criteria used for this risk assessment are the same as those used for marine mammals. This assessment is supplemented with a detailed acoustic impact analysis found in Appendix III-M.

This assessment of potential impacts considers the full buildout of Phases 1 and 2 of New England Wind. Specifically, the assessment considers the potential for up to 130 wind turbine generator (WTG)/electrical service platform (ESP) grid positions. Two of these grid positions may potentially have co-located ESPs (i.e. , two monopile foundations installed at one grid position[87]), resulting in 132 foundations.[88]

To assess the potential impacts of anthropogenic sound to sea turtles, and following consultation with BOEM, both 12 m (39.4 ft]) and 13 m (42.7 ft) monopiles were considered for Phase 1 and Phase 2, respectively, but it is expected that the majority of the monopiles for Phase 2 will be close to 12 m (39.4 ft) in diameter (see Appendix III-M). Some monopile diameters may be less than 12 m. A modeling comparison showed minimal difference between the 12 m and 13 m monopile using a 5,000 kJ hammer. Given these similarities, the 13 m monopile was not modeled at 6,000 kJ in the acoustic assessment and the 12 m monopile with 6,000 kJ hammer energy was assumed to be a reasonable replacement in exposure calculations. The maximum jacket foundation pile size included in both Phases (4 m [13 ft]) is also assessed. Details of the acoustic modeling approach are described in Appendix III-M.

Table 6.8-1 Impact Producing Factors for Sea Turtles

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Underwater noise	•	•	•	•	•	•
Vessel collision	•	•	•	•	•	•
EMF	•	•	•	•	•	
Reduction in prey abundance	-	-		-	-	-
Habitat alteration	-	-		-	-	-
Entanglement hazard	-	-		-	-	-
Marine debris	-	-		-	-	-
Suspended sediments	-	-		-	-	-

Note:
The symbol "-" indicates an impact producing factor was assessed but is not expected to pose a risk to sea turtle populations.

87 If co-located ESPs are used, each ESP's monopile foundation would be located within 76 m (250 ft) of one of the potential ESP grid locations (i.e. the monopiles would be separated by up to 152 m [500 ft]).

88 A total of 132 foundations are presently proposed. New England Wind previously also included one additional foundation for a potential reactive compensation station (RCS), bringing the total to 133 foundations. All hydroacoustic modeling was conducted for 133 foundations prior to the elimination of the potential RCS, which reduced the number of foundations to 132. The reduction to 132 foundations was determined to have a negligible effect on the predicted number of exposures, so the modeling was not redone.

The potential risks posed by New England Wind activities and their associated stressors are categorized as very low, low, moderate, or high based on the probability of sea turtle exposure and the vulnerability of the sea turtle species to each stressor (see Table 6.8-1). Occurrence of sea turtle species and their relationships to the established criteria are evaluated using existing literature on sea turtle distribution and habitat use in the MA WEA and RI/MA WEA, impacts of marine construction, wind farm construction and operations in the US and globally.

Based on a review of studies that provide a general understanding of hearing, vessel collision risk, response to anthropogenic sound, and other factors that influence the potential impacts of offshore wind construction, operation, and decommissioning activities on sea turtles, some of the impact-producing factors are not expected to pose a risk to populations of sea turtles or the risk is very low. Very low risk IPFs include potential impacts from marine debris, reductions in prey availability, entanglement, and sediment mobilization (see Table 6.8-1 for criteria to assign an impact risk level of very low). An in-depth analysis was not conducted for very low risk IPFs, but each is briefly described below. The remainder of this section focuses on impacts to sea turtles associated with underwater sound, vessel collision, electromagnetic fields (EMFs), and habitat disturbance and modification during construction and installation, O&M, and decommissioning. Avoidance, minimization, and mitigation measures to reduce the effects of these IPFs during all development stages of New England Wind are provided in Section 6.8.4.

There are also positive impacts to sea turtles expected to occur from New England Wind, which are briefly described in Section 6.8.2.1.

6.8.2.1 IPFs Not Expected to Pose a Risk to Sea Turtle Populations

6.8.2.1.1 Reductions in Prey Availability

Potential risk of impacts to sea turtle prey availability, including crabs and whelks, from benthic disturbance during construction would be localized and short-term; therefore, risk of declining prey availability is not anticipated. During all phases of New England Wind, the loss of prey habitat would be localized, and the presence of the WTG/ESP foundations and associated scour protection would result in a very small loss of benthic habitat (see Section 6.5). During O&M, the WTG foundations can be expected to create habitat and increase prey availability (Friedlander et al. 2014; Petersen and Malm 2006), which would result in a long-term positive impact on sea turtles.

6.8.2.1.2 Entanglement Hazard

As with marine mammals, the direct risk of entanglement from construction and operation is extremely low. Steel anchor cables used on construction barges are typically five to seven centimeters (2–3 in) in diameter. Typically, these cables are under tension while deployed, eliminating the potential for entanglement. Similarly, tow lines for cable installation and taut lines for metocean buoys (described in Sections 3.3.1.11 and 4.3.1.11 of COP Volume I) are expected to be under constant tension and should not present an entanglement risk for sea turtles. Lost fishing gear and other marine debris could possibly catch on WTGs and present a secondary entanglement hazard to sea turtles; however, WTG/ESP foundations have large monopile diameters (up to 12 m [39 ft] for Phase 1 and up to 13 m [43 ft] for Phase 2) or jacket diameters (up to 4 m [13 ft] for each Phase) without the protrusions on which lost fishing gear or other marine debris would become snagged. Continual maintenance during the construction and operation of WTGs is expected to help remove debris. As such, it is unlikely that secondary entanglement of sea turtles in such debris would occur.

6.8.2.1.3 Marine Debris

The Clean Water Act and other applicable federal and international regulations will be followed to prevent the release of harmful substances into the ocean during construction, operation, and decommissioning of New England Wind. Any items that could become marine debris will be appropriately discarded ashore. Thus, activities occurring in the SWDA are not expected to produce marine debris and therefore would not pose a risk to sea turtles.

6.8.2.1.4 Suspended Sediments

Suspended sediments caused by disturbance of the seafloor would be limited to an area near construction or installation activities and be short-term. In addition, field verification of sediment plume modeling during Block Island Wind Farm cable installation indicated that the actual sediment plume was less than the modeled plume, without any evidence of a sediment plume in the water column resulting from use of the jet plow (Elliot et al. 2017). Sediment plumes are dependent on sediment type and mobilization of sediments and would be expected to vary from region to region. Sediments in the SWDA and offshore portion of the OECC in water depths greater than 30 m (98.4 ft) are predominately fine sand with some silt, fining in the offshore direction. Heading north through Muskeget Channel, median grain size increases, with sand and gravel dominant, along with coarser deposits (cobbles and boulders) locally. Continuing north into the main body of Nantucket Sound, sand still dominates the seabed, with coarser deposits concentrated around shoals and in high current areas and finer grained sediments occupying deeper water and/or more quiescent flow areas. A Sediment Transport Modeling Study provided in Appendix III-A predicts that suspended sediments from cable installation activities in the SWDA and along the OECC (including the Western Muskeget Variant) would settle out within approximately six hours or less at any given location. These sandy sediments would be expected to settle quickly. Therefore, based on the limited mobilization of sediment into the water column, New England Wind activities are not expected to pose a risk to sea turtles.

The potential risk producing factors that are not expected to impact, or are deemed very low risk to, sea turtles (reduction in prey availability, marine debris, entanglement, and sediments) (see Table 6.8-1) are not addressed further in this analysis.

The remaining IPFs are underwater sound, vessel interaction, habitat modification, and EMFs. These will be described in detail in the following sections.

6.8.2.2 Construction and Installation

6.8.2.2.1 Underwater Noise (Phases 1 and 2)

Very little is known about sea turtle hearing and vocalization (Cook and Forrest 2005; McKenna 2016), and a corresponding lack of data on sea turtles exposed to sounds makes it difficult to predict the potential sound-producing construction activities on their behavior and hearing structures. While there is some evidence that sea turtles use sound to communicate, the few vocalizations described are restricted to the grunts of nesting females and the chirps, grunts, and complex hybrid tones of eggs and hatchlings (Cook and Forrest 2005; Ferrara et al. 2014; Mrosovsky 1972). Most of what is understood about sea turtle hearing comes from studies of green and loggerhead sea turtles, with limited studies of juvenile Kemp's ridley and hatchling leatherback sea turtles (Bartol and Ketten 2006; Dow Piniak et al. 2012). The upper limit of sea turtle hearing is estimated to be approximately 1 kHz, with the greatest sensitivity at approximately 100–400 Hz. Piniak et al. (2016) found that green sea turtles detect underwater stimuli between 50 and 1,600 Hz, with maximum sensitivity between 200 and 400 Hz. Ridgway et al. (1969b) suggest that the maximum sensitivity for green sea turtles was between 300 and 400 Hz, with an upper limit of 1,000 Hz. Bartol et al. (1999) found that the loggerhead sea turtle's range of effective hearing was between 250 and 750 Hz, with the greatest sensitivity at the low end of that range; however, Lavender et al. (2014) estimate the range to be 50 to 1,100 Hz for post-hatchling and juvenile loggerheads, with the greatest sensitivity between 100 and 400 Hz. In support of this, Martin et al. (2012) also found the greatest sensitivity to sound occurs between 100 and 400 Hz in an adult loggerhead sea turtle. Acoustic Thresholds Used to Evaluate Potential Impacts to Sea Turtles

Acoustic Thresholds Used to Evaluate Potential Impacts to Sea Turtles

Injury, impairment, and behavioral thresholds for sea turtles were developed for use by the US Navy (Finneran et al. 2017) based on exposure studies (e.g. McCauley et al. 2000a). Dual criteria (PK and SEL) have been suggested for PTS and TTS, along with auditory weighting functions published by Finneran et al. (2017) used in conjunction with SEL thresholds for PTS and TTS. Finneran et al. (2017) presented revised thresholds for turtle injury, considering both PK (232 dB) and frequency weighted SEL (204 dB). Data on the behavioral response of sea turtles to acoustic exposure have been collected in a small number of research studies. McCauley et al. (2000a) observed the behavioral response of caged turtles—green and loggerhead sea turtles—to an approaching seismic air gun. Sea turtles showed behavioral responses and behaved erratically when the received SPL was approximately 175 dB.

Table 6.8-2 summarizes the acoustic thresholds that are used to evaluate potential impacts to sea turtles from New England Wind pile driving activities. For further discussion of acoustic thresholds for sea turtles, see Appendix III-M.

Table 6.8-2 Acoustic Thresholds Used to Evaluate Potential Injury, TTS, and Behavioral Response for Sea Turtles (Finneran et al. 2017)

Hearing Group	Impulsive Signals1				Behavior2
	Mortality or Potential Mortal Injury		Recoverable Injury		
	Lpk	LE	Lpk	LE	Lp
Sea turtles	232	204	226	189	175

Notes:
1. Lpk = peak sound pressure (dB re 1 µPa); LE, = sound exposure level (dB re 1 µPa2·s).
2. Lp = root mean square sound pressure (dB re 1 µPa).

Sea Turtle Exposure Estimates

Animal movement modeling was used to sample the sound fields generated during New England Wind pile driving by incorporating real animal movement using species-typical behavioral parameters derived from animal observations. Animal movement models integrate the modeled sound fields with biologically meaningful movement rules for each sea turtle species. The result of animal movement modeling is a sound exposure history for each animal in the model, from which the probability of exposure can be calculated. The modeled exposure probabilities are then scaled by the density of real-world animals and duration of construction to get an estimate of the number of individuals expected to exceed regulatory thresholds. Key to this estimation is the modeled species' monthly densities (see Appendix III-M) and the proposed construction and installation schedules.

An estimated piling construction schedule that includes the installation of jacket and monopile foundations with associated estimated hammer energies was used to predict the number of potential sea turtle exposures. The estimated piling construction schedules used in the exposure modeling and estimated sea turtle exposures are shown in Appendix III-M.

Modeled Range to Sea Turtle Acoustic Thresholds

Appendix III-M provides a detailed acoustic impact assessment with modeled radial distances to regulatorily defined threshold levels of sound produced by impact pile driving of various pile diameters and hammer energies. Exposure-based ranges for each of the sea turtle species were estimated using animal movement and exposure modeling results. These ranges were calculated for use in suggesting monitoring and mitigation zones. Exposure modeling was done assuming 0, 6, 10, and 12 dB broadband attenuation and summary results in this section focus on 10 dB only. For complete results at all attenuation levels, and for each of the modeled foundation types, see Section 4.4.2 in Appendix III-M.

6.8.2.2.1.1 Impact Pile Driving

The primary sound source associated with New England Wind construction and installation is impact pile driving, described in Section 6.7.2.2.1 as a low-frequency, impulsive sound.

There is a paucity of data regarding responses of sea turtles to acoustic exposure, and no studies of noise-induced hearing effects. Based on physiology, it is likely that temporary threshold shift (TTS) (see details in Section 6.8.2.3.1) can occur in sea turtles, as it does in other vertebrates, but no studies have been conducted to confirm this hypothesis. It is also unknown if lost or damaged sensory cells in the sea turtles' auditory system can regrow after a loss, as occurs in fish (Warchol 2011). Because of their rigid external anatomy, it is possible that sea turtles are protected from impulsive sound effects such as pile driving (Popper et al. 2014).

Sea turtles have been observed adjusting their behavior in response to low-frequency, impulsive sounds (DeRuiter and Larbi Doukara 2012). Data are limited regarding sea turtle behavioral responses to sound levels below those expected to cause injury, and some research indicates that sea turtles have limited capacity to detect sound (Moein et al. 1995; Ridgway et al. 1969a). Behavioral responses to anthropogenic sound exposure can lead to spatial avoidance. Sea turtles have displayed avoidance reactions to low-frequency, impulsive seismic signals at levels between 166–179 decibels (dB) re 1µPa (McCauley et al. 2000b; Moein et al. 1995); however, due to the experimental conditions, the extent of avoidance could not be monitored. Moein et al. (1995) also observed a habituation response from sea turtles to a seismic source with animals ceasing to respond to the signal after three presentations. It is unknown if the lack of behavioral response was a result of habituation, TTS, or permanent threshold shift (PTS). Pile driving activities are short-term, and the results of one investigation have suggested that, while sea turtles may avoid an area of active pile driving, they will return to the area upon completion (USCG 2006). Although data on the effects of pile driving on sea turtles are limited (Popper et al. 2014), it can be inferred that the low-frequency impulsive sound that will result from pile driving of the New England Wind foundations has the potential to impact sea turtles within the SWDA.

Acoustic masking is one of the main effects of sound pollution on marine animals (Peng et al. 2015; Vasconcelos et al. 2007). Sound associated with New England Wind activities has the potential to mask relevant sounds for sea turtles in the environment, though the impact of masking on sea turtles is currently unknown, (Dow Piniak et al. 2012; Lucke et al. 2014). If it occurs, masking can interfere with the localization of prey or a mate, the avoidance of predators, and, in the case of sea turtles, identification of an appropriate nesting site (Nunny et al. 2008). The risk to sea turtles from pile driving sound must also be considered in the context of existing ambient noise. Other soundscape contributors, ranging from natural to anthropogenic sounds (e.g. wind, waves, shipping traffic, military sonar operations, and pile driving) have the potential to mask relevant biological signals within the hearing range of sea turtles (below 1 kHz) (CBD 2012; Hildebrand 2005). Kraus et al. (2016) recorded ambient noise in the frequency range of 70.8–224 Hz in the RI/MA WEA from 2011 to 2015. Sound levels ranged from 96 dB re 1 µPa to 103 dB during 50% of recording time. Sound pressure levels were 95 dB re 1 µPa or less 40% of the time and greater than 104 dB re 1 µPa 10% of the time. These recordings will have included natural sound contributors and anthropogenic inputs typical for the area such as vessel noise.

Any impact risks are limited to the seasons when sea turtles are present (i.e. primarily summer and fall). With the implementation of monitoring, mitigation, and best management practices (BMPs), the risk to sea turtles due to pile driving is low. These mitigation measures would not be materially different from those employed for marine mammals and are expected to provide protection for both marine mammals and sea turtles. Pile driving activities are also unlikely to result in long-term behavioral modification. Overall, impact risks are expected to be seasonal, short-term, localized, and minimized or offset through BMPs and/or mitigation.

6.8.2.2.1.2 Vibratory Pile Setting

Vibratory pile setting associated with construction activity is expected to be within the hearing range of sea turtles. Recent assessment of vibratory pile setting underwater sound propagation indicates that acoustic ranges to injury and behavioral thresholds are relatively small, with only 31 m (102 ft) to injury thresholds and 53 m (174 ft) to behavioral thresholds (Denes et al., 2021a). At these ranges, no injury or mortality is expected, and behavioral exposures are unlikely. Underwater noise that is detectable by sea turtles can mask signal detection, and influence behavior, but the consequences of masking and attendant behavioral changes on the survival of sea turtles are not known (Popper et al. 2014).

Vibratory pile setting is anticipated to have negligible impacts on sea turtle species and may have no effect depending on the season in which this activity would take place. If behavioral exposures occur, behavioral responses are expected to be temporary, short-term, and are not expected to affect sea turtle species present within the SWDA. Risks to sea turtles due to vibratory pile setting are very low to low.

6.8.2.2.1.3 Drilling

There is insufficient information on the impacts of underwater drilling sounds to sea turtles. However, sea turtle hearing sensitivity is within the frequency range (100-1000 Hz) of sound produced by low-frequency sources such as marine drilling (for a summary, see Popper et al. 2014). Sound levels emitted by construction drilling operations are likely to be audible to sea turtles. However, it is unlikely that the sound from construction drilling operations will reach behavioral thresholds, and even more unlikely that the sound will reach injury thresholds, unless the sea turtle is within close proximity to the drilling activity (McCauley et al. 2000b, Dow Piniak et al. 2012, Finneran et al. 2017). Risks of impact are expected to be low, but further research is required to understand the potential effects.

6.8.2.2.1.4 HRG Surveys

High-resolution geophysical (HRG) surveys that use non-impulsive sources are not expected to impact sea turtles because they operate at frequencies above the sea turtle hearing range (<1 kHz). Low-frequency impulsive HRG equipment may produce sounds within the hearing ranges of sea turtles and impacts should be evaluated using a quantitative approach (McCauley et al. 2000b, Dow Piniak et al. 2012, Finneran et al. 2017).

The limited information on the impacts of underwater sounds to sea turtles suggests there may be behavioral changes during HRG surveys (Nelms et al. 2016). Behavior audiograms from sea turtles suggest that loggerheads (*Caretta caretta*) may be more sensitive to behavioral disturbance from underwater sound (Lavender et al. 2011). McCauley et al. (2000) documented sea turtle avoidance responses to seismic signals at received SPL between 166 and 179 dB within a caged environment study. During experiments using airguns to repel sea turtles from dredging operations, Moein et al. (1995) observed a habituation effect to seismic sounds. However, it was not clear during each study (McCauley et al. 2000, Moein et al. 1995) whether behavioral impacts would occur in a field setting, or if there were any physical effects to sea turtles.

Given the mobile nature of HRG surveys, the short-duration and infrequent surveying of small areas of the seafloor relative to the overall area, the impacts of underwater noise from impulsive HRG source surveys are expected to be low.

6.8.2.2.1.5 UXO Detonation

Sea turtles may be exposed to sound from UXO detonation in the water and near the water surface. Underwater sound from an explosion is capable of causing mortality, injury, hearing loss, behavioral response, masking, or physiological stress (O'Keeffe and Young 1984, Kilma et al. 1988, Viada et al. 2008). Although the amount of the animal's exposure to the blast was undetermined, Klima et al. (1988) observed a turtle mortality subsequent to an oil platform removal blast. Klima et al. (1988) also analyzed the impact of piling detonation exposure to several sea turtles and noted varying responses, including losing consciousness, exhibiting vasodilation, or having no effect on the animal.

The overall impact of explosives to sea turtles depends on the location and duration of sound exposure. For example, three sea turtles were unintentionally exposed to underwater shock tests by the Naval Coastal Systems Center in 1981 off the coast of Panama City, Florida. These tests consisted of three detonations of 1,200 Ibs of TNT in about 120-ft water depth. The first detonation resulted in the injury of one turtle at a distance of around 500-700 ft from the detonation. The second detonation injured at sea turtle at about 1,200 ft from the detonation, and the third detonation resulted in one sea turtle exposure at about 2,000 ft distance, but no apparent injury (O'Keeffe and Young, 1984; Klima et al., 1988)

Exposures that result in non-auditory injuries or temporary threshold shift may limit an animal's ability interpret the surrounding environment. Impairment of these abilities can decrease an individual's chance of survival or affect its ability to reproduce.

6.8.2.2.1.6 Vessel Sounds

Most of the underwater sound produced by ships is low frequency (~20–500 Hz) and overlaps with the known or assumed best hearing frequency range of all sea turtles. The broadband (20–1,000 Hz) apparent source level of a modern commercial ship (54,000 gross ton container ship traveling at 21.7 knots) is up to 188 dB re 1µPa (McKenna et al. 2012). This source level is below the non-impulsive acoustic injury threshold of 200 dB re 1 µPa for sea turtles (Finneran et al. 2017), meaning that only behavioral responses could be expected from sea turtles exposed to construction related vessel noise. Underwater noise may mask signal detection, but the potential behavioral changes on the survival of sea turtles are not known (Popper et al. 2014).

Many of the proposed construction-related vessels are significantly smaller than cargo ships and most will transit at slower speeds than cargo ships. The apparent source levels of smaller, slower vessels may be below the behavioral response thresholds of sea turtles or limited to the area immediately adjacent to the vessel. As with marine mammals, sea turtles are regularly subjected to commercial shipping traffic and other vessel noise and may be habituated to vessel noise as a result of this exposure (BOEM 2014a). Given the lower sound levels associated with vessel transit and operation and the limited ensonified area produced by this source, the risk of impact to sea turtles is expected to be very low to low.

6.8.2.2.2 Vessel Collision (Phases 1 and 2)

Fisheries vessel collisions that result in serious injury or death occur for sea turtles (Barco et al. 2016; Love et al. 2017). Current literature suggests that sea turtles spend a substantial amount of time near the ocean surface (Shimada et al. 2017; Smolowitz et al. 2015), but they spend the majority of the time submerged. Hard-shell sea turtles spend 89 to 96% of the time submerged, while leatherbacks spend about 66% of the time submerged (Eckert et al. 1989; Hays et al. 2000; Renaud 1995; Thompson 1988). Sea turtles are less vulnerable to vessel collisions during these long periods of submergence.

As there is likely a correlation between vessel speed and the potential for a collision (Hazel et al. 2007; Shimada et al. 2017), the highest risk for vessel collision is likely to occur during transit to and from the SWDA due to increased vessel speeds. A field experiment conducted by Hazel et al. (2007) recorded 1890 encounters with sea turtles sighted within 10 m (33 ft) of a research vessel's track. The researchers found that greater vessel speeds increased the probability that sea turtles would fail to flee from the approaching vessels thus leaving a turtle vulnerable to collision risk. The study results suggested that sea turtles were less likely to actively avoid being struck by a vessel if it exceeded 4 km per hour (2.2 knots).

Risk of collision with vessels in the OECC (including the Western Muskeget Variant) is expected to be similar to the risk experienced with construction activities in the SWDA. Because portions of the OECC are closer to shore, vessels are likely to be on the water for less time because transits to land are shorter. This would reduce the overall risk of vessel collision.

Given sea turtles' seasonal use of the region, the low percentage of time they spend at the surface where they would be vulnerable to vessel strikes, and the mitigation measures/BMPs implemented to avoid collisions, the risk of vessel collision for sea turtles is low.

6.8.2.3 Operations and Maintenance

6.8.2.3.1 Underwater Noise (Phases 1 and 2)

The primary sound source present during the construction stage of New England Wind, impact pile driving, is not expected to occur during O&M. Secondary sound sources that are present in all stages of the development, such as vessel traffic, are relevant during each Phase of New England Wind. The acoustic characteristics of vessel sounds associated with O&M are the same as those produced during construction and operations. As there are likely to be a lower number and smaller vessels during O&M, the potential impacts of this anthropogenic sound on sea turtles are expected to be similar to, or less than, those generated during construction.

Possible sound sources other than vessel operations include the WTGs themselves, which generate sound in the nacelle that is transmitted from the topside to the foundation and then radiated into the water, and subsea cable vibration. Underwater sound radiated from operating WTGs is low-energy and low-frequency (Nedwell and Edwards 2004). Low-frequency sound is of concern for sea turtles, as their most sensitive hearing range is confined to low frequencies (Bartol et al. 1999; Ridgway et al. 1969b), and sea turtles have shown behavioral avoidance to low frequency sound (Dow Piniak et al. 2012; O'Hara and Wilcox 1990). Tougaard et al. (2009) found that sound level from three different WTG types in European waters was only measurable above ambient sound levels at frequencies below 500 Hz, and Thomsen et al. (2016) suggest that at approximately 500 m (1,640 ft) from operating WTGs, sound levels are expected to approach ambient levels. Kraus et al. (2016) recorded ambient noise in the frequency range of 71–224 Hz in the RI/MA WEA from 2011 to 2015. Sound levels ranged from 96 to 103 dB re 1 µPa during 50% of recording time. Sound pressure levels were 95 dB re 1 µPa or less 40% of the time and greater than 104 dB re 1 µPa 10% of the time. NOAA modeling of vessel traffic indicates that ambient sound levels are approximately 70 to 100 dB re 1 µPa (NOAA 2012). Sea turtles are unlikely to detect sounds generated by WTGs at large distances away from New England Wind in the presence of ambient sound. Overall, sea turtles are at very low risk from exposure due to WTG noise. Any behavioral changes caused by exposure to WTG sounds are expected to be short-term and localized to areas near the WTGs.

6.8.2.3.2 Vessel Collision (Phases 1 and 2)

Fewer vessels are required for O&M of New England Wind than are expected during construction and installation. Reductions in vessel speed have been shown to reduce the risk of collision-related mortality for NARW (Conn and Silber 2013) and is also inherently protective of other marine mammals and sea turtles. Adherence to vessel speed restrictions and the incorporation of BMPs for vessels in the area will reduce the individual and population level collision risk from vessel traffic for sea turtles (see Section 6.8.2.3.2).

6.8.2.3.3 Habitat Alteration (Phases 1 and 2)

Submerged WTG and oil and gas platform foundations create artificial reef habitat (Friedlander et al. 2014; Petersen and Malm 2006; Sammarco et al. 2014). Sea turtles are known to be attracted to reefs associated with artificial structures, likely because they are a source of both shelter and foraging habitat (Gitschlag et al. 1997; Stoneburner 1982). For these reasons, WTG foundations may have a long-term, positive impact on sea turtles.

Fish are also attracted to artificial habitat created by these submerged structures (Friedlander et al. 2014; Gallaway et al. 2009; Lowe et al. 2009), which in turn may attract both commercial and recreational fishing activities (Hooper et al. 2015; Stanley and Wilson 1989). Both active and derelict fishing gear are known to cause injury or death to sea turtles from hook ingestion and entanglement (Casale et al. 2010; Chaloupka et al. 2008). Hence, artificial habitat created by WTG foundations may create a risk of fisheries interaction with sea turtles that are attracted to them due to potential increase in the use of these reefs for fishing. Implementation of mitigation and BMPs would avoid potential impacts to sea turtles resulting from habitat alteration.

6.8.2.3.4 Electromagnetic Fields (Phases 1 and 2)

New England Wind's offshore cable system will generate EMFs that could have a risk of impacting sea turtle activities; however, the intensity of any generated EMFs will be minimized by cable sheathing and burial into the seafloor at target depths of 1.5–2.5 m (5–8 ft), reducing this to low risk for sea turtles. Sea turtles navigate using a "magnetic map" that allows them to derive positional information from the Earth's magnetic field. (Lohmann et al. 2007). Hatchling turtles can orient to the Earth's magnetic field and can use magnetic field intensities to derive positional information in their marine environment (Lohmann 1991; Lohmann and Lohmann 1994; 1996).

Copping et al. (2016) suggests that EMFs have the potential to impact navigation, attraction behavior, and avoidance behavior in sea turtles. However, cable EMFs are likely less intense than the Earth's geomagnetic field and it is generally assumed that sea turtles will not be affected by these EMFs (Copping et al. 2016). Modeling of EMFs from New England Wind-specific[89] submarine cables indicated magnetic fields would be much lower than the Earth's magnetic field

[89] Phase 1 cables were modeled.

(550 milligauss [mG] in North America) and likely only able to be sensed, if at all, directly over the cable centerline (Gradient 2020). Modeling also confirmed that EMFs from cables decrease with distance, with a maximum of 84.3 mG directly above the centerline and 5.6 mG, 6 m (20 ft) from the centerline (Gradient 2020). The New Jersey Department of Environmental Protection (Geo-Marine 2010) did not identify sea turtles as marine fauna that might be impacted by EMF. The literature suggests that sea turtles spend most of their time near (though not at) the surface rather than near the benthos where a cable would be buried (Smolowitz et al. 2015). In coastal, neritic habitats less than 200 m (656 ft) depth, however, hard-shell sea turtles forage on benthic invertebrates (Burke et al. 1993). While foraging, they may come in close proximity to EMFs generated from New England Wind cables. Based on EMF intensity, sheathing and burial of cables, and limited time spent on the seafloor in proximity to cables, the risk to sea turtles from EMFs is expected to be low.

6.8.2.4 Decommissioning

Decommissioning of the offshore components includes removal of WTG/ESP foundations below the mudline. Scour protection would also be removed. The offshore export cables, inter-array cables, and inter-link cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies and stakeholders on the preferred approach to minimize environmental impacts.

As previously described in Section 6.8.2.3.1, anthropogenic sounds associated with decommissioning the WTGs and ESPs are expected to be unique for each site and dependent on the method chosen for structure decommissioning. The offshore export cables may be abandoned in place to minimize environmental impact; in this instance, there would be no risk from decommissioning. Until specific decommissioning approaches are agreed, it is reasonable to assume that sounds associated with decommissioning may be similar to, or less than, those produced during construction and operations.

Similarly, the acoustic characteristics of vessel sounds associated with decommissioning are expected to be the same as those produced during construction and operations and, therefore, the potential impacts are likely to be similar, with the risk assessed as very low.

Vessel traffic rates during decommissioning are expected to be similar to traffic rates during construction (see Section 6.8.2.2). Consequently, the risk from vessel collisions on marine mammals and sea turtles during decommissioning are anticipated to be similar to those during construction. The offshore export cables may be retired in place to minimize environmental impact; in this instance, no vessels would be required for offshore export cable removal, so there would be no risk of vessel collisions from cable decommissioning. If removal of the cables is required, the cables would be removed from their embedded position in the seabed and reeled up onto barges. Collision risk from removing the cables would be short-term and localized to the SWDA.

During decommissioning, BMPs and mitigation will be used to avoid vessel collisions. BMP and mitigation options that can reduce the risk of vessel collision during decommissioning are described in Section 6.8.4.

6.8.3 Conclusions

There are four species of sea turtles that may be exposed to IPFs associated with New England Wind activities: Kemp's ridley, leatherback, loggerhead, and green sea turtles. Hawksbill sea turtles are only reported in this region in the historical literature and have not been documented near the MA WEA and RI/MA WEA. All species of the sea turtles found in the MA WEA and RI/MA WEA are listed under the ESA with increasing populations.

Key IPFs for sea turtles are associated with underwater sound exposure and vessel collision, with habitat modification and EMFs considered lower risk. Underwater sound exposure is short-term and localized, particularly sound from piling operations, which is limited to construction and installation. Vessel noise and vessel collision may occur over the life of New England Wind; however, both risks are associated with moving sound sources, limiting both the temporal and spatial impact. Habitat modification and EMF exposure are associated with the full lifecycle of New England Wind. Habitat modification may result in both positive and negative impacts to sea turtles. On balance, the risk of impact to sea turtles from habitat modification is low, as is EMF exposure. Both leatherback and loggerhead sea turtles have a higher risk of exposure to IPFs than other sea turtle species because of their common use of the SWDA and surrounding areas. Species' vulnerability to stressors varies, but risk to individuals of these species generally remains low due to their seasonal use of the SWDA and planned implementation of monitoring and mitigation measures to avoid impact. Behavioral vulnerability for turtles is likely limited to short-term disturbance.

Given the low estimated number of acoustic exposures and that monitoring, mitigation, and BMPs will be implemented to reduce the potentially negative impacts to sea turtles, no population level impacts are anticipated.

6.8.4 Avoidance, Minimization, and Mitigation Measures

Proposed avoidance, minimization, and mitigation measures for threatened and endangered sea turtle species would be the same as those employed for marine mammals (Tetra Tech 2012). In many cases, measures put in place to minimize potential impacts for marine mammals are more stringent than those required for sea turtles and will therefore be protective of this faunal group (e.g. pile driving soft-start procedures and use of noise attenuation systems). Mitigation and BMPs will be applied to reduce potential impacts with consideration of both practicability for a large-scale project and effectiveness at avoiding and minimizing impacts to sea turtles. Practicability includes safety, operations logistics, project integrity, environmental impacts, and the potential to increase New England Wind construction duration, which may have secondary potential impacts on other New England Wind resources. Mitigation measures implemented during construction and installation can decrease potential impacts to marine animals by reducing the zone of potential impact and, therefore, the likelihood of injurious and behavioral sound interaction.

Working collaboratively with BOEM and NOAA, the Proponent will develop mitigation measures that are expected to effectively minimize and avoid the risk of impacts to sea turtles from construction and installation, O&M, and decommissioning. New England Wind will incorporate knowledge and lessons learned from Vineyard Wind 1 and other offshore wind farm development in the MA WEA and RI/MA WEA. The Proponent will comply with all applicable monitoring and mitigation regulations and any permit conditions defined by regulatory agencies. The core menu of potential monitoring and mitigation measures that are broadly applicable to sea turtles is described in Section 6.7.4.

In addition to monitoring and mitigation specific to New England Wind, the Proponent is establishing the Offshore Wind Protected Marine Species Mitigation Fund as part of Phase 1 of New England Wind. The Proponent has committed to provide up to $2.5 million to the Mystic Aquarium in Connecticut to investigate best practices and advance technologies to reduce potential sound impacts and collision threats from offshore wind project development. Although the fund will be prioritized around the protection of marine mammals, benefits of the fund will likely also be shared with sea turtles and other marine fauna.

7.0 SOCIOECONOMIC RESOURCES

The Offshore Development Region and Onshore Development Region are the broader geographic regions offshore and onshore, respectively, that could be affected by New England Wind-related activities. The Offshore Development Region and Onshore Development Region are defined specific to each resource and may encompass the following areas:

- **Onshore Development Areas:** Each Phase has a separate Onshore Development Area. For each Phase, the Onshore Development Area consists of the areas where the onshore facilities could be physically located, which includes the landfall sites, the Onshore Export Cable Routes, the onshore substation sites, the Grid Interconnection Routes, and the grid interconnection point. The Onshore Development Areas are within the Town of Barnstable in Barnstable County, Massachusetts.

- **Offshore Development Area:** The Offshore Development Area is the offshore area where the Proponent's offshore facilities are physically located, which includes all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]). The SWDA is located in federal waters. The Offshore Development Area also includes the corridor identified for routing the offshore export cables and is referred to as the Offshore Export Cable Corridor [OECC]. The OECC is located within the waters of Dukes County, Nantucket County, and Barnstable County in Massachusetts, as well as within federal waters.

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables[90] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[91] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

- **Port facilities and construction staging areas:** The Proponent has identified several port facilities and construction staging areas in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for major Phase 1 or Phase 2 construction staging activities. In addition, some components, materials, and vessels could come from Canadian[92] and European ports. A complete list of the possible ports that may be used

[90] It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

[91] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

[92] Analysis of potential Canadian ports that may be used is ongoing.

for major construction staging activities for Phases 1 or 2 can be found in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. It is not expected that all ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning. Some activities such as refueling, restocking supplies, sourcing parts for repairs, vessel repairs, vessel mobilization/demobilization, some crew transfer, and other construction staging activities may occur out of ports other than those listed in the table below. These activities would occur at industrial ports suitable for such uses and would be well within the realm of normal port activities.

Operations and maintenance (O&M) activities may occur out of any of the ports identified for potential use in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I, though it is expected that O&M activities will be primarily staged from port facilities located in Connecticut and/or Massachusetts. Decommissioning activities will likely affect similar locations as the construction process.

- **O&M facilities:** The Proponent expects to use one or more facilities in support of O&M activities for Phases 1 and 2. As described further in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I, the O&M facilities may include management and administrative team offices, a control room, office and training space for technicians and engineers, and/or warehouse space for parts and tools. The O&M facilities are also expected to include pier space for crew transfer vessels and/or other larger support vessels, such as service operation vessels. O&M facilities will function for the operational life of each Phase, which is anticipated to extend up to 30 years after construction, and potentially during decommissioning. For Phases 1 and 2, O&M activities may occur at any of the ports identified for potential use in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I, though the Proponent will likely use O&M facilities in Bridgeport, Connecticut; Vineyard Haven, Massachusetts; and/or New Bedford Harbor, Massachusetts.

Accordingly, the Offshore Development Region and Onshore Development Region consist of the communities shown in Table 7.0-1.

Table 7.0-1 New England Wind Activities in the Offshore Development Region and Onshore Development Region

County	Location		New England Wind Activities		
	Municipality	Description	Construction	Operations & Maintenance	Decommissioning
Massachusetts					
Barnstable County	Town of Barnstable	Onshore and offshore	Installation of onshore export cables and grid interconnection cables, splice vaults, onshore substation, grid interconnection Construction activities at Phase 1 and Phase 2 Landfall Sites, including installation of export cables and construction of transition vaults Installation of offshore export cables in state waters to 5.56 kilometers (3.0 nautical miles) from shore	Maintenance of substations and onshore and offshore export cables (if needed) Periodic geophysical surveys of offshore export cables	Decommissioning of New England Wind facilities
Bristol County	City of New Bedford	New Bedford Terminal and other areas in New Bedford Harbor	Port usage/ Construction staging areas	Port usage	Port usage
Bristol County	City of Somerset	Brayton Point	Port usage/ Construction staging areas	Port usage	Port usage

Table 7.0-1 New England Wind Activities in the Offshore Development Region and Onshore Development Region (Continued)

County	Location		New England Wind Activities		
	Municipality	Description	Construction	Operations & Maintenance	Decommissioning
Massachusetts (Continued)					
Dukes County	Vineyard Haven, Martha's Vineyard	Vineyard Haven Harbor Vineyard Haven	Port usage/ Construction staging areas	Port usage	Port usage
Dukes County	Edgartown, Martha's Vineyard	Offshore	No onshore facilities Installation of offshore export cables in state waters	Maintenance of offshore export cables (if needed) Periodic geophysical surveys of offshore export cables	Decommissioning of offshore export cables
Nantucket County	Town of Nantucket	Offshore	No onshore facilities Installation of offshore export cables in state waters	Maintenance of offshore export cables (if needed) Periodic geophysical surveys of offshore export cables	Decommissioning of offshore export cables
Essex County	Salem	Salem Harbor Port	Port usage/ Construction staging areas	Port usage	Port usage
Rhode Island					
Providence County	Providence	ProvPort	Port usage/ Construction staging areas	Port usage	Port usage
Providence County	East Providence	South Quay Terminal	Port usage/ Construction staging areas	Port usage	Port usage
Washington County	Quonset/Davisville, North Kingstown	Port of Davisville	Port usage/ Construction staging areas	Port usage	Port usage

Table 7.0-1 New England Wind Activities in the Offshore Development Region and Onshore Development Region (Continued)

County	Location		New England Wind Activities		
	Municipality	Description	Construction	Operations & Maintenance	Decommissioning
Connecticut					
Fairfield County	City of Bridgeport	Bridgeport	Port usage/ Construction staging areas	Port usage	Port usage
New London County	New London	New London State Pier	Port usage/ Construction staging areas	Port usage	Port usage
New York					
Albany County	Albany and Coeymans	Capital Region Ports (Port of Albany, Coeymans)	Port usage/ Construction staging areas	Port usage	Port usage
Kings County	New York City	South Brooklyn Marine Terminal and GMD Shipyard	Port usage/ Construction staging areas	Port usage	Port usage
Rensselaer County	East Greenbush	New York Offshore Wind Port	Port usage/ Construction staging areas	Port usage	Port usage
Richmond County	New York City	Staten Island Ports (Arthur Kill & Homeport Pier)	Port usage/ Construction staging areas	Port usage	Port usage
Suffolk County	Shoreham and Greenport[1]	Long Island Ports (Shoreham and Greenport Harbor)	Port usage/ Construction staging areas	Port usage	Port usage
New Jersey					
Gloucester County	Paulsboro	Port of Paulsboro	Port usage/ Construction staging areas	Port usage	Port usage

7.1 Demographics, Employment, and Economics

With respect to demographics, employment, and economics, the Onshore Development Region is the broader onshore geographic region comprising of the cities, towns, and communities surrounding New England Wind's onshore facilities, O&M facilities, port facilities, and construction staging areas that could be affected by New England Wind-related activities. The Offshore Development Region is the broader offshore geographic region surrounding Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [the SWDA]), the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]), and ports that could be affected by New England Wind-related activities. The Offshore Development Region includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), and waters surrounding potential vessel routes to the ports identified for use by New England Wind.

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables[93] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[94] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

As described in Section 7.0 and Table 7.0-1 above, the Onshore Development Region and Offshore Development Region consist of the communities in Barnstable County, Bristol County, Dukes County, Essex County, and Nantucket County, Massachusetts; the communities in Providence County and Washington County, Rhode Island; the communities in Fairfield County and New London County, Connecticut; the communities in Albany County, Kings County, Rensselaer County, Richmond County, and Suffolk County, New York; and the communities in Gloucester County, New Jersey.

7.1.1 Description of the Affected Environment

Demographic, employment, and economic baselines, including existing socioeconomic activities and resources in the onshore and coastal environment that may be affected by New England Wind, are described in the sections that follow. It should be noted that many of the coastal and

[93] It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

[94] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

ocean amenities that attract visitors to these regions are free for public access, thereby generating limited direct employment, wages, or gross domestic product (GDP). Nonetheless, these nonmarket features function as key attributes of the Onshore Development Region's coastal economy, particularly within the recreation and tourism sectors.

7.1.1.1 Massachusetts

Population and economic statistics for Barnstable County, Bristol County, Dukes County, Essex County, and Nantucket County, as well as the Commonwealth of Massachusetts are provided in Table 7.1-1.

Table 7.1-1 Existing Economic Conditions in the Onshore Development Region (Massachusetts)

Location	Population (2019)[1]	Population Density[2] (people per square mile)	Per Capita Income (2019)[3]	Annual Total Employment (2019)[4]	Annual Unemployment Rate (2019)[4]
Massachusetts	6,892,503	839.4	$43,761	3,667,735	3.0%
Barnstable County	212,990	541.0	$44,505	109,493	4.0%
Bristol County	565,217	1,021.9	$35,747	289,623	3.9%
Dukes County	17,322	167.8	$45,990	9,166	4.3%
Essex County	789,034	1,508.8	$42,347	412,856	3.1%
Nantucket County	11,399	253.5	$55,398	7,288	4.4%

Notes:
1. United States (US) Census Bureau's (2019) Population Estimates Program (PEP) (updated annually).
2. US Census Bureau, land area is based on current information in the TIGER® data base, calculated for use with Census 2010; population from PEP V2019, accessed April 2020.
3. US Census Bureau's (2019) American Community Survey (ACS) 5-Year Estimates.
4. US Bureau of Labor Statistics' (2019) Local Area Unemployment Statistics (not seasonally adjusted, accessed August 2021).

7.1.1.1.1 Barnstable County

Demographics

Barnstable County consists of the 15 municipalities on the Cape Cod peninsula extending from the southeast coast of Massachusetts (see Figure 7.1-1).

The US Census Bureau's Population Estimates Program (PEP) data for 2019 count 212,990 residents of Barnstable County. The Towns of Barnstable and Falmouth are the largest population centers in Barnstable County with estimated populations of 44,477 and 30,993, respectively, as estimated in 2019 by the US Census Bureau's (2019) American Community Survey (ACS). From 2010 to 2019, the population of Barnstable County decreased by 1.3%.

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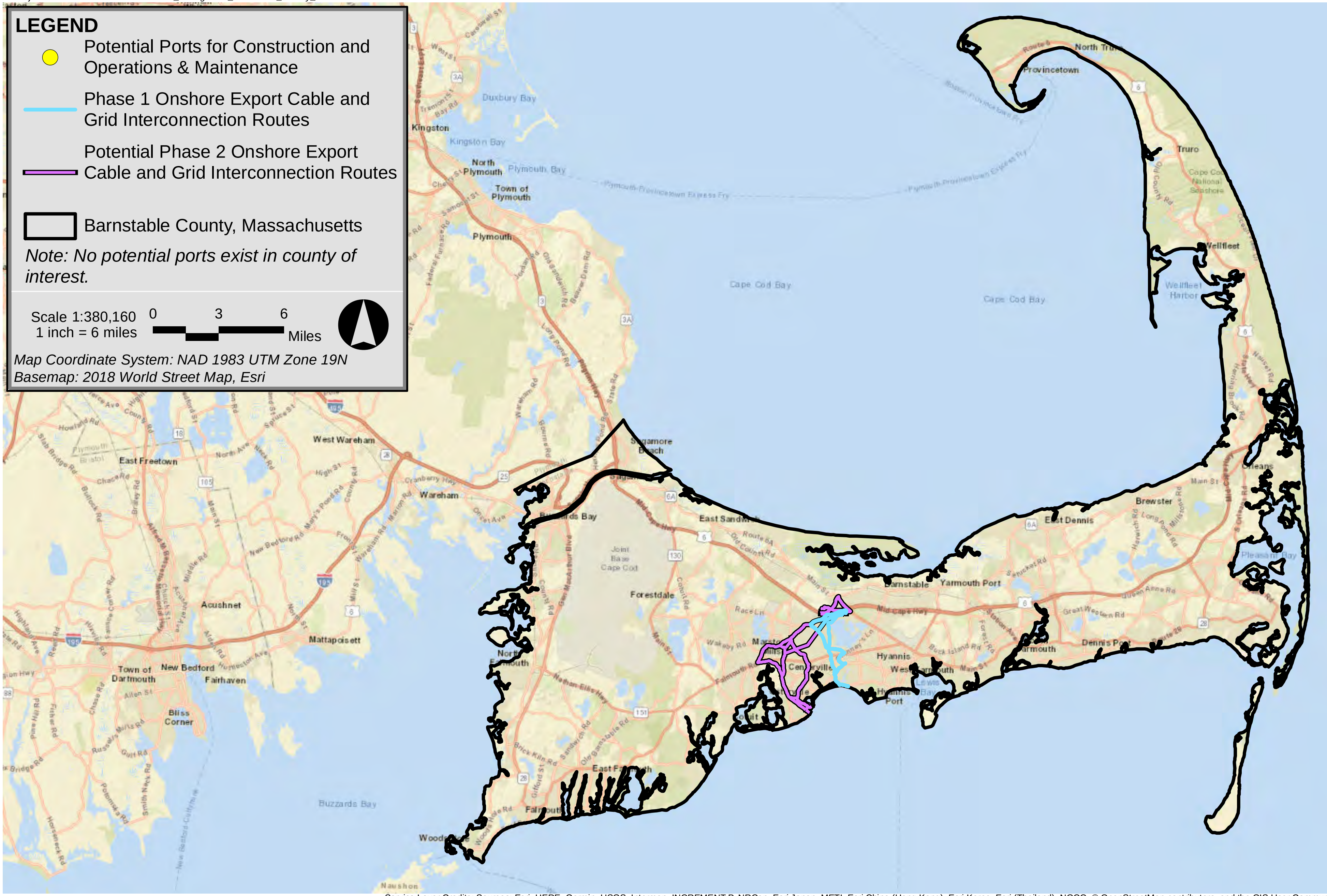

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New England Wind

AVANGRID RENEWABLES

Figure 7.1-1

Barnstable County, Massachusetts

Barnstable County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-1. Based on ACS five-year estimates for 2019, Barnstable County's median household income is $74,336, which is less than the statewide median of $81,215 (US Census Bureau 2019).

As occurs in certain other coastal communities, towns in Barnstable County experience significant seasonal population growth. The Cape Cod Commission estimates that the average annual seasonal population growth on Cape Cod was equivalent to 68,856 full-time residents in 2010 (Cape Cod Commission 2012). Seasonal population growth is estimated to occur primarily during the summer months, between June and August. The Cape Cod Commission's Regional Policy Plan (2012) notes that seasonal population continued to grow between 2010 and 2012 even as the number of Cape Cod's year-round residents decreased by 0.7%.

Barnstable County's population density, when calculated using only the year-round population, is less than the statewide average. When estimates of seasonal residents are included in population density calculations, Barnstable County's population density increases to approximately 717 people per square mile (people/mi^2).

Economy and Employment

According to Bureau of Labor Statistics (BLS) data for 2019, Barnstable County's average monthly labor force consisted of approximately 114,087 individuals with an unemployment rate of 4.0% (BLS 2019).

BLS data for 2019, show a total of 9,209 private sector employer establishments, which are physical locations at which business is conducted or where services or industrial operations are performed, employed 83,019 individuals (BLS 2018). In 2018, Barnstable County's workforce was comprised of 71.6% County residents and 28.4% non-residents.

As shown in Table 7.1-2, Barnstable County's largest employers by North American Industry Classification System (NAICS) sector, according to County Business Patterns (CBP) data for 2019, are: Health Care and Social Assistance, Retail Trade, and Accommodation and Food Services. According to the Massachusetts Executive Office of Labor and Workforce Development, the five largest employers in Barnstable County are: Cape Cod Hospital and its affiliates, Woods Hole Oceanographic Institute, Arris Group, Inc., Cape Cod Community College, and Falmouth Hospital (Executive Office of Labor and Workforce Development 2020). US Census Bureau data indicate that Barnstable County's highest concentrations of jobs surround the Falmouth and West Yarmouth communities.

Table 7.1-2 Paid Employees by NAICS Sector in Barnstable County and Commonwealth of Massachusetts (2019)[1]

Industry Sector	Barnstable County		Massachusetts	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	15,761	20.4%	625,474	18.5%
Retail Trade	14,998	19.4%	363,220	10.7%
Accommodation and Food Service	12,574	16.3%	316,291	9.3%
Construction	6,164	7.9%	151,366	4.5%
Professional, Scientific, and Technical Services	4,757	6.2%	315,966	9.3%

Notes:
1. US Census Bureau's (2019) CBP.

The National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management provides data on "Ocean Economy" activities. The categories for these activities are based on NAICS codes that depend on the ocean for input. They include: Living Resources (such as commercial fishing, aquaculture, and seafood processing, and markets), Marine Construction, Marine Transportation, Offshore Mineral Resources, Ship and Boat Building, and Tourism and Recreation.

Barnstable County's Ocean Economy GDP grew from approximately $683.9 million in 2009 to approximately $1.3 billion in 2018 and added 3,896 jobs. In 2018, the most recent year for which data are available, the Ocean Economy accounted for 12.1% of the County's total GDP, and employed approximately 18,108 individuals, including self-employed individuals. As indicated in Table 7.1-3, in 2018, Barnstable County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 87.0% of the total Ocean Economy. The portion of the Ocean Economy attributed to commercial fishing, aquaculture, and seafood processing is 2.6%.

Table 7.1-3 Ocean Economy Gross Domestic Product in Barnstable County and the Commonwealth of Massachusetts (2018)[1]

	Barnstable County		Massachusetts	
Total Ocean Economy	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$1,300	12.1%	$7,900	1.4%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$33.3	2.6%	$1,100	14.4%
Marine Construction	$12.9	1.0%	$190.4	2.4%
Ship and Boat Building	1.2	0.1	$49.3	0.6%
Marine Transportation	$116.3	9.2%	$1,800	22.4%
Offshore Mineral Extraction	*	*	$3.3	<0.1%
Tourism and Recreation	$1,100	87.0%	$4,700	60.1%

Notes:
1. NOAA Office for Coastal Management's (2020) Economics: National Ocean Watch (ENOW).
* Cannot be published without violating the confidentiality of one or more businesses.

Commercial fishing, a historically, culturally, and economically important activity taking place in state and federal waters of the Offshore Development Region, is a component of the Living Resource sector of NOAA's Coastal Economy index. Table 7.1-4 shows the 2016 average wage for Living Resource sector employees in Barnstable County and Massachusetts. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-4 Employment and Wages for Ocean Economy Living Resource Industries in Barnstable County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
Massachusetts	7,357	$66,900	3,135	$70,945	3,156,298	$73,405
Barnstable County	347	$43,100	921	$53,993	82,827	$45,626

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

The Proponent does not intend to make use of port facilities in Barnstable County.

Housing

Housing data for Barnstable County are presented in Table 7.1-5, below.

Table 7.1-5 Barnstable County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Barnstable County	164,674	68,177	2.3	7.9	$393,500	$1,311

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2018 counts 164,674 total housing units in Barnstable County, of which 68,177 are categorized as vacant. Of Barnstable County's 96,509 occupied housing units, 79,8% are owner-occupied. The high number of vacant housing units likely reflects the intensity of seasonal use and seasonal population growth noted above. In 2010, the most recent year for which housing vacancy status is categorized as "seasonal, recreational, or occasional," 88.1% of those vacant units were for seasonal, recreational, or occasional uses (US Census Bureau 2010).

Within the Onshore Development Region, Barnstable County is estimated to be the county most heavily influenced by seasonal tourism, suggesting that New England Wind-related housing impacts during the peak tourism season, if any, would be most acute in Barnstable County. Hotel room occupancy statistics made available by the Cape Cod Chamber of Commerce indicate that between 2010 and 2017, the peak hotel room occupancy rate in Barnstable County was 85%, which occurred in August of 2013. As noted in Section 7.5, Barnstable County's recreation and tourism sectors are supported by an estimated 239 facilities offering traveler accommodations. During winter months, the lodging demand in Barnstable County declines by 50,000 to 100,000 rooms per month (Center for Policy Analysis 2000). When lodging demand declines, New England Wind may provide additional economic benefits to local communities in the Onshore Development Region. The small number of personnel that may relocate to the Onshore Development Region, particularly within Barnstable County, are not anticipated to affect the availability of accommodations at any point in a given year.

7.1.1.1.2 Bristol County

Demographics

Bristol County consists of 20 cities and towns located in the southeast coastal region of Massachusetts (see Figure 7.1-2). The US Census Bureau's PEP data for 2019 counts 565,217 residents of Bristol County. The population of Bristol County increased by 3.1% from 2010 to 2019. In 2019, the estimated population of Bristol County's largest cities, New Bedford and Fall River, is 95,363 and 88,865 residents, respectively. Bristol County is more densely populated than the statewide average.

Bristol County's population density, per capita income, total employment, and unemployment rate are shown in Table 7.1-1. At $69,095, estimated median household income in Bristol County in 2019 falls below the statewide median of $81,215 (US Census Bureau 2019).

In recent years, Bristol County and surrounding areas in the southeast coastal region of Massachusetts have experienced population gain because of international migration. These gains, however, are offset by domestic out-migration, notably among the college-age population (Renski et al. 2015).

Economy and Employment

According to BLS (2019) data, Bristol County's average monthly labor force in 2019 consisted of approximately 301,317 individuals with an unemployment rate of 3.9%, which was greater than the statewide average.

A total 17,384 private sector employer establishments in Bristol County employed 200,285 individuals in 2019 (BLS 2018). In 2018, Bristol County's workforce was comprised of 55.0% County residents and 45.0% non-residents, with the largest concentration of jobs in the Attleboro, Fall River, New Bedford, and Taunton communities.

As shown in Table 7.1-6, the largest employers by NAICS sector are: Health Care and Social Assistance, Retail Trade, and Manufacturing. The five largest employers in Bristol County are: DePuy Spine, Inc., General Dynamics Mission Systems, Medtronic, Inc., Sensata Technologies, Inc., and Southcoast Health System, Inc. (Executive Office of Labor and Workforce Development 2020).

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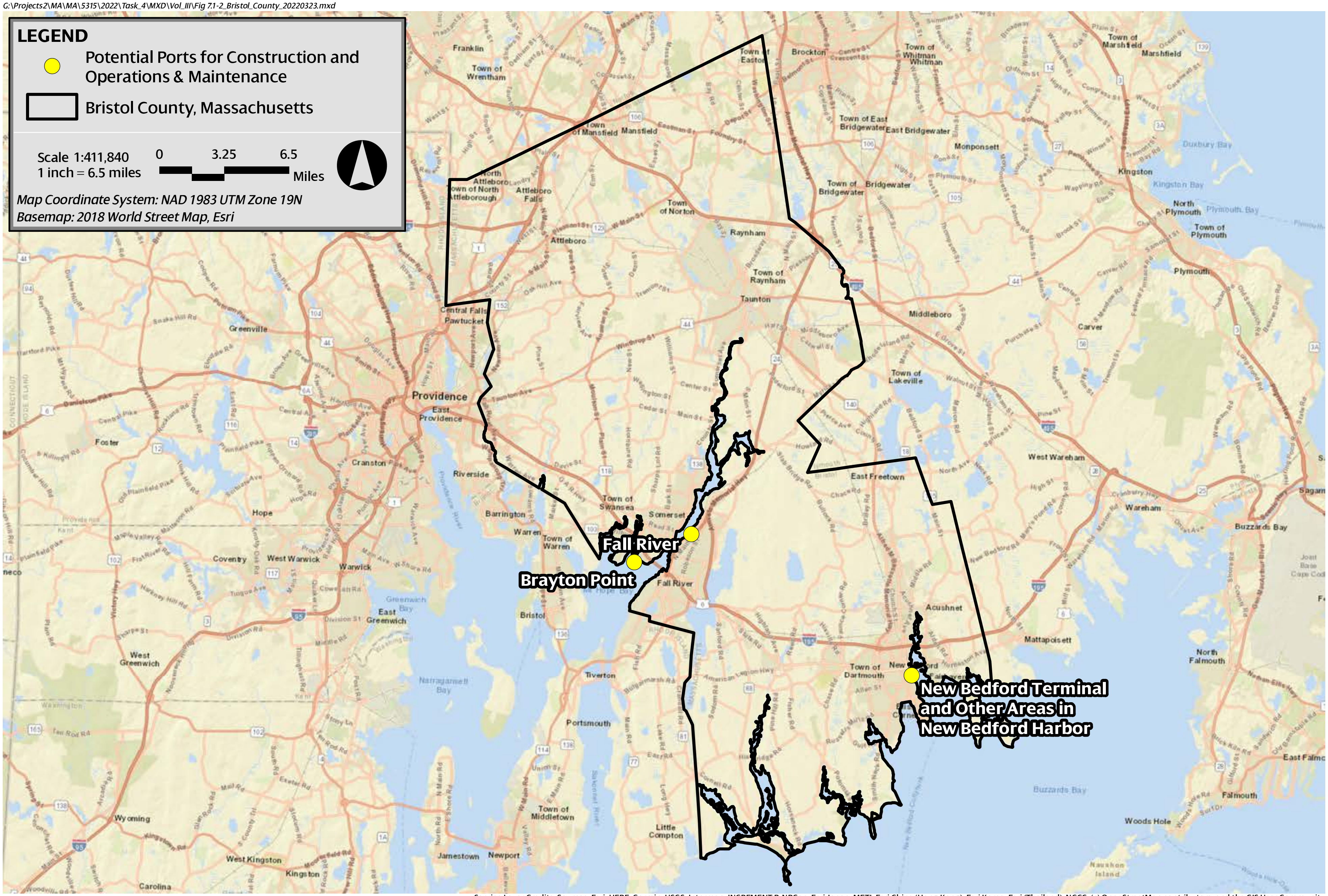

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Figure 7.1-2

Bristol County, Massachusetts

Table 7.1-6 Paid Employees by NAICS Sector in Bristol County and Commonwealth of Massachusetts (2019)[1]

Industry Sector	Bristol County		Massachusetts	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	41,948	20.6%	625,474	18.3%
Retail Trade	34,118	16.8%	363,220	10.7%
Manufacturing	24,323	12.0%	233,428	6.9%
Accommodation and Food Services	21,720	10.7%	316,291	9.3%
Wholesale Trade	15,132	7.4%	150,935	4.5%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, Bristol County's Ocean Economy GDP grew from approximately $638.96 million in 2009 to approximately $660.1 million in 2018 while employment decreased by 701 jobs. In 2018, the Ocean Economy accounted for 2.6% of the County's total GDP, and employed approximately 6,060 individuals, including self-employed individuals. As indicated in Table 7.1-7, in 2018, Bristol County's largest Ocean Economy sector by dollar value is Living Resources, which accounted for 77.4% of the total Ocean Economy.

Table 7.1-7 Ocean Economy Gross Domestic Product in Bristol County and the Commonwealth of Massachusetts (2018)[1]

	Bristol County		Massachusetts	
Total Ocean Economy	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$660.1	2.6%	$7,900	1.4%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$511.1	77.4%	$1,100	14.4%
Marine Construction	13.4	2.0	$190.4	2.4%
Shipbuilding	$28.7	4.3%	$49.3	0.6%

Table 7.1-7 Ocean Economy Gross Domestic Product in Bristol County and the Commonwealth of Massachusetts (2018)[1] (Continued)

	Bristol County		Massachusetts	
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Marine Transportation	$1.1	0.2%	$1,800	22.4%
Offshore Mineral Extraction	*	*	$3.3	<0.1%
Tourism and Recreation	$105.8	16.0%	$4,700	60.1%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.

* Cannot be published without violating the confidentiality of one or more businesses.

Table 7.1-8 shows the 2016 average wage for Living Resource sector employees in Bristol County and Massachusetts. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-8 Employment and Wages for Ocean Economy Living Resource Industries (2018) in Bristol County

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
Massachusetts	7,357	$66,900	3,135	$70,945	3,156,298	$73,405
Bristol County	2,661	$76,700	764	$98,421	200,405	$48,835

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

Bristol County's Port of New Bedford is a full-service port with well-established fishing and cargo handling industries. The Port of New Bedford's operations and facilities include warehouses, ice houses, boatyards and ship repair yards, construction, engineering, tug assists, pilots, and other maritime services (New Bedford Port Authority 2016). Recreational boating facilities are also located within and surrounding the Port. In 2015, 36,578 jobs were generated by Port of New Bedford activities (New Bedford Port Authority 2016).

Brayton Point, located on the Taunton River in Somerset, Massachusetts, is the site of the former Brayton Point Power Plant. The Proponent may use Brayton Point during Phase 1. Brayton Point is a 1.2-square kilometer (km^2) (307-acre) property located in Mount Hope Bay less than a mile from Interstate 195. The site owners, Commercial Development Company, Inc. and its affiliate Brayton Point, LLC plan to transform the former power plant site into a world-class logistics port, manufacturing hub, and support center for the offshore wind industry. Commercial Development Company, Inc. has signed an agreement with Patriot Stevedoring + Logistics LLC to manage operations of the marine commerce terminal. Additionally, Brayton Point's recent history of industrial use suggests a skilled workforce consistent with New England Wind's needs is located in reasonable proximity to the site.

The Proponent may use port facilities in Fall River if the necessary upgrades are made by the owner(s)/lessor(s). Potential ports could include those identified by Massachusetts Clean Energy Center (MassCEC) as potentially viable offshore wind ports, such as Weaver's Cover Energy Site, Fall River State Pier, and the Borden & Remington Complex.

Housing

Housing data for Bristol County are presented in Table 7.1-9.

Table 7.1-9 Bristol County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Bristol County	236,903	16,375	1.0	3.5	$329,200	$940

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2019 counts 236,903 total housing units in Bristol County, of which 16,375 are categorized as vacant. Of the County's 220,528 occupied housing units, 62.6% are owner-occupied. In 2010, the most recent year for which vacancy status is categorized as "seasonal, recreational, or occasional," 15.2% of those vacant units were for seasonal, recreational, or occasional uses (US Census Bureau 2010).

7.1.1.1.3 Dukes County

Demographics

Dukes County consists of 11 islands off the southeast coast of Massachusetts, including Martha's Vineyard, Dukes County's largest and most populous island (see Figure 7.1-3). Dukes County's population, according to the US Census Bureau's PEP data for 2019, is 17,322 year-round residents.

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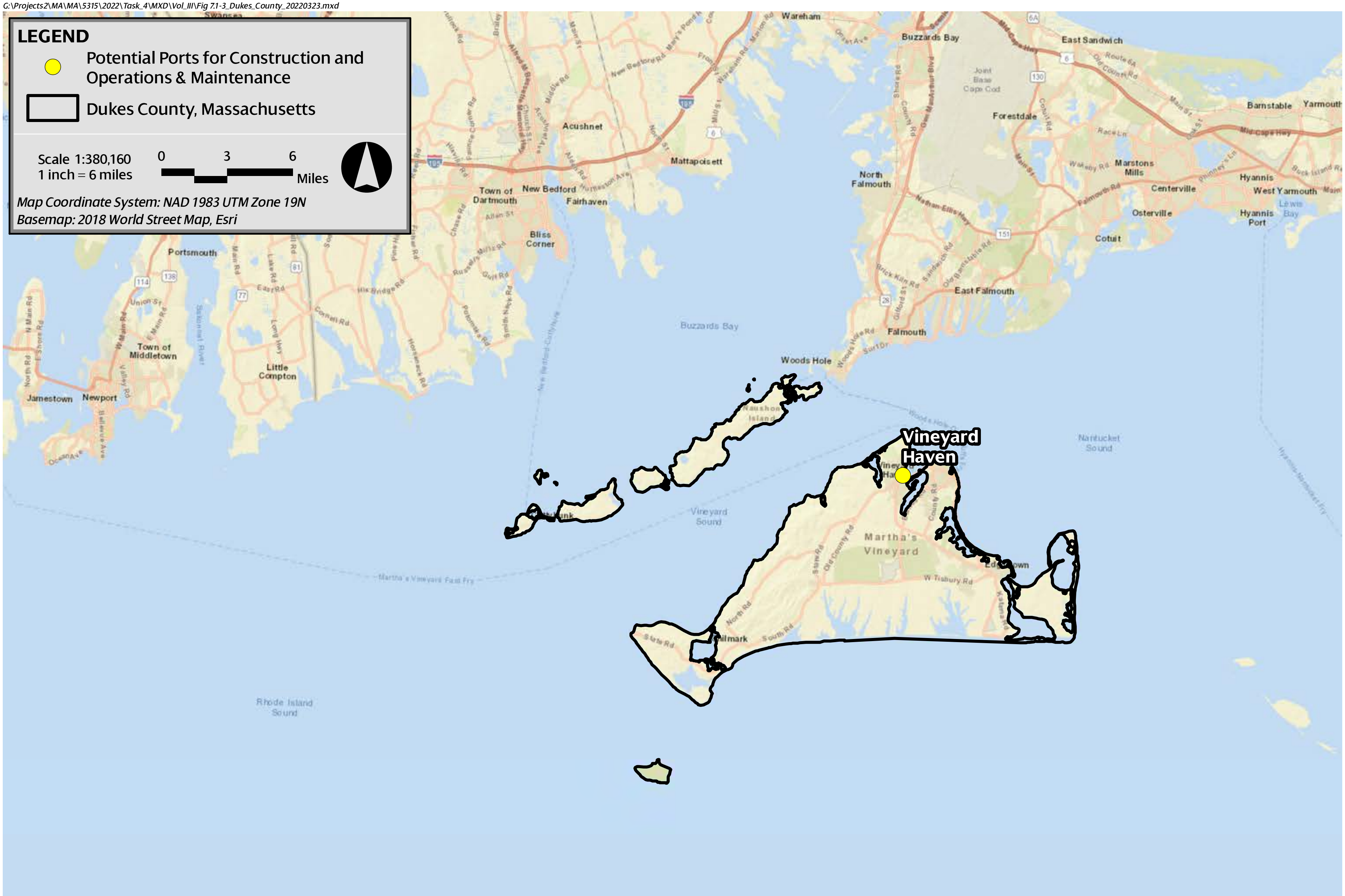

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Figure 7.1-3
Dukes County, Massachusetts

The population of Dukes County increased by 4.8% from 2010 to 2019. Dukes County's population density, per capita income, total employment, and unemployment rate are shown in Table 7.1-1. The Towns of Oak Bluffs and Edgartown are the largest population centers in Dukes County with estimated populations in 2019 of 4,667 and 4,348 residents, respectively.

The Martha's Vineyard Commission (2004) estimates that seasonal residents account for more than a tripling of the Martha Vineyard's population during the in-season months of June, July, and August, suggesting approximately 52,000 seasonal residents locate to the Martha's Vineyard annually.

Such significant population fluctuations dramatically alter Dukes County characteristics, including population density which, when not including seasonal residents, remains well below the statewide average of 839.4 people/mi^2. Estimated seasonal population growth increases density to approximately 671.5 people/mi^2. Dukes County's estimated median household income for 2017 is $71,811, which is below the statewide median of $81,215 (US Census Bureau 2019).

Economy and Employment

According to BLS (2019) data, Dukes County's average monthly labor force in 2018 included approximately 9,575 individuals with an unemployment rate of 4.3%. Unemployment rates, not seasonally adjusted, speak to the influence of recreation and tourism on the County's employment patterns. For example, the unemployment rate in August of 2019 was 1.9% but by January 2020, during the offseason, it had risen to 7.3%.

The economy of Dukes County is dominated by seasonal activities related to recreation and tourism. With the exception of the commercial fishing industry, which employs a limited number of people in Dukes County, there are no significant exports of goods or services. Dukes County's economic base is largely supported by visitors, particularly second homeowners, who purchase goods and services during their stay (Martha's Vineyard Commission 2008).

A total 1,222 private sector employer establishments in Dukes County employed 7,509 individuals in 2019 (BLS 2018). In 2019, the most recent year for which data are available, Dukes County's workforce was comprised of 61.6% County residents and 38.4% non-residents. The highest concentration of jobs was in the Vineyard Haven, Oak Bluffs, and Edgartown communities.

As shown in Table 7.1-10, the largest employers by NAICS sector are: Retail Trade, Health Care and Social Assistance, Construction, Accommodation and Food Services, and Administrative and support/Waste Management and Remediation Services. The five largest employers in Dukes County are: Martha's Vineyard Hospital, Harbor View Hotel, Martha's Vineyard Community Services, Martha's Vineyard Regional High School, and Martha's Vineyard Airport (Executive Office of Labor and Workforce Development 2020).

Table 7.1-10 Paid Employees by NAICS Sector in Dukes County and Commonwealth of Massachusetts (2019)[1]

Industry Sector	Dukes County		Massachusetts	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Retail Trade	1,007	17.6%	363,220	10.7%
Health Care and Social Assistance	832	14.6%	625,220	18.5%
Construction	804	14.0%	151,366	4.5%
Accommodation and Food Services	626	11.0%	316,291	9.3%
Administrative and Support/Waste Management and Remediation Services	464	8.1%	214,224	6.3%

Notes:

1. US Census Bureau's (2017) CBP.

According to NOAA, Dukes County's Ocean Economy GDP grew from approximately $86.7 million in 2009 to approximately $124.0 million in 2018 and added 32 jobs. In 2018, the Ocean Economy accounted for 11.8% of the County's total GDP, and employed approximately 1,587 individuals, including self-employed individuals. As indicated in Table 7.1-11, in 2018, Dukes County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 97.5% of the County's total Ocean Economy. The Living Resources sector accounted for 2.5% of the County's total Ocean Economy.

Table 7.1-11 Ocean Economy GDP in Dukes County and Commonwealth of Massachusetts (2018)[1]

	Dukes County		Massachusetts	
Total Ocean Economy	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$124.0	11.8%	$7,900	1.4%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Economy**
Living Resources	$3.9	3.1%	$1,100	14.4%
Marine Construction	*	*	$190.4	2.4%
Shipbuilding	*	*	$49.3	0.6%
Marine Transportation	*	*	$1,800	22.4%

Table 7.1-11 Ocean Economy GDP in Dukes County and Commonwealth of Massachusetts (2018)[1] (Continued)

	Dukes County		Massachusetts	
Ocean Economy Sector	GDP ($, million)	Percent of County Ocean Economy	GDP ($, million)	Percent of State Economy
Offshore Mineral Extraction	+	+	$3.3	<0.1%
Tourism and Recreation	$120.1	96.9%	$4,700	60.1%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.

* Cannot be published without violating the confidentiality of one or more businesses.

+ Indicates that either (a) no economic activity of that type occurs in the county or (b) all economic activity of that type is associated with the self-employed.

Table 7.1-12 shows the 2018 average wage for Living Resource sector employees in Dukes County and Massachusetts. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-12 Employment and Wages for Ocean Economy Living Resource Industries in Dukes County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
Massachusetts	7,357	$66,900	3,135	$70,945	3,156,298	$73,405
Dukes County	36	$60,100	96	$31,677	7,458	$50,939

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

New England Wind may make use of port facilities in Vineyard Haven. Vineyard Haven already provides a number of services to vessels as large as 84 meters (m) (275 feet [ft]) in length and has onshore facilities that house multiple business entities. The owner of a marina has existing plans (irrespective of New England Wind) to upgrade the facilities to accommodate additional marine industrial uses, as well as to increase the existing facility's protection from storms.

Housing

Housing statistics for Dukes County are presented in Table 7.1-13.

Table 7.1-13 Dukes County Housing

Location	Housing Units[1]	Vacant Housing Units[2]	Homeowner Vacancy Rate[2]	Rental Vacancy Rate[2]	Median Value of Owner-Occupied Units[1]	Median Gross Rent[1]
Dukes County	18,146	11,422	0.1	3.7	$699,500	$1,459

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.
2. US Census Bureau's (2018) ACS 5-Year Estimates

US Census Bureau data for 2019 counts 18,146 total housing units in Dukes County. In 2018, the more recent year for which data are available, 64.2% of housing units were categorized as vacant (US Census Bureau 2018). As with Barnstable County, the high vacancy rate likely reflects the intensity of seasonal use and population growth noted above. Of Dukes County's occupied housing units, 72.3% are owner-occupied. In 2010, the most recent year for which vacancy status is categorized as "seasonal, recreational, or occasional," 94.2% of vacant units were for seasonal, recreational, or occasional uses (US Census Bureau 2010).

7.1.1.1.4 Nantucket County

Demographics

Nantucket County comprises the Island of Nantucket and two nearby islands (see Figure 7.1-4). According to the US Census Bureau's PEP data for 2019, Nantucket County has 11,399 year-round residents and the County's population increased by 12.6% from 2010 to 2019. The Nantucket Planning Board estimates approximately 40,000 to 50,000 seasonal residents, an estimate that excludes short-term visitors of one week or less, locate to Nantucket County during the summer months (Nantucket Planning Board 2009).

As with the other counties in the Onshore Development Region, seasonal population fluctuations dramatically alter Nantucket County's population density which, when not accounting for seasonal residents, remains well below the statewide average of 884.9 people/mi^2. Estimated seasonal population growth potentially increases density to over 1,000 people/mi^2, exceeding the statewide average. The County's population density, per capita income, total employment, and unemployment rate are shown in Table 7.1-1. Nantucket County's estimated median household income in 2016 was $107,717, which is above the statewide median of $81,2015 (US Census Bureau 2019).

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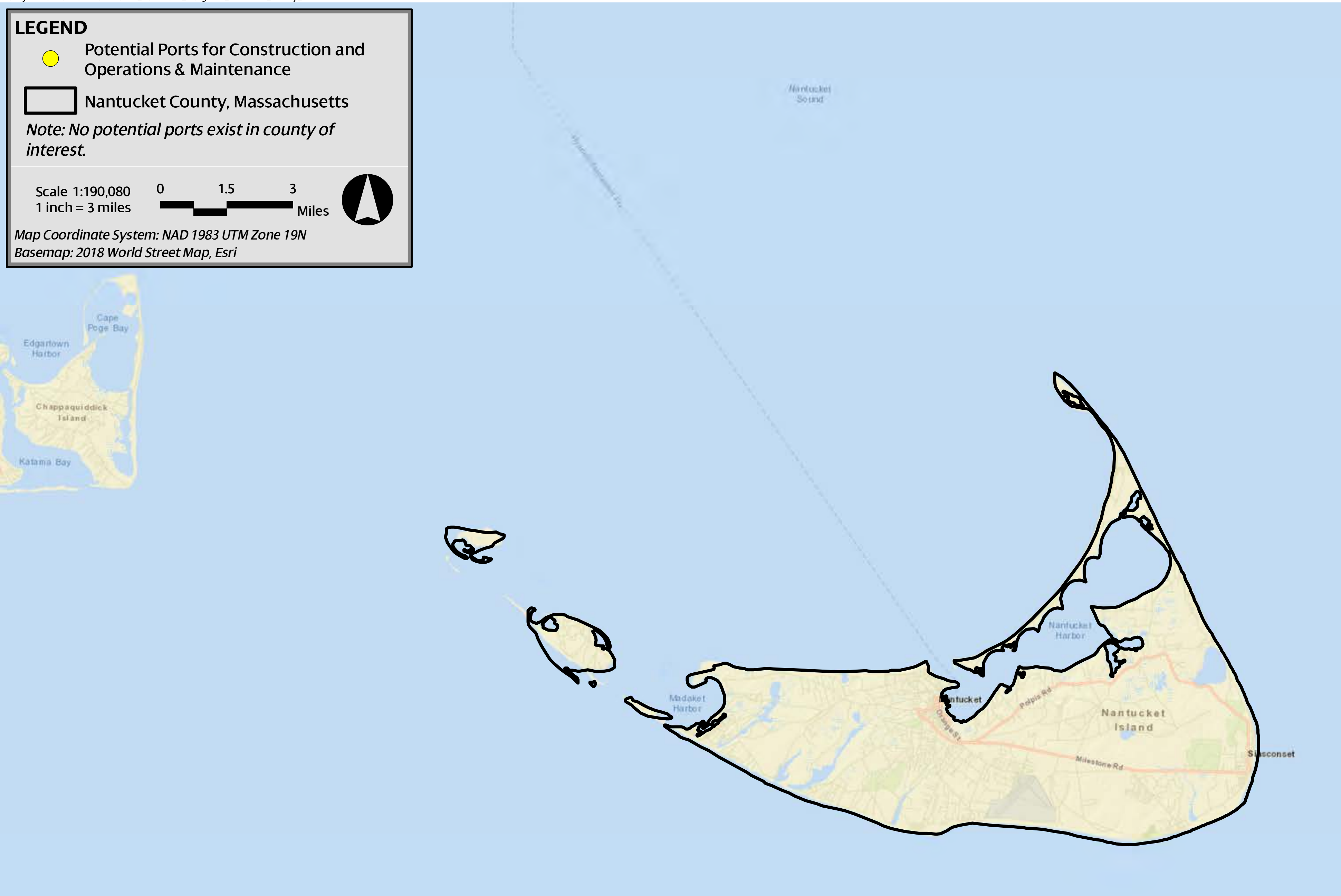

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New England Wind
AVANGRID RENEWABLES

Figure 7.1-4

Nantucket County, Massachusetts

Economy and Employment

According to BLS (2019) data, Nantucket County's average annual labor force in 2019 included approximately 7,620 individuals with an unemployment rate of 4.4%. Nantucket County's economy is dominated by seasonal activities related to recreation and tourism, which is reflected in monthly employment patterns. For example, the unemployment rate, not seasonally adjusted, in August of 2019 was 1.4% and increased to 11.2% in January of 2020 (BLS 2019). With some variation, this pattern is repeated annually.

A total 1,146 private sector employer establishments in Nantucket County employed 6,962 individuals in 2019 (BLS 2018). In 2018, the most recent year for which data are available, Nantucket County's workforce was comprised of 753.7% County residents and 24.3% non-residents.

As shown in Table 7.1-14, the largest employers by NAICS sector are: Construction, Retail Trade, Accommodation and Food Service, Health Care and Social Services, Administrative and Support/Waste Management and Remediation Services.

Table 7.1-14 Paid Employees by NAICS Sector in Nantucket County and Commonwealth of Massachusetts (2019)[1]

Industry Sector	Nantucket County		Massachusetts	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Construction	954	19.0%	151,366	4.5%
Retail Trade	887	17.7%	363,220	10.7%
Accommodation and Food Services	664	13.3%	316,291	9.3%
Health Care and Social Assistance	562	11.2%	625,474	18.5%
Administrative and Support/Waste Management and Remediation	501	10.0%	214,224	6.3%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, Nantucket County's Ocean Economy GDP grew from approximately $68.7 million in 2009 to approximately $160.1 million in 2018 and added 554 jobs. In 2018, the Ocean Economy accounted for 16.4% of the County's total GDP, and employed approximately 1,739 individuals, including self-employed individuals. As indicated in Table 7.1-15, in 2018, Nantucket

County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 99.8% of the County's total Ocean Economy. The Living Resources sector accounted for 0.2% of the County's total Ocean Economy.

Table 7.1-15 Ocean Economy Gross Domestic Product in Nantucket County and Commonwealth of Massachusetts (2018)[1]

	Nantucket County		Massachusetts	
Ocean Economy Sector	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$160.1	16.4%	$7,900	1.4%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$0.37	0.2%	$1,100	14.4%
Marine Construction	*	*	$190.4	2.4%
Shipbuilding	*	*	$49.3	0.6%
Marine Transportation	*	*	$1,800	22.4%
Offshore Mineral Extraction	*	*	$3.3	<0.1%
Tourism and Recreation	$159.7	99.8%	$4,700	60.1%

Notes:

1. NOAA Office for Coastal Management's (2020) ENOW.

* Cannot be published without violating the confidentiality of one or more businesses.

Table 7.1-16 shows the 2016 average wage for Living Resource sector employees in Nantucket County and Massachusetts. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-16 Employment and Wages for Ocean Economy Living Resource Industries in Nantucket County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
Massachusetts	7,357	$66,900	3,135	$70,945	3,156,298	$73,405
Nantucket County	8	$25,400	39	$59,923	*	$*

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

** Data do not meet BLS or State agency disclosure standards*

The Proponent does not intend to make use of port facilities in Nantucket County.

Housing

Housing data for Nantucket County are presented in Table 7.1-17.

Table 7.1-17 Nantucket County Housing

Location	Housing Units[1]	Vacant Units[2]	Homeowner Vacancy Rate[2]	Rental Vacancy Rate[2]	Median Value of Owner-Occupied Units[1]	Median Gross Rent[1]
Nantucket County	12,675	8,469	3.3	24.1	$1,084,700	$1,764

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.
2. US Census Bureau's (2018) ACS 5-Year Estimates

US Census Bureau data for 2019 counts 12,675 total housing units in Nantucket County. In 2018, the more recent year for which data are available, 69.5% of housing units were categorized as vacant. Of the County's occupied housing units, 69.2% are owner-occupied (US Census Bureau 2018). As with other counties in the Onshore Development Region, the high vacancy rate reflects the intensity of seasonal use and population growth noted above. In 2010, the most recent year for which vacancy status is categorized as "seasonal, recreational, or occasional," 91.0% of those vacant units were for seasonal, recreational, or occasional uses (US Census Bureau 2010).

7.1.1.1.5 Essex County

Demographics

Essex County comprises the 34 municipalities on the northeastern side of Massachusetts (see Figure 7.1-5). According to the US Census Bureau's PEP data for 2019, Essex County has 789,034 year-round residents and the County's population increased by 6.2% from 2010 to 2019.

The County's population density, per capita income, total employment, and unemployment rate are shown in Table 7.1-1. Essex County's estimated median household income in 2019 was $79,263, which is below the statewide median of $81,215 (US Census Bureau 2019).

Economy and Employment

According to BLS (2019) data, Essex County's average annual labor force in 2019 included approximately 426,042 individuals.

A total 26,379 private sector employer establishments in Essex County employed 286,835 individuals in 2019 (BLS 2018). In 2019, the most recent year for which data are available, Essex County's workforce was comprised of 55.9% County residents and 44.1% non-residents.

As shown in Table 7.1-18, the largest employers by NAICS sector are: Retail Trade, Construction, Health Care and Social Assistance, Professional, Scientific and Technical, and Other Services (except public administration).

Table 7.1-18 Paid Employees by NAICS Sector in Essex County and Commonwealth of Massachusetts (2019)[1]

Industry Sector	Essex County		Massachusetts	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	68,014	22.6%	625,474	18.5%
Manufacturing	42,411	14.1%	233,428	6.9%
Retail Trade	39,175	13.0%	363,220	10.7%
Accommodation and Food Services	29,596	9.9%	316,291	9.3%
Administrative and Support/Waste Management and Remediation	18,000	6.0%	214,224	6.3%

Notes:

1. US Census Bureau's (2019) CBP.

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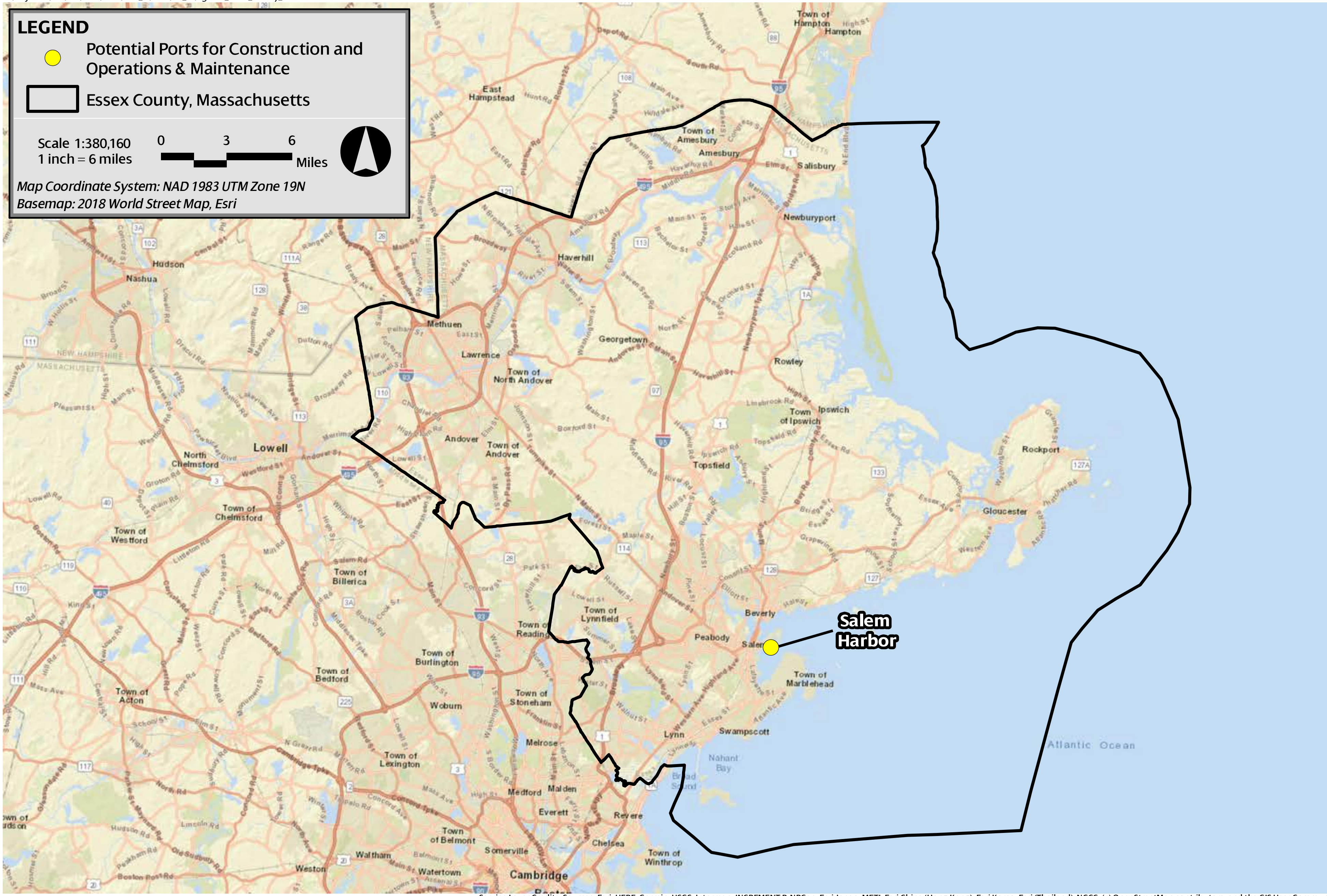

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According to NOAA, Essex County's Ocean Economy GDP grew from approximately $495.3 million in 2009 to approximately $1.0 billion in 2018 and added 4,618 jobs. In 2018, the total Ocean Economy accounted for 2.4% of the County's total GDP, and employed approximately 20,540 individuals, including self-employed individuals. As indicated in Table 7.1-19, in 2018, Essex County's largest Ocean Economy sector by dollar value was Tourism and Recreation, which accounted for 78.2% of the County's total Ocean Economy. The Living Resources sector accounted for 18.0% of the County's total Ocean Economy.

Table 7.1-19 Ocean Economy Gross Domestic Product in Essex County and Commonwealth of Massachusetts (2018)[1]

	Essex County		Massachusetts	
Ocean Economy Sector	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$1,000	2.4%	$7,900	1.4%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$187.5	18.0%	$1,100	14.4%
Marine Construction	$16.2	1.6%	$190.4	2.4%
Shipbuilding	*	*	$49.3	0.6%
Marine Transportation	$22.5	2.2%	$1,800	22.4%
Offshore Mineral Extraction	*	*	$3.3	<0.1%
Tourism and Recreation	$813.2	78.2%	$4,700	60.1%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
* Cannot be published without violating the confidentiality of one or more businesses.

Table 7.1-20 shows the 2016 average wage for Living Resource sector employees in Essex County and Massachusetts. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-20 Employment and Wages for Ocean Economy Living Resource Industries in Essex County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
Massachusetts	7,357	$66,900	3,135	$70,945	3,156,298	$73,405
Essex County	1,230	$72,600	691	$61,670	284,983	$60,149

Notes:

1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

New England Wind may make use of Salem Harbor. When the recently commissioned Salem Harbor Power Station natural gas power plant replaced a coal and oil plant in 2018 along the Salem waterfront, it opened 0.17 km^2 (42 acres) for development. The Salem Harbor Power Station mostly bisects the area available for development; the north side of the site is approximately 0.06 km^2 (13.7 acres) and the south side is approximately 0.12 km^2 (29 acres). The site 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 approximately 700 m (2,300 ft) of frontage on Salem Harbor, which hosts active commercial, recreational, and water transportation facilities. The site is located approximately 35 km (22 miles) northeast of Boston.

Housing data for Essex County are presented in Table 7.1-21.

Table 7.1-21 Essex County Housing[1]

Location	Housing Units[1]	Vacant Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Essex County	314,738	16,840	1.2	2.8	$381,600	$1,241

Notes:

1. US Census Bureau's (2019) ACS 5-Year Estimates.

7.1.1.2 Rhode Island

Population and economic statistics for Providence County, Washington County and the State of Rhode Island are provided in Table 7.1-22.

Table 7.1-22 Existing Economic Conditions in the Onshore Development Region (Rhode Island)

Location	Population (2019)[1]	Population Density[2] (people per square mile)	Per Capita Income (2019)[3]	Annual Total Employment (2019)[4]	Annual Unemployment Rate (2019)[4]
Rhode Island	1,059,361	1,018.1	$36,121	538,703	3.6%
Providence County	638,931	1,530.3	$31,522	315,3989	3.9%
Washington County	125,577	385.7,4	$42,869	66,949	3.2%

Notes:

1. US Census Bureau's (2019) PEP (updated annually).
2. US Census Bureau, land area is based on current information in the TIGER® data base, calculated for use with Census 2010; population from PEP V2019, accessed August 2021.
3. US Census Bureau's (2019) ACS 5-Year Estimates.
4. BLS's (2019) Local Area Unemployment Statistics (not seasonally adjusted, accessed August 2021).

7.1.1.2.1 Providence County

Demographics

Providence County consists of 16 cities and towns located in the northernmost region of Rhode Island (see Figure 7.1-6). The US Census Bureau's PEP data for 2019 counts 638,931 residents of Providence County. The population of Providence County increased by 0.7% from 2010 to 2019. In 2019, the estimated population of Providence County's largest city and the state capital, Providence, is 179,883 residents. From 2010 to 2019, the population of Providence County increased by 1.2%.

Providence County's population density, per capita income, total employment, and unemployment rate are shown in Table 7.1-22. Providence County is the most populous county in Rhode Island and is more densely populated than the statewide average. At $58,974, estimated median household income in Providence County in 2019 is below the statewide median of $67,167 (US Census Bureau 2019).

Economy and Employment

According to BLS (2019) data, Providence County's average monthly labor force in 2019 consisted of approximately 328,216 individuals with an unemployment rate of 3.9%, which was greater than the statewide average.

A total 18,624 private sector employer establishments in Providence County employed 253,897 individuals in 2019 (BLS 2018). In 2018, Providence County's workforce was comprised of 61.8% County residents and 38.2% non-residents, with the largest concentration of jobs in the Providence, Cranston, Pawtucket, and East Providence communities.

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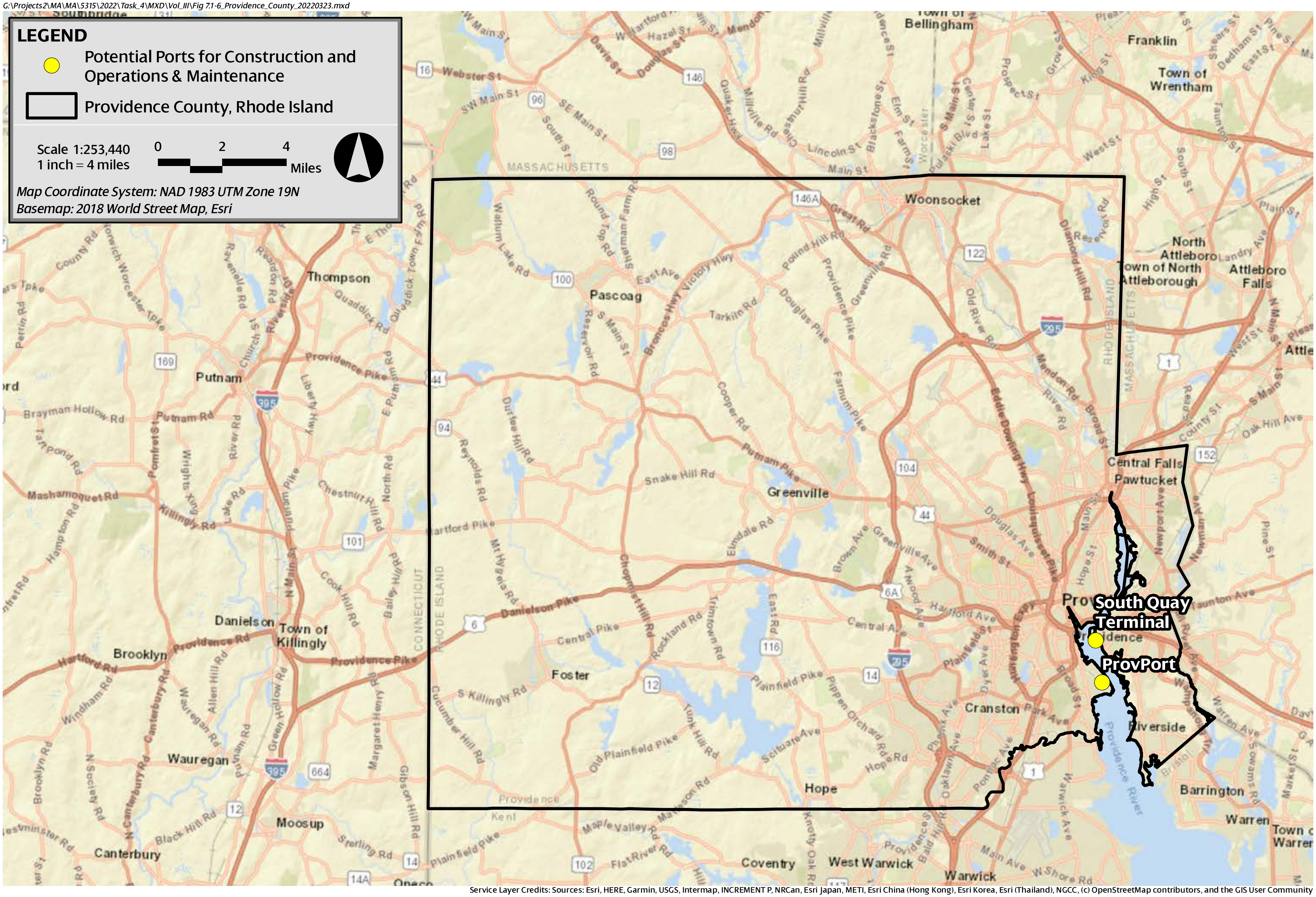

New England Wind

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Figure 7.1-6

Providence County, Rhode Island

As shown in Table 7.1-23, the largest employers by NAICS sector are: Health Care and Social Assistance, Accommodation and Food Services, Retail Trade, Educational Services, and Finance and Insurance.

Table 7.1-23 Paid Employees by NAICS Sector in Providence County and State of Rhode Island (2019)

Industry Sector	Providence County		Rhode Island	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	58,097	20.9%	87,067	19.6%
Accommodation and Food Service	29,373	10.6%	52,985	11.9%
Retail Trade	24,644	8.9%	47,840	10.8%
Educational Services	24,072	8.7%	30,312	6.8%
Finance and Insurance	23,874	8.6%	31,771	7.1%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, Providence County's Ocean Economy GDP grew from approximately $538.8 million in 2009 to approximately $796.5 million in 2018 and added 8,381 jobs. In 2018, the Ocean Economy accounted for 2.1% of the County's total GDP, and employed approximately 16,541 individuals, including self-employed individuals. As indicated in Table 7.1-24, in 2018, Providence County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 92.1% of the County's total Ocean Economy. The Living Resources sector accounted for 0.5% of the County's total Ocean Economy.

Table 7.1-24 Ocean Economy Gross Domestic Product in Providence County and State of Rhode Island (2018)[1]

	Providence County		Rhode Island	
Total Ocean Economy	GDP ($, million)	Percent of Total County Economy	GDP ($, million)	Percent of Total State Economy
Total Ocean Economy	$796.50	2.1%	$3,200	5.4%

Table 7.1-24 Ocean Economy Gross Domestic Product in Providence County and State of Rhode Island (2018)[1] (Continued)

	Providence County		Rhode Island	
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$6.5	0.8%	$176.9	3.4%
Marine Construction	$3.3	0.4%	$16.5	0.5%
Shipbuilding	*	*	*	*
Marine Transportation	$51.7	6.5%	$332.3	10.2%
Offshore Mineral Extraction	+	+	$26.4	0.8%
Tourism and Recreation	$628.4	85.9%	$1,900	58.2%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.

* Cannot be published without violating the confidentiality of one or more businesses.
+ Indicates that either (a) no economic activity of that type occurs in the county or (b) all economic activity of that type is associated with the self-employed.

Table 7.1-25 shows the 2016 average wage for Living Resource sector employees in Providence County and Rhode Island. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-25 Employment and Wages for Ocean Economy Living Resource Industries in Providence County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
Rhode Island	622	$55,000	940	$63,000	421,767	$51,709
Providence County	85	$30,800	103	$30,738	253,233	$53,932

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

New England Wind may make use of the Port of Providence (ProvPort), a privately-owned marine terminal located within the City of Providence, which occupies approximately 0.42 km^2 (105 acres) along the Providence River. According to ProvPort, terminal services have resulted in economic output of approximately $164 million for the City of Providence and $211 million for the State of Rhode Island since 1994. The indirect impact of the port has generated approximately $2.8 billion in economic output for the state since 1994, with $1 billion of that occurring within the City of Providence (ProvPort 2018).

New England Wind may also make use of the South Quay Terminal, an over 0.12 km^2 (30 acre) greenfield site located on the Providence River in East Providence. Waterfront Enterprises, LLC has announced plans to develop a staging area for offshore wind construction at the site as well as other mixed uses.

Housing

Housing data for Providence County are presented in Table 7.1-26.

Table 7.1-26 Providence County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Providence County	314,738	16,8400	1.21	2.8	$223,500	$967

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2019 counts 314,738 total housing units in Providence County, of which 16,840 are categorized as vacant. Of the County's 297,898 occupied housing units, 54.2% are owner-occupied. In 2010, the most recent year vacancy status is categorized as "seasonal, recreational, or occasional," 6.5% of those vacant units were for seasonal, recreational, or occasional uses.

7.1.1.2.2 Washington County

Demographics

Washington County consists of 16 cities and towns located in southern Rhode Island (see Figure 7.1-7). The US Census Bureau's PEP data for 2019 counts 125,577 residents of Washington County. The population of Washington County decreased by 1.1% from 2010 to 2019. In 2019, the estimated population of Washington County's largest city, South Kingstown, was 30,348 residents.

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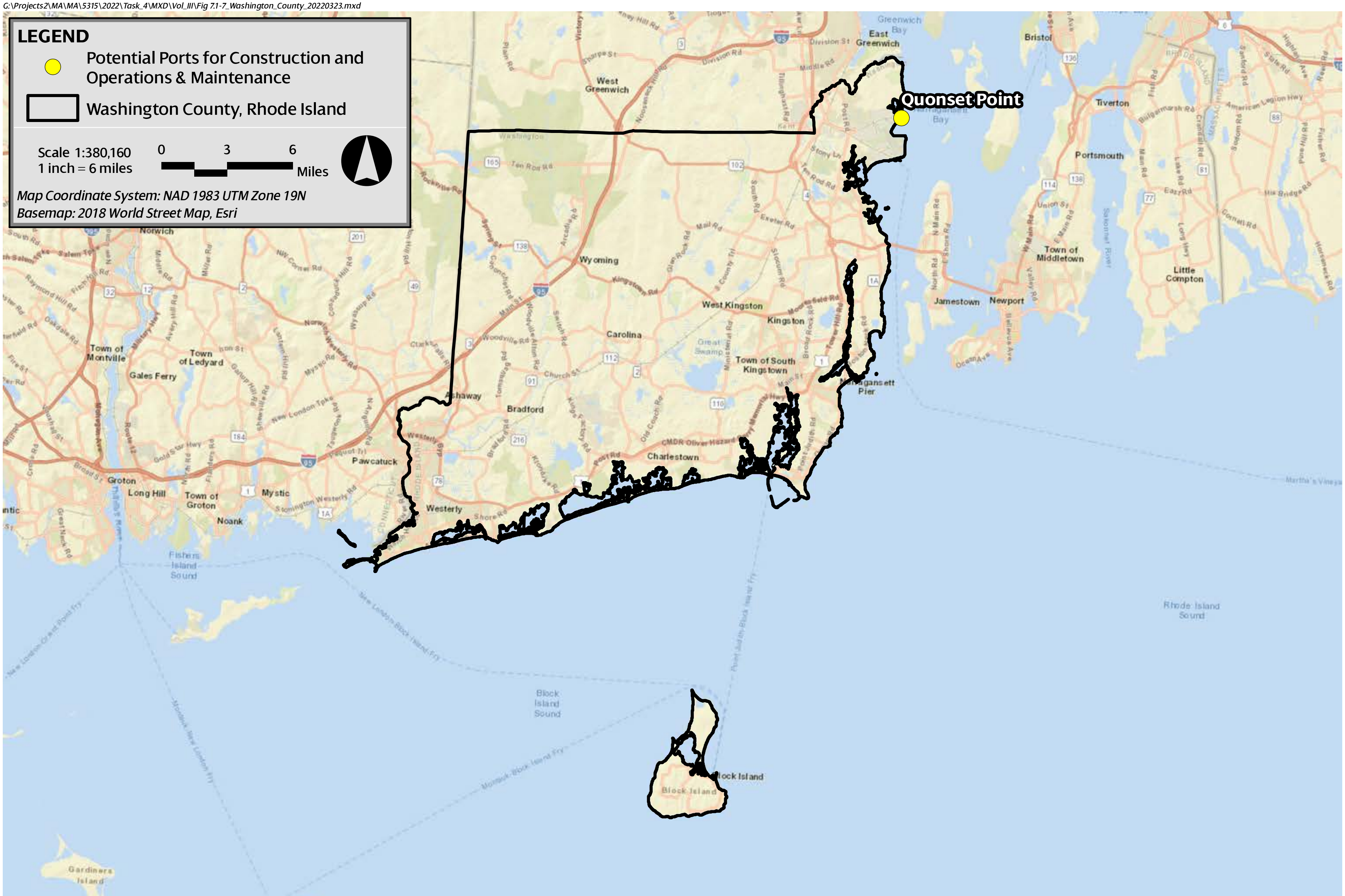

New England Wind

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Figure 7.1-7

Washington County, Rhode Island

Washington County's population density, per capita income, total employment, and unemployment rate are shown in Table 7.1-22. At $85,531, estimated median household income in Washington County in 2019 is above the statewide median of $67,167 (US Census Bureau 2019).

Economy and Employment

According to BLS (2019) data, Washington County's average monthly labor force in 2019 consisted of approximately 69,141 individuals with an unemployment rate of 3.2%, which was less than the statewide average.

A total 4,404 private sector employer establishments in Washington County employed 45,707 individuals in 2018 (BLS 2018). In 20187, Washington County's workforce was comprised of 44.5% County residents and 55.5% non-residents, with the largest concentration of jobs in the Wakefield and Westerly communities.

As shown in Table 7.1-27, the largest employers by NAICS sector are: Manufacturing, Health Care and Social Assistance, Retail Trade, Accommodation and Food Services, and Wholesale Trade.

Table 7.1-27 Paid Employees by NAICS Sector in Washington County and State of Rhode Island (2019)

Industry Sector	Washington County		Rhode Island	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Manufacturing	8,587	19.8%	39,467	8.9%
Health Care and Social Assistance	7,359	17.0%	87,067	19.6%
Retail Trade	6,521	15.1%	47,840	10.8%
Accommodation and Food Service	5,963	13.8%	59,985	11.9%
Wholesale Trade	2,813	6.5	20,075	4.5%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, Washington County's Ocean Economy GDP grew from approximately $427.6 million in 2007 to approximately $918.7 million in 2016 and added 2,815 jobs. In 2016, the Ocean Economy accounted for 16.2% of the County's total GDP, and employed approximately 10,760 individuals, including self-employed individuals. As indicated in Table 7.1-28, in 2016, Washington County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 32.7% of the County's total Ocean Economy. The Living Resources sector accounted for 10.7% of the County's total Ocean Economy.

Table 7.1-28 Ocean Economy Gross Domestic Product in Washington County and State of Rhode Island (2018)[1]

	Washington County		Rhode Island	
Total Ocean Economy	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$1,200	18.8%	$1,2	5.4%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$81.6	6.9%	$176.9	3.4%
Marine Construction	$9.3	0.8%	$16.5	0.5%
Shipbuilding	*	*	*	*
Marine Transportation	*	*	$332.3	10.2%
Offshore Mineral Extraction	+	+	$26.4	0.8%
Tourism and Recreation	$327.6	27.6%	$1,900	58.2%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
* Cannot be published without violating the confidentiality of one or more businesses.
+ Indicates that either (a) no economic activity of that type occurs in the county or (b) all economic activity of that type is associated with the self-employed.

Table 7.1-29 shows the 2016 average wage for Living Resource sector employees in Washington County and Rhode Island. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-29 Employment and Wages for Ocean Economy Living Resource Industries in Washington County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
Rhode Island	622	$55,000	940	$63,000	421,767	$51,709
Washington County	267	$70,600	490	$49,398	45,037	$47,282

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

New England Wind may make use of the Port of Davisville (Quonset) which is located near the mouth of Narragansett Bay and offers five terminals, 1,372 linear meters (4,500 linear feet) of berthing space at two 366 m (1,200 ft) long piers, a bulkhead, on-dock rail, and 58 acres of laydown and terminal storage. The port also has heavy lift capacity and ongoing renovations to Quonset's Pier 2 will increase the port's overall capacity to support the offshore wind industry.

According to the State of Rhode Island, the Port of Davisville accounted for approximately $333 million in business output within the State of Rhode Island, over 1,500 direct and indirect jobs, and more than $97 million in household income in 2014 (Rhode Island Commerce Corporation, 2016).

Housing

Housing data for Providence County are presented in Table 7.1-30.

Table 7.1-30 Providence County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Providence County	64,710	16,659	1.1	6.0	$343,000	$1,133

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2019 counts 64,710 total housing units in Washington County, of which 16,659 are categorized as vacant. Of the County's 48,051 occupied housing units, 74.0% are owner-occupied. In 2010, the most recent year vacancy status is categorized as "seasonal, recreational, or occasional," 6.5% of those vacant units were for seasonal, recreational, or occasional uses.

7.1.1.3 Connecticut

Population and economic statistics for Fairfield County, New London County, and the State of Connecticut are provided in Table 7.1-31.

Table 7.1-31 Existing Economic Conditions in the Onshore Development Region (Connecticut)

Location	Population (2019)[1]	Population Density[2] (people per sq. mile)	Per Capita Income (2019)[3]	Total Employment (2019)[4]	Unemployment Rate (2019)[4]
Connecticut	3,565,287	736.3	$44,496	1,848,476	3.6%
Fairfield County	943,332	1,509.6	$57,263	463,937	3.5%
New London County	265,206	398.9	$39,426	132,673	3.5%

Notes:
1. US Census Bureau's (2019) PEP (updated annually).
2. US Census Bureau, Census of Population and Housing. Land area is based on current information in the TIGER® data base, calculated for use with Census 2010; population from PEP V2019, accessed August 2021.
3. US Census Bureau's (2019) ACS 5-Year Estimates.
4. BLS's (2019) Local Area Unemployment Statistics (accessed August 2021, not seasonally adjusted).

7.1.1.3.1 Fairfield County

Demographics

Fairfield County consists of 24 cities and towns located in the southwestern region of Connecticut (see Figure 7.1-8). The US Census Bureau's PEP data for 2019 counts 943,332 residents of Fairfield County. From 2010 to 2019, the population of Fairfield County increased by 2.9 %. In 2019, the estimated population of Fairfield County's largest city, Bridgeport, was 144,399 residents.

Fairfield County's population density, per capita income, total employment, and unemployment rate are shown in Table 7.1-31. At $95,645, estimated median household income in Fairfield County in 2019 is above the statewide median of $78,444 (US Census Bureau 2019).

Economy and Employment

According to BLS data, Fairfield County's average monthly labor force in 2018 consisted of approximately 480,817 individuals with an unemployment rate of 3.5%, which was less than the statewide average (BLS 2019).

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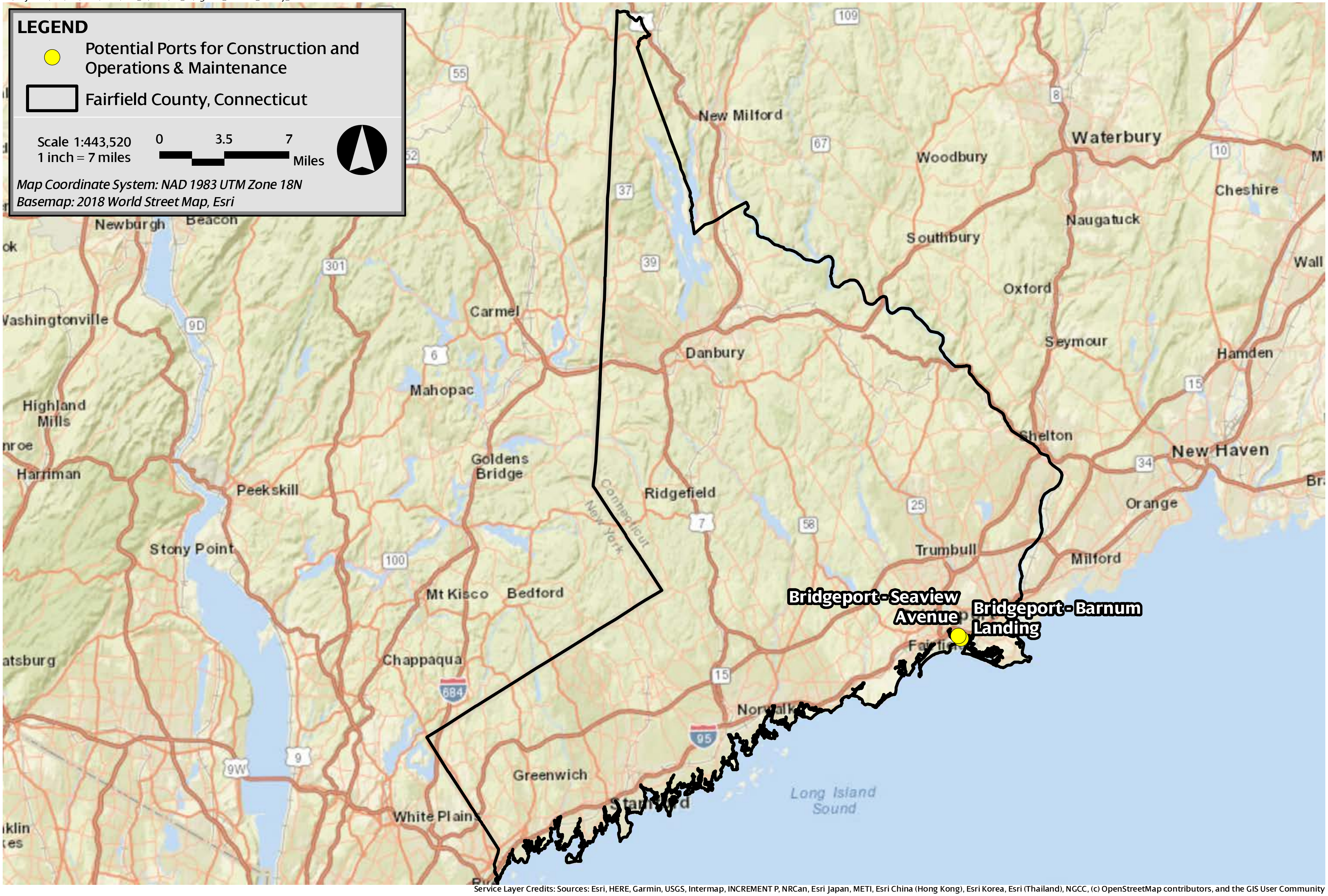

New England Wind
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Figure 7.1-8

Fairfield County, Connecticut

A total 36,213 private sector employer establishments in Fairfield County employed 373,018 individuals in 2019 (BLS 2018). In 2018, Fairfield County's workforce was comprised of 61.5% County residents and 38.5% non-residents, with the largest concentration of jobs in the Stamford, Norwalk, Danbury, and Bridgeport communities.

As shown in Table 7.1-32, the largest employers by NAICS sector are: Health Care and Social Assistance, Retail Trade, Professional, Scientific and Technical Services, Accommodation and Food Services, and Manufacturing.

Table 7.1-32 Paid Employees by NAICS Sector (2019) in Fairfield County and State of Connecticut[1]

Industry Sector	Fairfield County		Connecticut	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	73,060	17.3%	295,248	19.2%
Retail Trade	49,143	11.6%	179,766	11.7%
Professional, Scientific and Technical Services	38,822	9.2%	106,252	6.9%
Accommodation and Food Service	36,577	8.6%	148,969	9.7%
Manufacturing	34,516	8.2%	159,618	10.4%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, Fairfield County's Ocean Economy GDP has remained steady, producing approximately $1.2 billion of goods and services each year from 2009 to 2018 and added 5,706 jobs. In 2018, the Ocean Economy accounted for 1.2% of the County's total GDP, and employed approximately 19,142 individuals, including self-employed individuals. As indicated in Table 7.1-33, in 2018, Fairfield County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 781.5% of the County's total Ocean Economy. The Living Resources sector accounted for 1.7% of the County's total Ocean Economy.

Table 7.1-33 Ocean Economy GDP in Fairfield County and the State of Connecticut (2018)[1]

	Fairfield County		Connecticut	
Total Ocean Economy	GDP ($, million)	Percent of Total County Economy	GDP ($, million)	Percent of Total State Economy
Total Ocean Economy	$1,200	1.2%	$4,700	1.7%

Table 7.1-33 Ocean Economy GDP in Fairfield County and the State of Connecticut (2018)[1] (Continued)

	Fairfield County		Connecticut	
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$13.4	1.2%	$71.7	1.5%
Marine Construction	$16.8	1.5%	*	*
Shipbuilding	$2.3	0.2%	*	*
Marine Transportation	$37.8	3.3%	520.6	11.1
Offshore Mineral Extraction	*	*	$113.9	2.4%
Tourism and Recreation	$988.6	85.4%	$2,000	43.5%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
* Cannot be published without violating the confidentiality of one or more businesses.

Table 7.1-34 shows the 2016 average wage for Living Resource sector employees in Fairfield County and Connecticut. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-34 Employment and Wages for Ocean Economy Living Resource Industries in Fairfield County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	**Average Wage**	**Number**	**Average Gross Receipts**	**Total Employment**	**Average Wage**
Connecticut	676	$43,300	292	$55,404	1,449,072	$68,303
Fairfield County	126	$44,700	68	$37,912	376,207	$88,369

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

Fairfield County's Port of Bridgeport is one of three deep-water ports in Connecticut and currently contains a mix of industrial, commercial, and recreational uses. The Port of Bridgeport has established berthing facilities, cargo handling, and vessel servicing facilities (Apex 2010). The port could serve as a construction staging area for New England Wind and, for Phase 1, the Proponent will likely establish a long-term service operation vessel O&M base at the port. The Proponent may also use O&M facilities in Bridgeport for Phase 2.

Housing

Housing data for Fairfield County are presented in Table 7.1-35.

Table 7.1-35 Fairfield County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Fairfield County	375,368	34,811	2.3	8.6	$428,500	$1,499

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2018 counts 375,3689 total housing units in Fairfield County, of which 30,508 are categorized as vacant. Of the County's 340,557 occupied housing units, 67.1% are owner-occupied. In 2010, the most recent year for which vacancy status is categorized as "seasonal, recreational, or occasional," 21.2% of those vacant units were for seasonal, recreational, or occasional uses (US Census Bureau 2010).

7.1.1.3.2 New London County

Demographics

New London County consists of 23 municipalities in the southeastern corner of Connecticut along the Interstate 95 corridor (see Figure 7.1-9).

The US Census Bureau's PEP data for 2019 counts 265,206 residents of New London County. In 2019, the municipalities of Norwich and New London were the largest population centers in New London County with estimated populations of 38,768 and 26,858, respectively.

New London County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-31. Based on ACS five-year estimates for 2019, New London County's median household income is $73,490, which is less than the statewide median of $78,444 (US Census Bureau 2019).

New London County's population density is less than the statewide average at approximately 412.2 people/mi^2.

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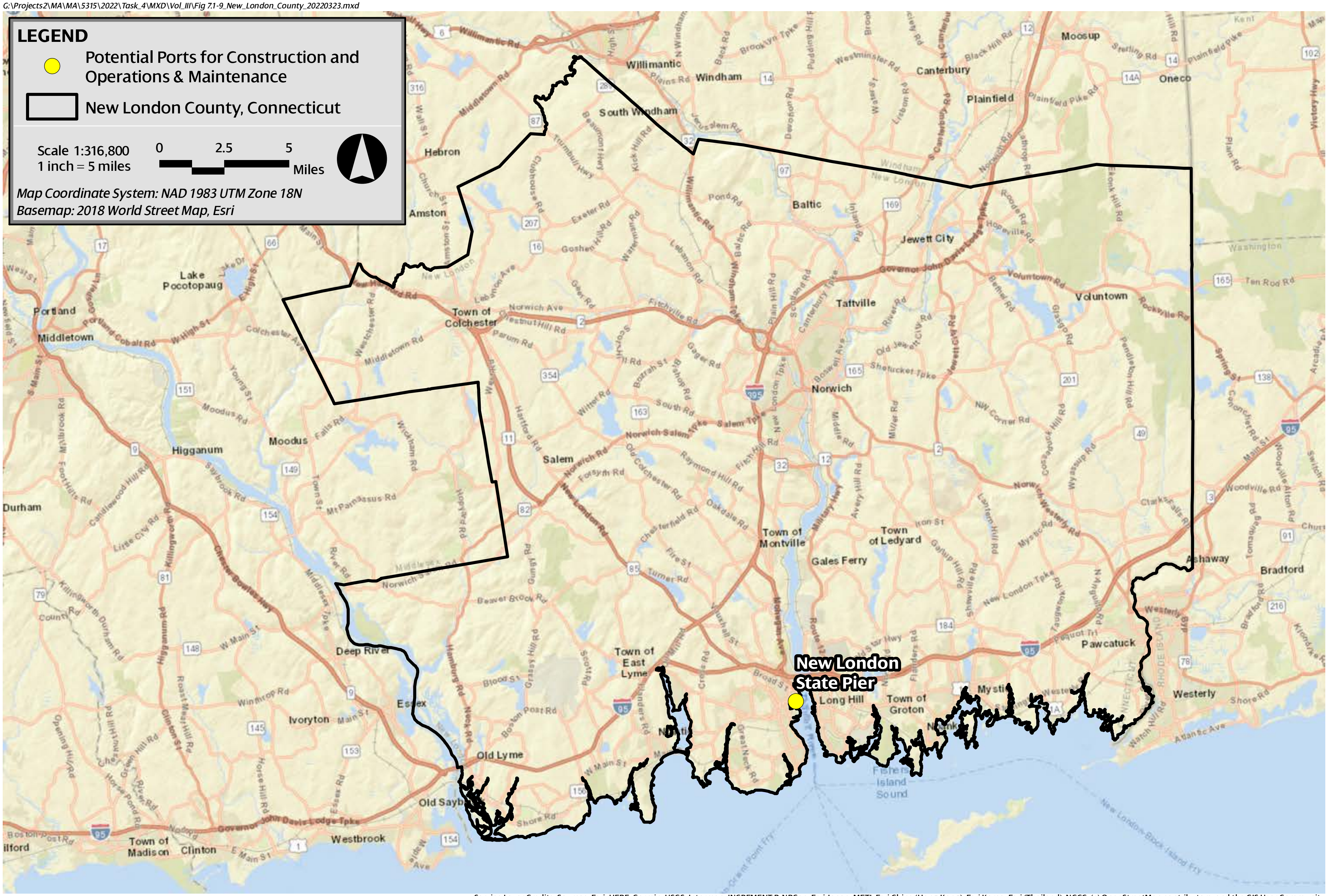

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New England Wind

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Figure 7.1-9

New London County, Connecticut

Economy and Employment

According to BLS data for 2018, New London County's average monthly labor force consisted of approximately 137,448 individuals with an unemployment rate of 3.5% (BLS 2019).

CBP data show that in 2017 New London County's 7,266 private sector employer establishments employed 93,931 individuals. In 2018, the most recent year for which data are available, New London County's workforce was comprised of 63.7% County residents and 36.3% non-residents.

As shown in Table 7.1-36, New London County's largest employers by NAICS sector are: Accommodation and Food Services, Health Care and Social Assistance, Manufacturing, Retail Trade, and Professional, Scientific, and Technical Services. According to the Connecticut Department of Labor, the five largest employers in New London County are General Dynamics Electric Boat, Foxwoods Resort & Casino, Pfizer and its affiliates, Connecticut College, and Lawrence and Memorial Hospital (Connecticut Department of Labor 2018). US Census Bureau data indicate that New London County's highest concentrations of jobs surround the New London and Norwich communities.

Table 7.1-36 Paid Employees by NAICS Sector in New London County and State of Connecticut (2019)[1]

Industry Sector	New London County		Connecticut	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Accommodation and Food Service	25,222	23.4%	148,969	9.7%
Health Care and Social Assistance	17,922	16.6%	295,248	19.2%
Manufacturing	15,038	13.9%	159,618	10.4%
Retail Trade	14,801	13.7%	179,766155,755	11.7%
Professional, Scientific, and Technical Services	7,994	7.4%	106,252	6.9%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, New London County's Ocean Economy GDP grew from approximately $1.8 billion in 2009 to approximately $2.41 billion in 2018 and added 5,652 jobs. In 2018, the Ocean Economy accounted for 13.7% of the County's total GDP, and employed approximately 20,431 individuals, including self-employed individuals. As indicated in Table 7.1-37, in 2018, New London County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 15.5% of the County's total Ocean Economy. The Living Resources sector accounted for 0.2% of the County's total Ocean Economy.

Table 7.1-37 Ocean Economy GDP in New London County and State of Connecticut (2018)[1]

	New London County		Connecticut	
Total Ocean Economy	**GDP ($, million)[2]**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$2,400	13.7%	$4,700	1.7%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$2.5	0.1%	$71.7	1.5%
Marine Construction	$4.2	0.2%	*	*
Ship and Boat Building	$74.7	3.1%	*	*
Marine Transportation	*	*	520.6	11.1
Offshore Mineral Extraction	$19.2	0.8%	$113.9	2.4%
Tourism and Recreation	$374.3	15.58.8%	$2,000	43.5%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. 76.3% of New London County's Ocean Economy GDP is "suppressed" to preserve the confidentiality of one or more businesses and cannot be attributed to an Ocean Economy sector.

* Cannot be published without violating the confidentiality of one or more businesses.

Table 7.1-38 shows the 2016 average wage for Living Resource sector employees in New London County and Connecticut. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-38 Employment and Wages for Ocean Economy Living Resource Industries in New London County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	**Average Wage**	**Number**	**Average Gross Receipts**	**Total Employment**	**Average Wage**
Connecticut	676	$43,300	292	$55,404	1,449,072	$68,303
New London County	39	$29,200	118	$75,475	93,931	$56,5373,025

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

New England Wind may use the New London State Pier, located on the Thames River, which will be redeveloped for offshore wind through a private-public partnership between the Connecticut Port Authority, Eversource, and Ørsted. The ~0.12 km^2 (~30 acre) site has no air draft restrictions, direct access to a federally-maintained deep-water channel, and access to rail and highway. If the site is developed and available, it may be used for Phase 1 or Phase 2 of New England Wind.

Housing

Housing data for New London County are presented in Table 7.1-39.

Table 7.1-39 New London County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
New London County	124,208	14,456	1.3	4.6	$241,700	$1,130

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2019 counts 124,208 total housing units in New London County, of which 14,456 are categorized as vacant. Of the County's 109,752 occupied housing units, 66.1% are owner-occupied.

7.1.1.4 New York

Population and economic statistics for Albany County, Kings County, Rensselaer County, Richmond County, Suffolk County, and the State of New York are provided in Table 7.1-40.

Table 7.1-40 Existing Economic Conditions in the Onshore Development Region (New York)

Location	Population (2019)[1]	Population Density[2] (people per sq. mile)	Per Capita Income (2019)[3]	Total Employment (2019)[4]	Unemployment Rate (2019)[4]
New York	19,543,561	411.2	$39,326	9,143,287	3.8%
Albany County	305,506	581.9	$37,635	151,417	3.5%
Kings County	2,559,903	35,369.1	$34,173	1,148,750	4.0%
Rensselaer County	158,714	244.4	$35,903	77,940	3.6%
Richmond County	476,143	8,030.3	$36,9077	215,509	3.8%

Table 7.1-40 Existing Economic Conditions in the Onshore Development Region (New York) (Continued)

Location	Population (2019)[1]	Population Density[2] (people per sq. mile)	Per Capita Income (2019)[3]	Total Employment (2018)[4]	Unemployment Rate (2019)[4]
Suffolk County	1,476,601	1,637.4	$44,465	749,233	3.5%

Notes:

1. US Census Bureau's (2019) PEP (updated annually).
2. US Census Bureau, land area is based on current information in the TIGER® data base, calculated for use with Census 2010; population from PEP V2019, accessed August 2021.
3. US Census Bureau's (2019) ACS 5-Year Estimates.
4. BLS's (2019) Local Area Unemployment Statistics (not seasonally adjusted, accessed August 2021).

7.1.1.4.1 Albany County

Demographics

Albany County consists of 18 municipalities in the east central part of New York, on the west side of the Hudson River (see Figure 7.1-10).

The US Census Bureau's PEP data for 2019 counts 305,506 residents of Albany County. The City of Albany and the town of Colonie are the largest population centers in Albany County with estimated populations of 96,460 and 82,9788, respectively (US Census Bureau 2018). From 2010 to 2019, the population of Albany County increased by 0.4%.

Albany County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-40. At $66,252, estimated median household income in Albany County in 2019 is less than the statewide median of $68,486 (US Census Bureau 2018).

Economy and Employment Population

According to BLS data, Albany County's average monthly labor force in 2019 consisted of approximately 156,887 individuals with an unemployment rate of 3.5%, which was less than the statewide average (BLS 2019).

A total 9,926 private sector employer establishments in Albany County employed 172,480 individuals in 2019 (BLS 2018). In 2018, the most recent year for which data are available, Albany County's workforce was comprised of 57.7% County residents and 42.3% non-residents, with the largest concentration of jobs in the City of Albany.

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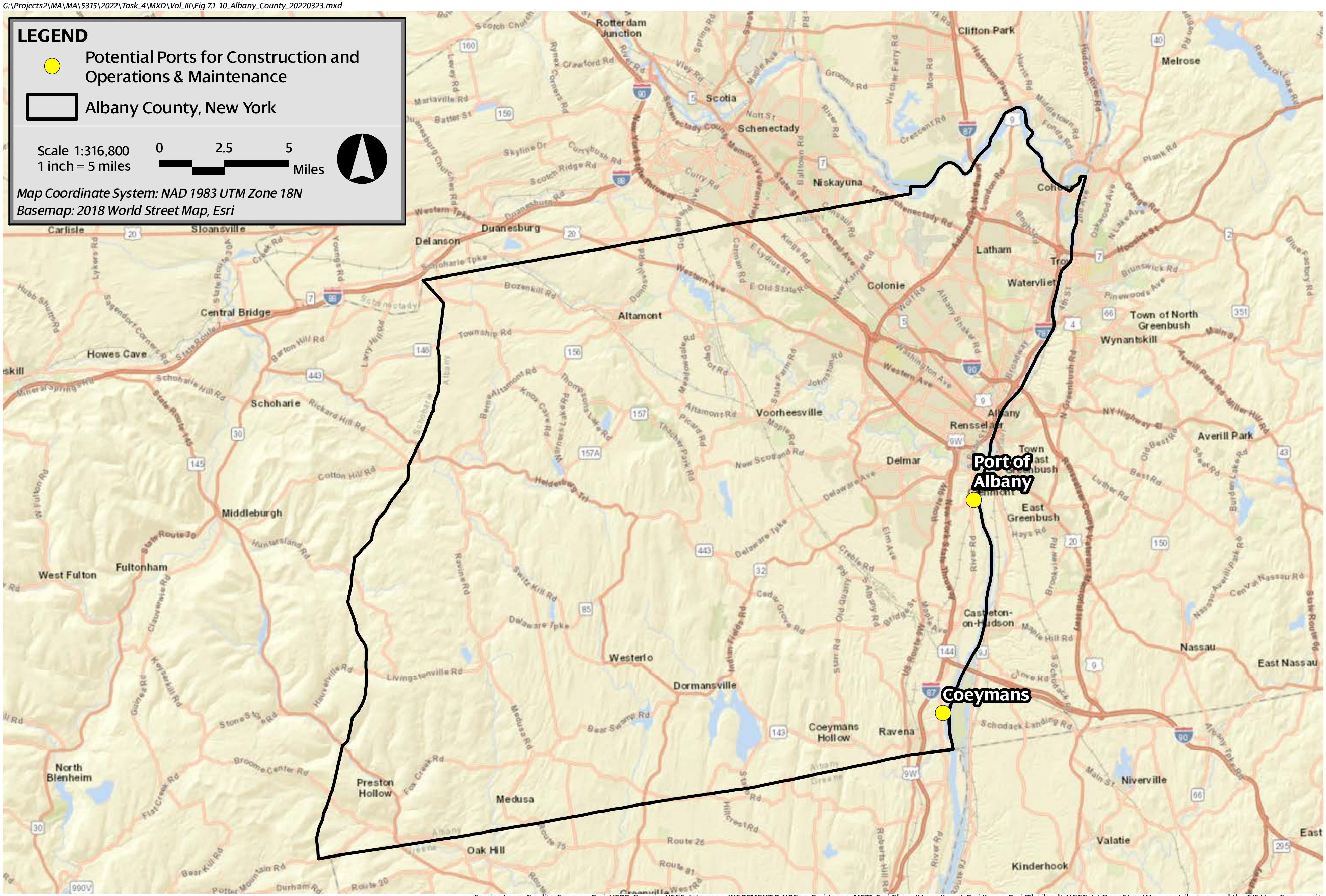

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Figure 7.1-10

Albany County, New York

As shown in Table 7.1-41, Albany County's largest employers by NAICS sector, according to CBP data for 2017, are: Health Care and Social Assistance, Retail Trade, Professional, Scientific and Technical Services, Accommodation and Food Service, and Finance and Insurance. According to the New York Executive Office of Labor and Workforce Development, the five largest employers in Albany County are: Albany Med System, St. Peter's Health Partners, Golub Corp., Hannaford Supermarkets, and GE (Capital Regional Chamber, Albany, New York 2019).

Table 7.1-41 Paid Employees by NAICS Sector in Albany County and State of New York (2019)[1]

Industry Sector	Albany County		New York	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	38,118	20.8%	1,734,587	20.2%
Retail Trade	22,351	12.2%	914,248	10.6%
Professional, Scientific, and Technical Services	18,755	10.2%	657,125	7.6%
Accommodation and Food Service	16,371	8.9%	824,003	9.6%
Finance and Insurance	12,916	7.0%	554,574	6.5%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, Albany County's Ocean Economy GDP grew from approximately $20.7 million in 2009 to approximately $32.7 million in 20186 and added 320 jobs. In 2018, the Ocean Economy accounted for 0.1% of the County's total GDP, and employed approximately 625 individuals, including self-employed individuals. As indicated in Table 7.1-42, in 2018, Albany County's largest Ocean Economy sector by dollar value is Marine Transportation, which accounted for 100% of the County's total Ocean Economy.

Table 7.1-42 Ocean Economy Gross Domestic Product in Albany County and State of New York (2018)[1]

	Albany County		New York	
Total Ocean Economy	GDP ($, million)	Percent of Total County Economy	GDP ($, million)	Percent of Total State Economy
Total Ocean Economy	$32.7	0.1%	$33,600	2.0%

Table 7.1-42 Ocean Economy Gross Domestic Product in Albany County and State of New York (2018)[1] (Continued)

	Albany County		New York	
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	*	0%	$552.3	1.6%
Marine Construction	*	0%	$464.0	1.4%
Ship and Boat Building	*	*	$143.1	0.4%
Marine Transportation	$32.7	100%	$3,300.0	9.9%
Offshore Mineral Extraction	*	*	$38.0	0.1%
Tourism and Recreation	+	+	$29,000	86.5%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
* Cannot be published without violating the confidentiality of one or more businesses.
+ Indicates that either (a) no economic activity of that type occurs in the county or (b) all economic activity of that type is associated with the self-employed.

Table 7.1-43 shows the 2018 average wage for Living Resource sector employees in Albany County and New York. Many workers within this sector are self-employed and because income data for company-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-43 Employment and Wages for Ocean Economy Living Resource Industries in Albany County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	**Average Wage**	**Number**	**Average Gross Receipts**	**Total Employment**	**Average Wage**
New York	5,019	$43,600	1,470	$44,039	8,07,398	$73,476
Albany County			19	$55,789	151,4175	$55,186

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.
* Cannot be published without violating the confidentiality of one or more businesses.

Phase 1 of New England Wind may make use of the Port of Albany, which the Albany Port District Commission is proposing to expand by developing ~0.33 km^2 (~81.5 acres) of riverfront property in Glenmont that could be used as a staging area for offshore wind farm components.

Phase 1 may also use the Port of Coeymans, an existing 1.6 km^2 (400 acre) privately-owned marine terminal on the Hudson River south of Albany that is used for large-scale construction projects.

Housing

Housing data for Albany County are presented in Table 7.1-44.

Table 7.1-44 Albany County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Albany County	142,884	14,600	2.0	6.0	$222,500	$1,022

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2018 counts 142,884 total housing units in Albany County, of which 14,600 are categorized as vacant. Of the County's 128,284 occupied housing units, 56.4% are owner-occupied.

7.1.1.4.2 Kings County

Demographics

Kings County, coterminous with the New York borough of Brooklyn, is located at the southwestern edge of Long Island, New York (see Figure 7.1-11). The US Census Bureau's PEP data for 2019 counts 2,559,903 residents of Kings County. From 2010 to 2019, the population of Kings County increased by 2.2%.

Kings County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-40. Based on ACS five-year estimates for 2019, Kings County's median household income is $60,213, which is less than the statewide median of $68,486 (US Census Bureau 2019).

Kings County's population density is greater than the statewide average, with approximately 35,369.1 people per square mile (people/mi^2).

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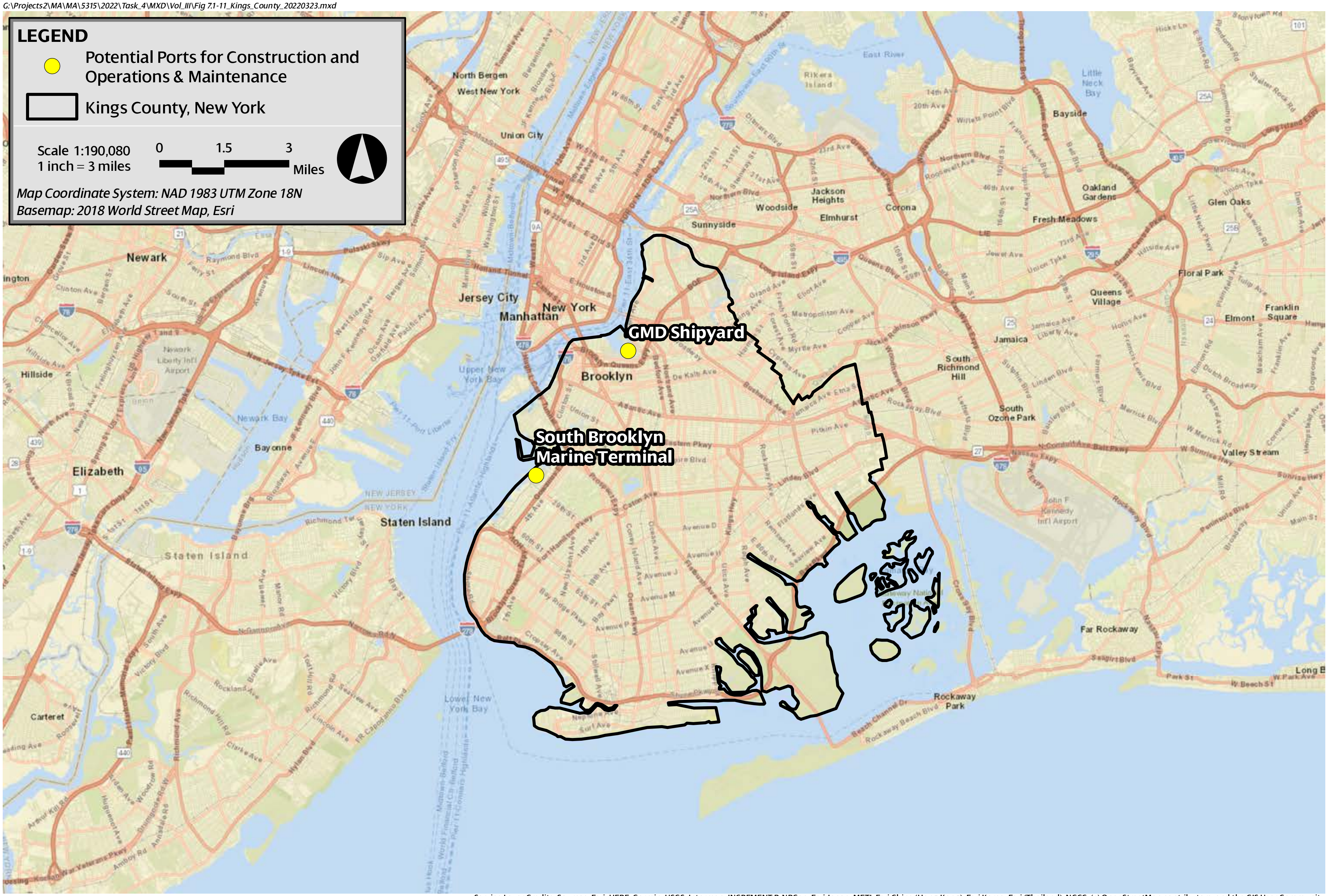

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Figure 7.1-11
Kings County, New York

Economy and Employment

According to BLS data for 2018, Kings County's average monthly labor force consisted of approximately 1,196,433 individuals with an unemployment rate of 4.0% (BLS 2019). A total 63,702 private sector employer establishments in Kings County employed 672,217 individuals in 2019 (BLS 2018). In 2018, the most recent year for which data are available, Kings County's workforce was comprised of 54.3% County residents and 45.7% non-residents.

As shown in Table 7.1-45, Kings County's largest employers by NAICS sector are: Health Care and Social Assistance, Retail Trade, and Accommodation and Food Service, Educational Services, and Construction. According to the New York State Department of Labor, the five largest employers in Kings County are: Mt. Sinai Brooklyn Hospital, Maimonides Medical Center, NYC Health Hospitals/Kings, New York-Presbyterian Brooklyn, and NY City College of Technology (New York State Department of Labor 2019). US Census Bureau data indicate that Kings County's highest concentrations of jobs surround downtown Brooklyn and the Interstate-287 corridor.

Table 7.1-45 Paid Employees by NAICS Sector in Kings County and State of New York (2019)[1]

Industry Sector	Kings County		New York	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	254,232	37.5%	1,734,587	20.2%
Retail Trade	75,621	11.2%	914,248	10.6%
Accommodation and Food Service	56,813	8.4%	824,003	9.6%
Educational Services	38,399	5.7%	4436,571	5.1%
Construction	33,782	5.0%	388,131	4.5%

Notes:
1. US Census Bureau's (2019) CBP.

According to NOAA, Kings County's Ocean Economy GDP grew from approximately $796.1 million in 2009 to approximately $2.1 billion in 2018 and added 19,172 jobs. In 2018, the Ocean Economy accounted for 2.2% of the County's total GDP, and employed approximately 38,536 individuals, including self-employed individuals. As indicated in Table 7.1-46, in 2018, Kings County's largest Ocean Economy sector by dollar value is Tourism and Recreation, which accounted for 91.9% of the County's total Ocean Economy. The Living Resources sector accounted for 3.9% of the County's total Ocean Economy.

Table 7.1-46 Ocean Economy Gross Domestic Product in Kings County and State of New York (2018)[1]

	Kings County		New York	
Total Ocean Economy	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$2,100	2.2%	$33,600	2.0%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$167.4	8.2%	$552.3	1.6%
Marine Construction	*	*	$464.0	1.4%
Ship and Boat Building	*	*	$143.1	0.4%
Marine Transportation	$82.4	4.0%	$3,300.0	9.9%
Offshore Mineral Extraction	*	*	$38.0	0.1%
Tourism and Recreation	$1,800	87.8%	$29,000	86.5%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
* Cannot be published without violating the confidentiality of one or more businesses.

Table 7.1-47 shows the 2016 average wage for Living Resource sector employees in Kings County and New York. Many workers within this sector are self-employed and because income data for company-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-47 Employment and Wages for Ocean Economy Living Resource Industries in Kings County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
New York	5,019	$43,600	1,470	$44,039	8,07,398	$73,476
Kings County	1,412	$43,600	89	$66,921	644,151	$43,646

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.
* Cannot be published without violating the confidentiality of one or more businesses.

New England Wind may use South Brooklyn Marine Terminal, a ~0.3 km^2 (~65 acre) facility with two piers with 1,950 m (6,400 ft) of water frontage on the Upper Bay of New York Harbor. The port will be upgraded by others to support staging, construction and installation, and maintenance of offshore wind farms. New England Wind may also use the GMD Shipyard, located within the Brooklyn Navy Yard on the East River.

Housing

Housing data for Kings County are presented in Table 7.1-48.

Table 7.1-48 Kings County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Kings County	1,065,363	87,272	1.8	2.9	$706,000	$1,426

Notes:
1. US Census Bureau's (20198) ACS 5-Year Estimates.

US Census Bureau data for 2019 counts 1,065,363 total housing units in Kings County, of which 87,272 are categorized as vacant. Of the County's 978,091 occupied housing units, 30.0% are owner-occupied.

7.1.1.4.3 Rensselaer County

Demographics

Rensselaer County consists of 20 municipalities in the east central part of New York on the east side of the Hudson River (see Figure 7.1-12).

The US Census Bureau's PEP data for 2019 counts 158,714 residents of Rensselaer County. The Towns of Troy and East Greenbush are the largest population centers in Rensselaer County with estimated populations of 49,154 and 16,221, respectively, as estimated in 2019 by the US Census Bureau's ACS (US Census Bureau 2019).

Rensselaer County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-40. Based on ACS five-year estimates for 2019, Rensselaer County's median household income is $68,991, which is greater than the statewide median of $68,486 (US Census Bureau 2019).

Rensselaer County's population density is less than the statewide average with approximately 244.4 people/mi^2.

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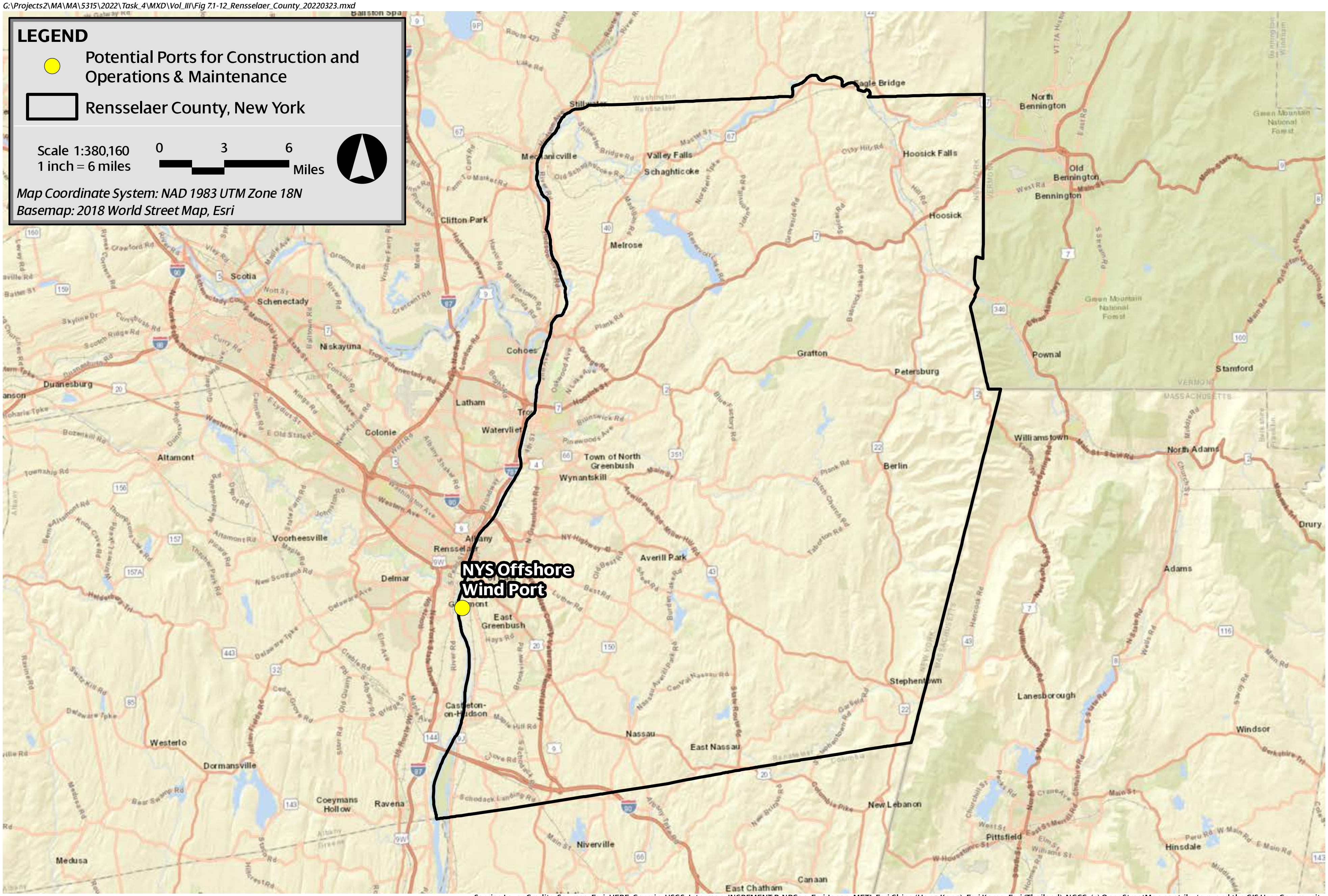

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New England Wind
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Figure 7.1-12
Rensselaer County, New York

Economy and Employment

According to BLS data for 2019, Rensselaer County's average monthly labor force consisted of approximately 80,862 individuals with an unemployment rate of 3.6%, which is less than the statewide average (BLS 2019).

A total 3,153 private sector employer establishments in Rensselaer County employed 42,896 individuals in 2019 (BLS 2018). In 2018, the most recent year for which data are available, Rensselaer County's workforce was comprised of 39.1% County residents and 60.9% non-residents, with the largest concentration of jobs in the City of Troy.

As shown in Table 7.1-49, Rensselaer County's largest employers by NAICS sector are: Health Care and Social Assistance, Retail Trade, and Accommodation and Food Service, Educational Services, and Manufacturing. According to the Rensselaer Chamber of Commerce, the five largest employers in Rensselaer County are: St. Peter's Health Partners, Rensselaer Polytechnic Institute, Rensselaer County, Regeneron, and Hudson Valley Community College (Rensselaer County Regional Chamber of Commerce 2016). US Census Bureau data indicate that Rensselaer County's highest concentrations of jobs surround the Troy and Hampton Manor communities. NOAA does not provide Ocean Economy data for Rensselaer County.

Table 7.1-49 Paid Employees by NAICS Sector in Rensselaer County and State of New York (2019)[1]

Industry Sector	Rensselaer County		New York	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	8,595	18.9%	1,734,578	20.2%
Retail Trade	5,794	12.8%	914,248	10.6%
Accommodation and Food Service	5,114	11.3%	824,003	9.6%
Educational Services	5,098	11.3%	436,571	5.1%
Manufacturing	4,840	10.7%	415,886	4.8%

Notes:
1. US Census Bureau's (2019) CBP.

If the necessary upgrades are made by the owner/lessor, New England Wind may use the New York Offshore Wind Port in East Greenbush, New York, which is being developed to support the needs of the offshore wind industry. The site consists of ~0.5 km^2 (~112 acres) with over 1,188 m (3,900 ft) of riverfront.

Housing

Housing data for Rensselaer County are presented in Table 7.1-50.

Table 7.1-50 Rensselaer County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Rensselaer County	73,431	7,641	1.5	6.7	$188,700	$973

Notes:
1. US Census Bureau's (2098) ACS 5-Year Estimates.

US Census Bureau data for 2019 counts 73,431 total housing units in Rensselaer County, of which 7,641 are categorized as vacant. Of the County's 65,790 occupied housing units, 62.8% are owner-occupied.

7.1.1.4.4 Richmond County

Demographics

Richmond County, coterminous with Staten Island Borough, is located along the North Atlantic Ocean at the southern tip of New York and is nuzzled between New York and New Jersey states (see Figure 7.1-13).

The US Census Bureau's PEP data counts 476,143 residents in Richmond County in 2019 (US Census Bureau 2019). The population of Richmond County has increased by 1.6% since 2010. The County consists of the North Shore, the most urban part of the island, the East Shore, the South Shore, which is mostly suburban, and the West Shore, the least populated and most industrial part of the island (New York State 2020).

Richmond County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-40. Based on the 2018 ACS five-year estimates, Richmond County's median household income is $82,783, which is greater than the statewide median of $68,486 (US Census Bureau 2019).

Richmond County's population density, at 8,030.3 people/mi^2, is greater than the statewide average.

Economy and Employment

According to BLS data, Richmond County's average monthly labor force consisted of approximately 223,9570,621 individuals with an unemployment rate of 3.8%, which is equal to the statewide average (BLS 2019).

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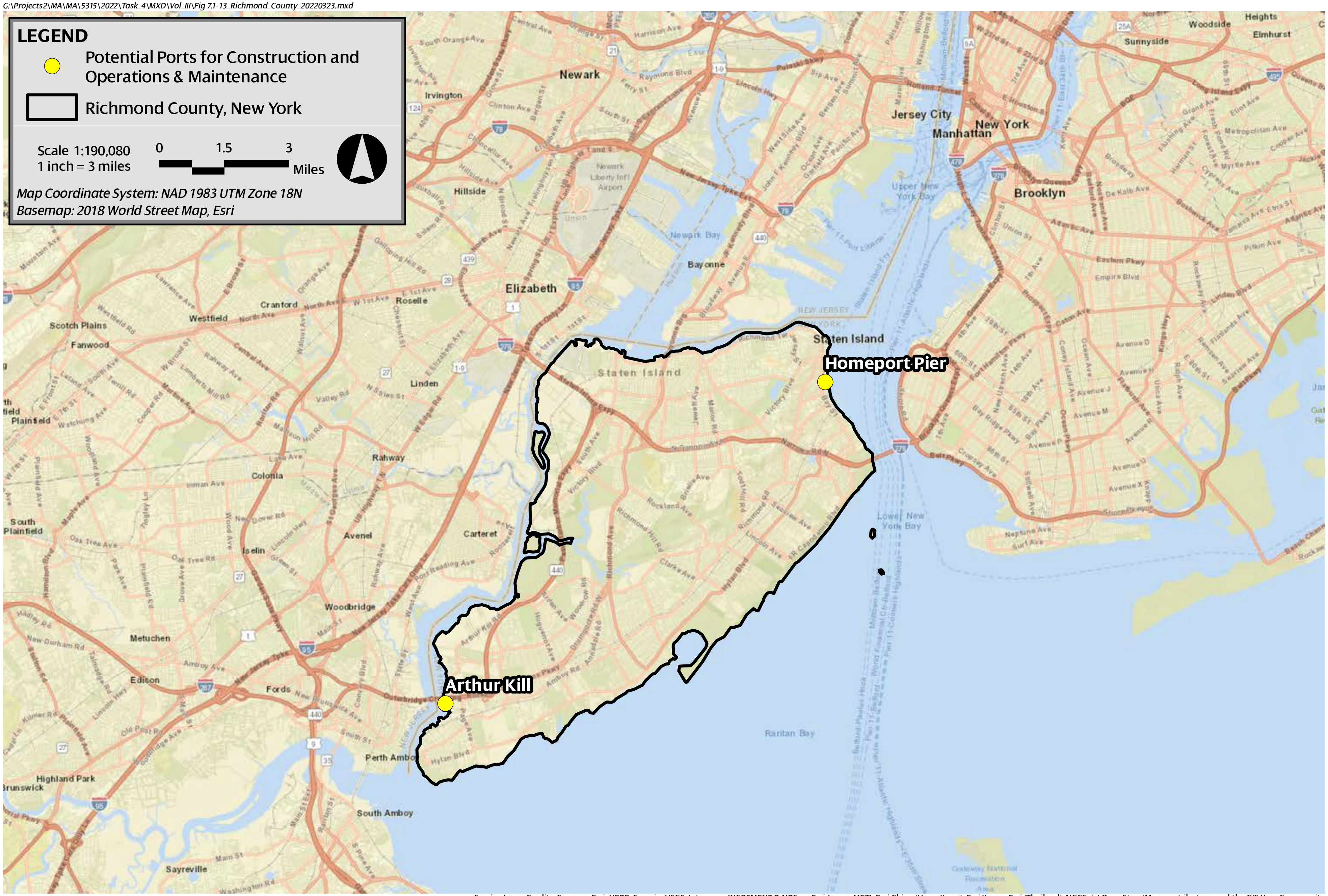

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New England Wind
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Figure 7.1-13

Richmond County, New York

A total 9,738 private sector employer establishments in Richmond County employed 215,5094 individuals in 2019 (BLS 2018). In 2018, the most recent year for which data are available, Richmond County's workforce was comprised of 51.8% County residents and 48.2% non-residents. US Census Bureau data indicate that Richmond County's highest concentrations of jobs are in northerly portions of the County.

As shown in Table 7.1-51, Richmond County's largest employers by NAICS sector are: Health Care and Social Assistance, Retail Trade, Accommodation and Food Service, Construction, and Other Services. According to the New York State Department of Labor, the five largest employers in Richmond County are: Staten Island University Hospital, Richmond University Medical Center, College of Staten Island, Metro One Loss Prevention Svc, and Tottenville High School (New York State Department of Labor 2020).

Table 7.1-51 Paid Employees by NAICS Sector in Richmond County and State of New York (2019)[1]

Industry Sector	Richmond County		New York	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	34,418	31.4%	1,734,5875	20.2%
Retail Trade	16,167	14.8%	914,248	10.6%
Accommodation and Food Service	10,002	9.1%	824,003	9.6%
Construction	9,866	9.0%	388,131	4.5%
Other services (except public administration)	5,997	5.5%	397,119	4.68%

Notes:
1. US Census Bureau's (2019) CBP.

Richmond County's Ocean Economy GDP grew from approximately $301.7 million in 2009 to approximately $461.7 million in 2018 and added 1,751 jobs. In 2018, the most recent year for which data are available, the Ocean Economy accounted for 2.8% of Richmond County's total GDP, and employed approximately 9,416 individuals, including self-employed individuals. As indicated on Table 7.1-52, in 2018, the largest Ocean Economy sector by dollar value was Tourism and Recreation, which accounted for 82.5% of the total Ocean Economy. The Living Resources sector accounted for 2.1% of the County's total Ocean Economy.

Table 7.1-52 Ocean Economy Gross Domestic Product in Richmond County and State of New York (2018)[1]

	Richmond County		New York	
Total Ocean Economy	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$461.7	2.8%	$33,600	2.0%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$9.9	2.1%	$552.3	1.6%
Marine Construction	$35.7	7.7%	$464.0	1.4%
Ship and Boat Building	*	*	$143.1	0.4%
Marine Transportation	$35.3	7.7%	$3,300.0	9.9%
Offshore Mineral Extraction	+	+	$38.0	0.1%
Tourism and Recreation	$380.8	82.5%	$29,000	86.5%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.

* Cannot be published without violating the confidentiality of one or more businesses.
+ Indicates that either (a) no economic activity of that type occurs in the county or (b) all economic activity of that type is associated with the self-employed.

Table 7.1-53 shows the 2016 average wage for Living Resource sector employees in Richmond County and New York. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-53 Employment and Wages for Ocean Economy Living Resource Industries in Richmond County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
New York	5,019	$43,600	1,470	$44,039	8,07,398	$73,476
Richmond County	72	$54,700	27	$54,704	99,174	$47,707

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

New England Wind may use the proposed Arthur Kill Terminal on Staten Island, which would be an over 0.12 km^2 (32 acre) port facility designed for the staging and assembly of offshore wind farm components. New England Wind may use the Homeport Pier, located on Staten Island just north of the Verrazano-Narrows Bridge and is the former site of a 0.14 km^2 (35 acre) Naval Base with a 430 m (1,410 ft) pier.

Housing

Housing data for Richmond County are presented in Table 7.1-54 below.

Table 7.1-54 Richmond County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Richmond County	181,765	15,468	3.4	5.6	$504,800	$1,39

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2018 counts 181,765 total housing units in Richmond County, of which 15,468 are categorized as vacant. Of the County's 166,297 occupied housing units, 69.3% are owner-occupied.

7.1.1.4.5 Suffolk County

Demographics

Suffolk County consists of the 10 towns with 32 villages on the eastern most section of New York State, adjacent to the North Atlantic Ocean (see Figure 7.1-14).

The US Census Bureau's PEP data for 2019 counts 1,476,601 residents of Suffolk County (US Census Bureau 2019). The Towns of Brookhaven and Islip are the largest population centers in Suffolk County with estimated populations of 480,763 and 329,610, respectively (US Census Bureau 2019). From 2010 to 2019, the population of Suffolk County decreased by 1.1%.

Suffolk County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-40. Based on ACS five-year estimates for 2019, Suffolk County's median household income is $101,031, which is greater than the statewide median of $68,486 (US Census Bureau 2019). Suffolk County's population density, at 1,637.4 people/mi^2, is greater than the statewide average.

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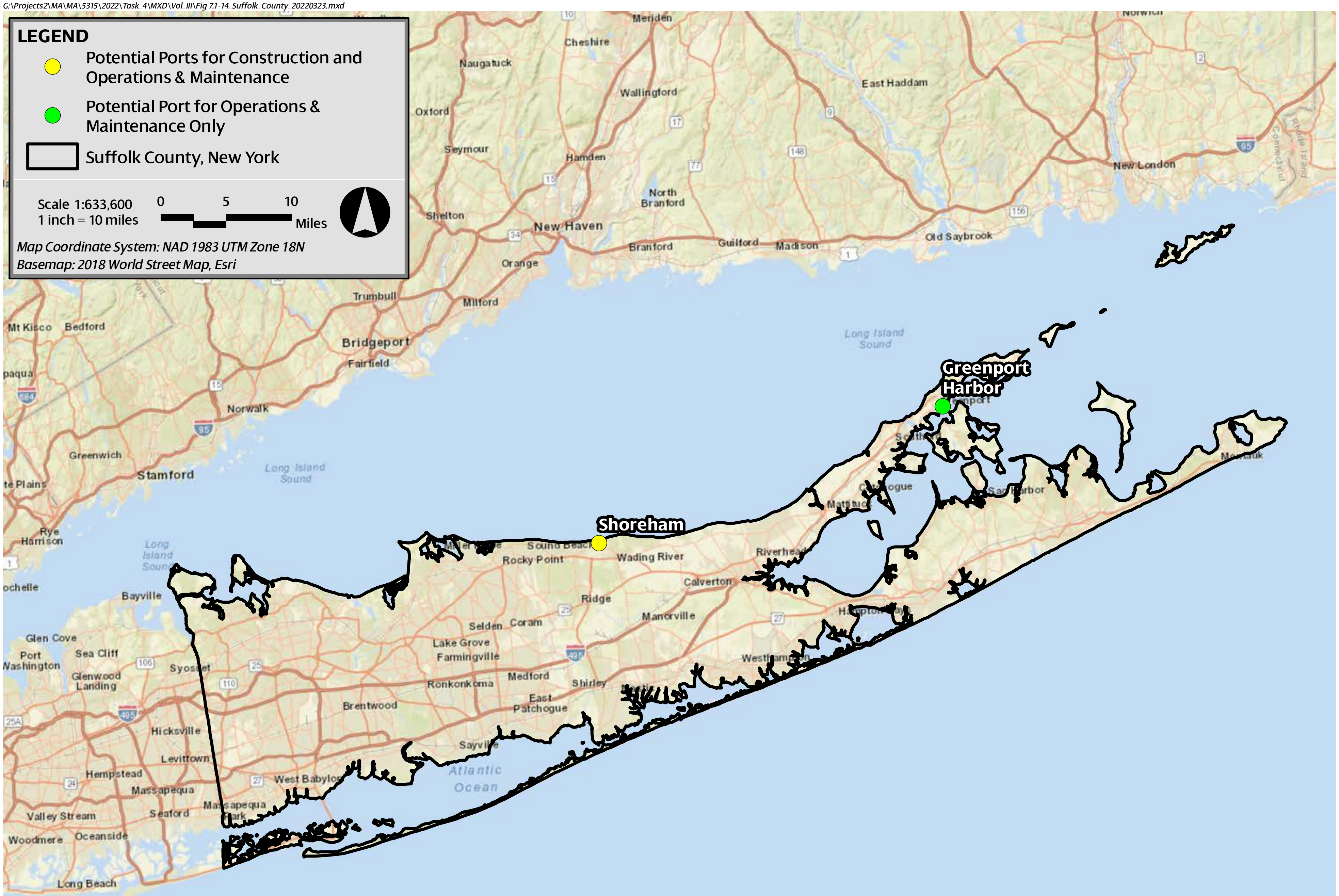

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New England Wind
AVANGRID RENEWABLES

Figure 7.1-14
Suffolk County, New York

Economy and Employment

According to BLS data, Suffolk County's average monthly labor force consisted of approximately 776,768 individuals with an unemployment rate of 3.5%, which is lower than the statewide average (BLS 2019).

A total 54,490 private sector employer establishments in Suffolk County employed 561,032 individuals in 2019 (BLS 2018). In 2018, the most recent year for which data are available, Suffolk County's workforce was comprised of 68.3% County residents and 31.7% non-residents with the largest concentration of jobs in the towns of Brookhaven, Islip, and Huntington.

According to 2019 CBP data (shown in Table 7.1-55), Suffolk County's largest employer by NAICS sector are: Health Care and Social Assistance, Retail Trade, Accommodation and Food Service, Manufacturing, and Construction. According to the New York State Department of Labor, the five largest employers in Suffolk County are: Stony Brook University, Stony Brook University Medical Center, Good Samaritan Hospital Medical Center, Southside Hospital, and John T. Mather Memorial Hospital (New York State Department of Labor 2020).

Table 7.1-55 Paid Employees by NAICS Sector in Suffolk County and State of New York (2019)[1]

Industry Sector	Suffolk County		New York	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Health Care and Social Assistance	110,973	18.7%	1,734,587	20.2%
Retail Trade	82,122	13.8%	914,248	10.6%
Accommodation and Food Service	54,732	9.2%	824,003	9.6%
Manufacturing	53,452	9.1%	415,886	4.8%
Construction	50,255	8.5%	388,131	4.5%

Notes:
1. US Census Bureau's (2019) CBP.

Suffolk County's Ocean Economy GDP grew from approximately $1.4 billion in 2009 to approximately $2.6 billion in 2018 and added 15,193 jobs. In 2018, the most recent year for which data are available, the Ocean Economy accounted for 2.6% of the County's total GDP, and employed approximately 43,138 individuals, including self-employed individuals. As indicated on Table 7.1-56, in 2016, the largest Ocean Economy sector by dollar value was Tourism and Recreation, which accounted for 73.4% of the total Ocean Economy. The Living Resources sector accounted for 2.1% of the County's total Ocean Economy.

Table 7.1-56 Ocean Economy Gross Domestic Product in Suffolk County and State of New York (2018)[1]

	Suffolk County		New York	
Total Ocean Economy	**GDP ($, million)**	**Percent of Total County Economy**	**GDP ($, million)**	**Percent of Total State Economy**
Total Ocean Economy	$2,600	2.6%	$33,600	2.0%
Ocean Economy Sector	**GDP ($, million)**	**Percent of County Ocean Economy**	**GDP ($, million)**	**Percent of State Ocean Economy**
Living Resources	$54.1	2.1%	$552.3	1.6%
Marine Construction	$73.7	2.8%	$464.0	1.4%
Ship and Boat Building	$6.9	0.3%	$143.1	0.4%
Marine Transportation	$557.5	21.3%	$3,300.0	9.9%
Offshore Mineral Extraction	$2.6	0.1%	$38.0	0.1%
Tourism and Recreation	$1,900	73.4%	$29,000	86.5%

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

Table 7.1-57 shows the 2018 average wage for Living Resource sector employees in Suffolk County and New York. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-57 Employment and Wages for Ocean Economy Living Resource Industries in Suffolk County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
New York	5,019	$43,600	1,470	$44,039	8,07,398	$73,476
Suffolk County	614	$37,300	693	$42,8560	556,559	$57,639

Notes:
1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

New England Wind may use the decommissioned Shoreham Nuclear Power Plant, which has been identified by the New York State Energy Research and Development Authority as a potential site for offshore wind port facilities. The site, located adjacent to Long Island Sound on Long Island, would require significant investment and upgrades because the facility is not currently a functioning waterfront terminal. The site would only be used by Phase 1 of New England Wind if such improvements were made by the owner/lessor. New England Wind may also use Greenport Harbor, located on the tip of Long Island, for O&M activities. Greenport Harbor is home to numerous commercial docks that could be rented to offshore wind developers and used for provisioning, crew changes, weather standby, repairs, equipment change, and possibly fuel and water delivery.

Housing

Housing data for Suffolk County are presented in Table 7.1-58.

Table 7.1-58 Suffolk County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Suffolk County	577,470	77,726	1.1	3.7	$397,400	$1,7428

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2018 counts 577,470 total housing units in Suffolk County, of which 77,726 are categorized as vacant. Of the County's 499,744 occupied housing units, 80.6% are owner-occupied.

7.1.1.5 New Jersey

Population and economic statistics for Gloucester County and the State of New Jersey are provided in Table 7.1-59.

Table 7.1-59 Existing Economic Conditions in the Onshore Development Region (New Jersey)

Location	Population (2019)[1]	Population Density (people per square mile)[2]	Per Capita Income (2019)[3]	Annual Total Employment (2019)[4]	Annual Unemployment Rate (2019)[5]
New Jersey	8,882,190	1,195.5	$42,745	4,367,251	3.4%
Gloucester County	291,636	895.3	$39,33737,888	145,571	3.5%

Notes:

1. US Census Bureau's (2019) PEP (updated annually).
2. US Census Bureau, land area is based on current information in the TIGER® data base, calculated for use with Census 2010; population from PEP V2019, accessed August 2021.
3. US Census Bureau's (2019) ACS 5-Year Estimates.
4. BLS's (2019) Local Area Unemployment Statistics (not seasonally adjusted, accessed August 2021).

7.1.1.5.1 Gloucester County

Demographics

Gloucester County, located on the southern half of New Jersey borders, lies along the Delaware River and across Pennsylvania State (see Figure 7.1-15). The county consists of 24 municipalities.

The US Census Bureau's (2019) PEP data count 291,636 people reside in Gloucester County. The largest municipalities, Washington Township and Deptford Township, have an estimated population of 47,753 and 30,349 respectively (US Census Bureau 2019). From 2010 to 2019, the population of Gloucester County increased by 1.0%.

Gloucester County's population density, per capita income, total employment, and unemployment rate are provided in Table 7.1-59. Based on ACS five-year estimates for 2018, Gloucester County's median household income is $87,283 which is more than the statewide median of $82,545 (US Census Bureau 2019). Gloucester County's population density, 895.5 people/mi^2, is lower than the statewide average.

Economy and Employment

According to BLS data, Gloucester County's average monthly labor force consisted of approximately 150,912 individuals with an unemployment rate of 3.5%, which is greater than the statewide average (BLS 2019).

A total 6,307 private sector employer establishments in Gloucester County employed 95,177 individuals in 2019 (BLS 2018). In 2018, the most recent year for which data are available, Gloucester County's workforce was comprised of 35.8% County residents and 64.2% non-residents.

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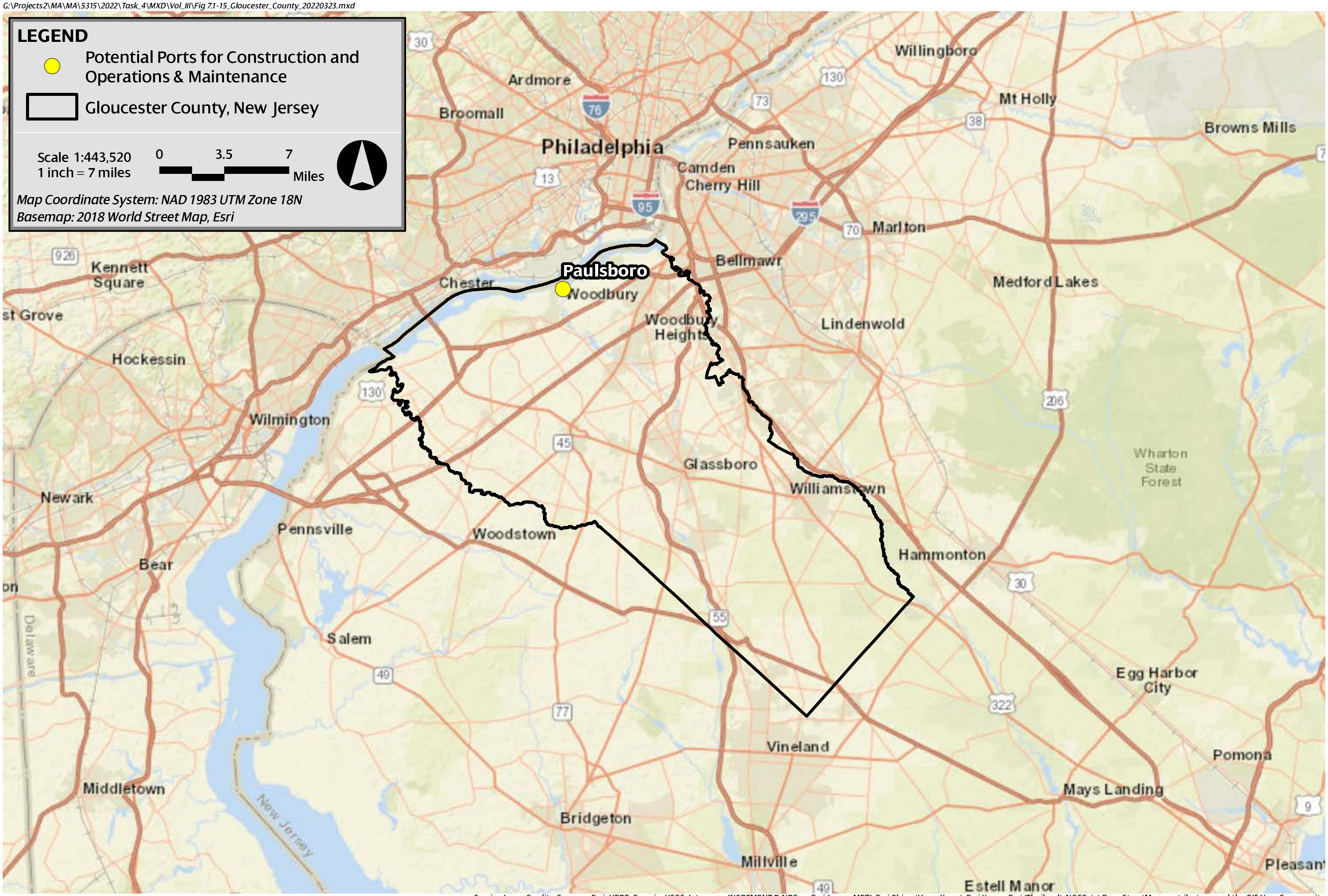

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

New England Wind
AVANGRID RENEWABLES

Figure 7.1-15
Gloucester County, New Jersey

According to CBP data (shown in Table 7.1-60), Gloucester County's largest employers by NAICS sector are: Retail Trade, Health Care and Social Assistance, Accommodation and Food Services, Manufacturing, and Wholesale Trade. According to the Gloucester County's webpage, the five largest employers in Gloucester County are: Amazon, Rowan University, Inspira Healthcare Network, Jefferson Health, and Shop Rite (Gloucester County New Jersey 2020). US Census Bureau data indicate that Gloucester County's highest concentrations of jobs are in the Washington, Deptford, and Logan townships.

Table 7.1-60 Paid Employees by NAICS Sector in Gloucester County and State of New Jersey (2019)[1]

Industry Sector	Gloucester County		New Jersey	
	Employees	Percent of Employees in County	Employees	Percent of Employees in State
Retail Trade	17,048	17.4%	451,038	11.9%
Healthcare and Social Assistance	15,491	15.8%	624,050	16.4%
Accommodation and Food Services	10,490	10.7%	337,567	8.9%
Manufacturing	9,694	9.9%	223,226	5.9%
Wholesale Trade	8,097	8.3%	278,002	7.3%

Notes:
1. US Census Bureau's (2017) CBP.

Gloucester County's Ocean Economy GDP grew from approximately $122.8 million in 2009 to approximately $275.1 million in 2018 and added 3,912 jobs. In 2018, the most recent year for which data are available, the Ocean Economy accounted for 2.2% of the County's total GDP, and employed approximately 5,579 individuals, including self-employed individuals. As indicated on Table 7.1-61, in 2018, the largest Ocean Economy sector by dollar value was Marine Transportation, which accounted for 51.5% of the total Ocean Economy. Data for the Gloucester County's Living Resources sector is "suppressed" to preserve the confidentiality of one or more businesses.

Table 7.1-61 Ocean Economy Gross Domestic Product in Gloucester County and State of New Jersey (2018)[1]

	Gloucester County		New Jersey	
Total Ocean Economy	GDP ($, million)	Percent of Total County Economy	GDP ($, million)	Percent of Total State Economy
Total Ocean Economy	$275.1	2.2%	$11,200	1.8%
Living Resources	*	*	$282.8	2.5%

Table 7.1-61 Ocean Economy Gross Domestic Product in Gloucester County and State of New Jersey (2018)[1] (Continued)

	Gloucester County		New Jersey	
Ocean Economy Sector	GDP ($, million)	Percent of County Ocean Economy	GDP ($, million)	Percent of State Ocean Economy
Marine Construction	$53.0	19.3%	$546.5	4.9%
Ship and Boat Building	*	*	*	*
Marine Transportation	$141.7	51.5%	$5,800	51.6%
Offshore Mineral Extraction	*	*	$106.9	1.0%
Tourism and Recreation	$52.3	19.0%	$4,300	38.5%

Notes:

1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

* Cannot be published without violating the confidentiality of one or more businesses.

Table 7.1-62 shows the 2018 average wage for Living Resource sector employees in Gloucester County and New Jersey. Many workers within this sector are self-employed and because income data for self-employed workers are not available, average gross receipts for self-employed workers are used to estimate the average wage of these workers.

Table 7.1-62 Employment and Wages for Ocean Economy Living Resource Industries in Gloucester County (2018)

	Ocean Economy Living Resources Sector[1]				All Private Industry Sectors[2]	
	Company Employees		Self-Employed Workers		All Workers	
	Number	Average Wage	Number	Average Gross Receipts	Total Employment	Average Wage
New Jersey	**2,444**	**$47,600**	**1,051**	**$91,951**	**3,472,611**	**$ 65,353**
Gloucester County	*****	*****	**15**	**$46,533**	**91,768**	**$ 44,701**

Notes:

1. NOAA Office for Coastal Management's (2020) ENOW.
2. BLS's (2018) Quarterly Census of Employment and Wages.

* Cannot be published without violating the confidentiality of one or more businesses.

New England Wind may use facilities in Paulsboro, New Jersey, located on the Delaware River. The site may become a monopile foundation factory. If adjacent port facilities were developed by the owner/lessor in time for New England Wind, the Proponent may use port facilities in the vicinity of the proposed factory.

Housing

Housing data for Gloucester County are presented in Table 7.1-63.

Table 7.1-63 Gloucester County Housing[1]

Location	Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value of Owner-Occupied Units	Median Gross Rent
Gloucester County	114,452	7,747	1.9	1.6	$219,700	$1,225

Notes:
1. US Census Bureau's (2019) ACS 5-Year Estimates.

US Census Bureau data for 2019 counts 114,452 total housing units in Gloucester County, of which 7,747 are categorized as vacant. Of the County's 106,705 occupied housing units, 80.1% are owner-occupied.

7.1.2 Potential Impacts of New England Wind

New England Wind will result in significant long-term economic benefits and high-quality jobs in each Phase and will therefore play an important role in further establishing the US offshore wind sector and realizing the tremendous potential economic benefits of this rapidly emerging industry in Connecticut, Massachusetts, and elsewhere in the Northeastern US.

Appendix III-L details the primary job creation and other economic benefits that New England Wind can be expected to produce through the pre-construction, construction and installation, and operations phases. New England Wind will be developed in two phases that will deliver over 2,000 MW of clean energy to New England.

Prior to the submission of the COP in July 2020, New England Wind entered into a Power Purchase Agreement (PPA) with electric distribution companies in Connecticut and, following COP submission, with electric distribution companies in Massachusetts; these PPAs totaled 2,036 MW. The Proponent has agreed with the electric distribution companies in Connecticut and Massachusetts to terminate the Phase 1 and Phase 2 PPAs to enable New England Wind to participate in future offshore wind solicitations by Northeast states including, but not limited to, recent multi-state solicitations issued by Massachusetts, Rhode Island, and Connecticut in Fall 2023. These actions are necessary to address global circumstances beyond New England Wind's control that have significantly increased costs.

The Proponent remains committed to the development and permitting of both phases of New England to enable the projects to assist the federal government and the states of Connecticut, Massachusetts, and Rhode Island to meet climate and renewable energy/offshore wind goals. Massachusetts, Connecticut, and Rhode Island have all issued solicitations in Fall 2023 for additional offshore wind capacity that collectively total 6.8 GW. These three states have also signed a memorandum of understanding to allow developers to submit multi-state bids, and for the states to collaborate on their procurement decisions. The Proponent intends to submit one or more proposals for this, and if necessary, future solicitation(s).

As described further in Appendix III-L, for the purposes of this assessment, the economic estimates presented below for Phase 1 and Phase 2 are based on the previous awards and are considered representative of potential benefits that will occur as a result of new Power Purchase Agreement(s). Projected economic impacts are described separately for each phase. Further, development of additional renewable energy capacity within New England Wind (i.e., beyond the 2,036 MW previously awarded) would result in economic and workforce benefits that would be additive to those described below.

To determine the anticipated economic benefits of Phase 1 of New England Wind, the Proponent relied on a comprehensive analysis conducted by the University of Connecticut's Connecticut Center for Economic Analysis (CCEA) in October 2019. At the Proponent's request, CCEA analyzed the economic impacts of Phase 1 (see the 804 MW analysis) using Regional Economic Model Inc.'s (REMI) dynamic economic model of Connecticut. To determine the anticipated economic benefits of Phase 2 of New England Wind, the Proponent relied on a comprehensive analysis conducted by Daymark Energy Advisors (Daymark) in September 2021. Daymark analyzed the economic impacts of Phase 2 (see the 1,232 MW analysis) using the IMPLAN model, an input/output model developed by the IMPLAN Group. The resulting reports are included as Appendix III-L.

Specific to Phase 1 of New England Wind, direct expenditures, investments, and funding commitments during Phase 1 will firmly establish the offshore wind industry in Connecticut, while at the same time integrating the state's businesses and workers into skilled and well-paying jobs, redeveloping local marine infrastructure to serve the burgeoning offshore wind market, and cementing Connecticut's leadership in the nation's offshore wind future. Beyond these direct benefits, Phase 1 (Park City Wind) also offers Connecticut an opportunity to establish Greater Bridgeport as an offshore wind development, manufacturing, construction, and operations hub and realize additional job and economic benefits.

As with Phase 1, the Proponent intends to interconnect the entire electrical capacity of Phase 2 into the electrical grid at the West Barnstable Substation unless technical, logistical, grid interconnection, or other unforeseen issues arise. As further described in Appendix III-L, Phase 2 will also result in significant long-term economic benefits and high-quality jobs in Massachusetts and the surrounding region.

The potential impact producing factors as they relate to specific elements of New England Wind are presented in Table 7.1-64. Economic impacts to commercial and recreational fishermen are described in in Sections 7.5 and 7.6.

Table 7.1-64 Impact Producing Factors for Employment and Economics

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Economic activity	•	•	•	•	•	•
Workforce initiatives	•	•	•	•	•	
Community benefits	•	•	•	•	•	•

7.1.2.1 Construction and Installation

As described in Sections 3 and 4 of COP Volume I, New England Wind components will be installed in the onshore and offshore environments. Onshore facilities for Phases 1 and 2 will include landfall sites, Onshore Export Cable Routes, Grid Interconnection Routes, and new onshore substations.

Construction and installation activities will also occur offshore along the OECC. Offshore export cable installation procedures, including vessel and equipment types, are described in Sections 3.3.1 and 4.3.1 of COP Volume I. Offshore components such as wind turbine generators, electrical service platforms, and inter-array and inter-link cables will be installed in the SWDA. The SWDA (excluding the two separate aliquots[95] that are closer to shore) is just over 32 kilometers (km) (20 miles [mi]) from the southwest corner of Martha's Vineyard and approximately 38 km (24 mi) from Nantucket.

As described in Section 7.0 and COP Volume I, several port facilities in the Onshore Development Region may be used for major Phase 1 or Phase 2 construction staging activities. For each Phase, the Proponent expects to use one or more of these ports for frequent crew transfer and to offload/load shipments of components, store components, prepare them for installation, and then load components onto jack-up vessels or other suitable vessels for delivery to the SWDA for installation. Some component fabrication and assembly may occur at these ports as well. The Proponent anticipates that the number of vessels, equipment, and personnel at these ports may fluctuate depending on the development Phase and availability of space and facilities at the respective ports.

Construction staging activities occurring at each of the ports being evaluated are compatible with existing or planned surrounding and active port uses. Each port facility being considered for either Phase 1 or Phase 2 is either already located within an industrial waterfront area with sufficient existing infrastructure or is identified as an area where other entities intend to develop infrastructure with the capacity to host construction activities under the Phase 1 or Phase 2

95 Although these aliquots are a part of the SWDA, at this time, the Proponent does not intend to develop the two "vacant" positions located in these separate aliquots as part of New England Wind (see Figure 2.2-1 of COP Volume I).

schedule. Some other activities such as refueling, restocking supplies, sourcing parts for repairs, vessel repairs, vessel mobilization/demobilization, some crew transfer, and other construction staging activities may occur out of ports other than those evaluated. These activities would occur at industrial ports suitable for such uses and would be well within the realm of normal port activities.

Construction and installation activities may affect the Onshore Development Region as described below.

7.1.2.1.1 Workforce Impacts (Phases 1 and 2)

Overview—Phases 1 and 2

During the construction and installation of Phases 1 and 2, the Proponent anticipates directly hiring a workforce spanning a diverse range of professions for fabrication, construction, and/or assembly of components. It is expected that New England Wind will support a number of direct, indirect, and induced jobs during pre-construction and construction, and installation. Construction and installation activities are also anticipated to diversify and generate jobs and revenues in the Development Region's "ocean economy" sectors, particularly for tug and other vessel charters, dockage, fueling, inspection/repairs, provisioning, and crew work in the port communities identified in Section 3.2.2.5 and 4.2.2.5 of COP Volume I.[96] These ports offer well-established industrial and commercial port facilities and affiliated workforces or are in areas already identified by other entities for port development.

The Proponent expects that most of the jobs that New England Wind creates will be located within the Onshore Development Region and Offshore Development Region, as this is where most of the construction activities will occur. A small number of other personnel may temporarily relocate to the Onshore Development Region, including vessel crew and those with specialized technical skills or project-specific management experience. The Proponent has already staffed regional offices and has engaged a number of environmental consultants, engineers, and attorneys throughout the Onshore Development Region to support elements of the design effort, licensing, and permitting. It is anticipated that the share of local supply chain jobs will vary over each Phase of New England Wind as regional investments in the supply chain materialize, particularly as the offshore wind energy sector develops along the United States (US) East Coast.

To the extent feasible, construction materials and other supplies, including vessel provisioning and servicing, and certain fabrication work will be sourced from within the Onshore Development Region and Offshore Development Region. Impacts associated with materials sourcing are

[96] It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.

anticipated to have a stimulating effect on the Onshore Development Region's economy. In sum, New England Wind is expected to provide steady, well-paying jobs that will have direct positive and stabilizing impacts on the workforce within the Onshore Development Region and Offshore Development Region.

Job Creation—Phase 1

Phase 1 (Park City Wind) will support an estimated minimum of 770 direct full-time equivalent (FTE) job years[97] in Connecticut during the pre-construction and construction period. Spending associated with this period is also estimated to generate and support a significant number of additional indirect and induced jobs.[98] Specifically, direct payroll and non-payroll expenditures are expected to result in 495 indirect and induced jobs in Connecticut. Of the jobs generated by Park City Wind, the Proponent estimates that approximately 80% will be located in Bridgeport. Statewide, the estimated direct, indirect, and induced impacts of Phase 1 will result in Direct Labor Income of $138 million and Direct Expenditures (other than payroll) of $200 million. These figures are summarized in Table 7.1-65.

Table 7.1-65 Phase 1 (Park City Wind) Projected Jobs and Expenditures During Pre-Construction and Construction

Category		Park City Wind 804 MW
Jobs (FTE)[1]	Direct	770
	Indirect and Induced	495
	Total	1,265
Direct Labor Income	Direct	$84,302,000
	Indirect and Induced	$54,194,000
	Total	$138,496,000
Direct Expenditures Other than Payroll[2]	Direct	$121,919,000
	Indirect and Induced	$78,377,000
	Total	$200,296,000

Notes:
1. One FTE job is the equivalent of one person working full time for 1 year (2,080 hours). Thus, two half-time employees would equal one FTE. The estimate only includes jobs that would occur in Connecticut.
2. Amount to be spent procuring materials and services from the suppliers in Connecticut to support the development and construction of the wind facility.

Job Creation—Phase 2

Phase 2, which includes Commonwealth Wind, will deliver power to one or more Northeastern states and/or to other offtake users.

97 Direct jobs refers to FTE job-years created directly by a project or commercial enterprise.

98 Indirect jobs are those created as a result of spending on goods and services associated with a project or commercial enterprise. Induced jobs are those created by the spending of a project's or commercial enterprise's employees within a region.

Based on the results of the analysis in Appendix III-L, a 1,232 MW buildout of Phase 2 is estimated to directly support a minimum of 2,596 direct FTE job years during the pre-construction and construction period. Phase 2, during this period, is estimated to generate and support a significant number of additional indirect and induced jobs. Specifically, direct payroll and non-payroll expenditures are expected to result in at least 4,425 indirect and induced jobs. Phase 2 is also estimated to generate total Direct Labor Income of approximately $688 million and total Direct Expenditures (other than payroll) of $988.8 million. These figures are summarized in Table 7.1-66.

Table 7.1-66 Phase 2 (Commonwealth Wind) 1,232 MW Buildout Projected Jobs and Expenditures During Pre-Construction and Construction

Category		Commonwealth Wind 1,232 MW[3]
Jobs (FTE)[1]	Direct	2,596
	Indirect and Induced	4,425
	Total	7,021
Direct Labor Income	Direct	$421,000,000
	Indirect and Induced	$267,000,000
	Total	$688,000,000
Direct Expenditures Other than Payroll[2]	Direct	$538,400,000
	Indirect and Induced	$450,400,000
	Total	$988,800,000

Notes:

1. One FTE job is the equivalent of one person working full time for 1 year (2,080 hours). Thus, two half-time employees would equal one FTE.
2. Amount to be spent procuring materials and services from the suppliers to support the development and construction of the wind facility.
3. These values are derived from Table 23 in the Daymark Economic Impact Analysis included as Appendix III-L. Note that the timeframe covered in Table 23 includes both pre-construction and construction.

7.1.2.1.2 Economic Impacts (Phases 1 and 2)

Most New England Wind activities are anticipated to have location-specific effects, largely dependent on the magnitude of changes relative to existing local conditions. In addition, New England Wind will create opportunities for new market growth in sectors servicing the offshore wind industry along the US East Coast. The Proponent also expects that it will expend significant funds procuring materials and services from suppliers in the Onshore Development Region to support the development and construction of New England Wind. Estimates of capital expenditures are presented in Appendix III-L.

In addition to supporting local and regional suppliers, the Proponent will deliver substantial community and environmental benefits through the development of New England Wind. These community and environmental benefits are detailed in Appendix III-O.

During Phase 1 (Park City Wind), the Proponent has committed $26.5 million (nominal) to support the economic and community initiatives such as supply chain integration, workforce development, offshore wind-related marine and fisheries research and support the local communities in Connecticut. These initiatives, which are further described below, will build a skilled offshore wind workforce centered in Bridgeport, facilitate local supply chain development, support research that furthers understanding of potential environmental impacts of offshore wind, and fund community betterment, environmental improvement, and fishing community programs. These initiatives may be managed by the Proponent or an independent third party to, at a minimum, track expenditures and provide necessary reports.

Phase 2 (Commonwealth Wind) includes an investment of up to $35 million in local partnerships and programs. These programs include a robust Diversity, Equity, and Inclusion (DEI) Plan aimed at building a diverse, equitable, and inclusive offshore wind sector as well as a range of community benefits, environmental benefits, and innovation initiatives.

Supply Chain Network Initiative (Phase 1): $9 Million

The Proponent is committing to invest up to $9 million in projects and initiatives to accelerate the development of the offshore wind supply chain and businesses. This initiative aims to develop and establish a Connecticut supply chain database and facilitate further development of the local offshore wind supply chain in Connecticut. In doing so, the Supply Chain Network Initiative supports the state's goals to expand the offshore wind economy, encourage local businesses to join the offshore wind supply chain, and create jobs in distressed communities. Further details are provided below.

Connecticut Supply Chain Database

The Proponent is proposing to work with the Connecticut Center for Advanced Technology (CCAT) to establish and administer an offshore wind supply chain development and integration program for Tier 2 and Tier 3 suppliers based in Connecticut, in particular those based in Bridgeport, to integrate local businesses directly with Park City Wind's Tier 1 suppliers, and to fully integrate local businesses into the supply chain for current and future projects by the Proponent and others. Key program elements include:

- A supply chain network program administered by dedicated CCAT staff to support local businesses seeking to become part of the offshore wind industry in connection with Park City Wind, suppliers, and their subcontractors;
- A supply chain directory leveraging CCAT's previous experience in the aerospace industry to catalog Connecticut companies and their capabilities, which can be used by local businesses, project developers, and suppliers to find other local suppliers and contractors;

- A comprehensive study of where and how Tier 2 through Tier 4 businesses could integrate into offshore wind; and

- Meet-the-Buyer events hosted by the Park City Wind project team with the project's major contractors to introduce and connect with local businesses who can supply goods or services as subcontractors.

Connecticut Supply Chain Support and Integration

Utilizing the database developed by CCAT in outlining supply chain opportunities, the Proponent commits to help Connecticut businesses undertake the necessary business development and capital improvements to serve the offshore wind industry. The Proponent envisions that funds could be used to support the following:

- Business development grants to reduce the entry costs to the offshore wind industry for Connecticut businesses, including small businesses with socially and economically disadvantaged owners, and to attract businesses to Connecticut seeking to enter the offshore wind industry. Grants might be used to offset capital expenditures such as new equipment purchases, facility upgrades, or new facility construction in or near Connecticut's major ports.

- Collaboration with Connecticut's existing commercial fishing fleet to identify economic opportunities for fishermen in offshore wind and help interested parties upskill crews and enhance vessels to enable participation on offshore wind pre-construction work in addition to construction and operations.

- Further investigation of existing port facilities in Bridgeport and the surrounding communities to better understand opportunities for port redevelopment to serve the offshore wind industry.

Connecticut Windward Workforce Initiative (Phase 1): $5 Million

The Proponent has committed up to $5 million to educate, recruit, mentor, and train residents of Connecticut, particularly Bridgeport, for careers in the offshore wind industry. These programs will ensure that Connecticut is able to provide the workforce needed for Park City Wind as well as all future offshore wind projects in the US. The experience gained from working on Park City Wind will be invaluable in launching careers in offshore wind for Connecticut residents. The ultimate objective of the Windward Workforce Initiative is to ensure Connecticut has one of the best trained, most experienced offshore wind workforces in the country.

The Connecticut Windward Workforce Initiative will be undertaken in partnership with vocational schools, community colleges, local businesses, unions, and others, and is expected to fund the following:

- ♦ Offshore wind safety and technical training courses and tuition assistance to provide the certifications required for any number of high-skills offshore wind jobs or support services.

- ♦ Higher education offshore wind courses at one more Connecticut State College & Universities as well as other Connecticut (community) colleges, and universities.

- ♦ Programs to support work placement, apprenticeships, and internships for Connecticut students and residents with Park City Wind and its suppliers.

- ♦ K-12 education and career readiness program development at vocational technical secondary schools around offshore wind career paths and opportunities in the trades alongside outreach to traditional high schools and 4^{th}-12^{th} grade students to introduce offshore wind and future career opportunities.

- ♦ Labor and pre-apprenticeship programs developed in partnership with Connecticut building trades councils and other partners.

Offshore Wind Protected Marine Species Mitigation Fund (Phase 1): $2.5 Million

The Proponent has committed to provide up to $2.5 million to the Mystic Aquarium in Connecticut to continue evolving the understanding of underwater noise generated by offshore wind projects and potential impacts on cetacean and pinniped behavior, hearing, and physiology. In addition, this fund will further the investigation of best practices and advance technologies to reduce potential sound impacts and collision threats from offshore wind project development.

Connecticut's Initiative on Environmental Research of Offshore Wind (Phase 1): $2.5 Million

The Proponent has committed to provide up to $2.5 million to support fisheries research and education as part of a new initiative launched by the University of Connecticut to improve the understanding of potential environmental impacts from offshore wind. In partnership with the Connecticut Sea Grant, the University of Connecticut's Department of Marine Sciences will also use funding to support public education efforts focused on ocean literacy, wind energy, and the environmental research that is being undertaken by Connecticut's Initiative on Environmental Research of Offshore Wind.

Environmental, Fisheries, and Local Community Enhancement (Phase 1): $7.5 million

The Proponent will allocate up to $7.5 million in funds to support environmental initiatives, assist Connecticut fishermen, and further bolster local communities where offshore wind development is taking place. The Proponent anticipates working with federal and state agencies as well as environmental, fisheries, and local community stakeholders to identify key priorities and programs these funds could support.

Investments in Diversity, Equity, and Inclusion (DEI) (Phase 2): $15 million

The DEI Plan for Commonwealth Wind includes $15 million to fund DEI, workforce, and supply chain initiatives that will support local content, increase diversity in the industry, and provide Environmental Justice (EJ) Population residents and other underrepresented populations real opportunities to join the offshore workforce and supply chain. To execute the DEI Plan, the Proponent has partnered with a diverse group of nonprofit partners located throughout Massachusetts. As part of the DEI Plan, the Proponent will also leverage its "buying power" through Commonwealth Wind's procurement process to ensure DEI is advanced by its industry partners and becomes a core value of the offshore wind sector as it is established in the U.S.

Community Benefits, Environmental Benefits, and Innovation Initiatives (Phase 2): $20 million

Commonwealth Wind includes an investment of $20 million in education, innovation, and environmental initiatives to benefit local communities. The Proponent has developed meaningful partnerships, including several with local nonprofits, to provide wide-ranging economic and job opportunities as well as new opportunities for EJ Population residents to directly benefit from offshore wind.

Transforming Coal-Fired Power Plants into Clean Energy Centers (Phase 2)

Commonwealth Wind includes two transformative initiatives that convert former coal-fired power plant sites into clean energy centers. The Proponent has partnered with Prysmian Group, a leading international subsea cable manufacturer which intends to build a state-of-the-art manufacturing facility for subsea transmission cables at Brayton Point, the former coal-fired power plant in Somerset, Massachusetts. Commonwealth Wind also enables Crowley Marine, in partnership with the City of Salem, to redevelop 42 acres surrounding Salem Harbor Station to serve as an offshore wind assembly and turbine staging port for the project. These ports will provide an anchor for building long-term jobs to service this new industry.

7.1.2.1.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The construction period is anticipated to increase employment and income within the Onshore Development Region, including growth in sectors servicing the offshore wind industry. Accordingly, impacts associated with construction and installation will largely be beneficial to the Onshore Development Region. Temporary impacts from construction and installation will be mitigated through best management practices, where practicable. Monitoring, outreach, and communication plans are expected to be implemented, as necessary, to assess and address impacts resulting from construction of New England Wind. Such plans are anticipated to include the implementation of the Fisheries Communication Plan (included as Attachment III-E), the use of a Marine Coordinator, distribution of Offshore Wind Mariner Update Bulletins, and other navigational safety measures as further described in Section 7.8. Additional coordination with federal, state, local authorities, and other stakeholders will be pursued in advance of the construction and installation process.

The Proponent is committed to working cooperatively with Connecticut educational institutions, including the University of Bridgeport and the Connecticut State Colleges and Universities. The Proponent will also continue to work cooperatively with southeastern Massachusetts educational institutions, such as the Massachusetts Maritime Academy, University of Massachusetts Dartmouth, Bristol Community College, Cape Cod Community College and others to maintain and further evolve training and educational opportunities for their students and faculty throughout each Phase of New England Wind.

7.1.2.2 Operations and Maintenance

As described further in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I, the Proponent expects to use one or more facilities in support of O&M activities for Phases 1 and 2. The O&M facilities may include management and administrative team offices, a control room, office and training space for technicians and engineers, and/or warehouse space for parts and tools. The O&M facilities are also expected to include pier space for crew transfer vessels and/or other larger support vessels, such as service operation vessels. O&M facilities will function for the operational life of each Phase, which is anticipated to extend up to 30 years after construction and installation.

For Phases 1 and 2, O&M activities may occur at any of the ports identified for potential use in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I. For Phase 1, the Proponent will likely establish a long-term SOV O&M base in Bridgeport, Connecticut. The SOV O&M base would be the primary homeport for the SOV and would likely be used for some crew exchange, bunkering,[99] spare part storage, and load-out of spares to the SOV and/or other vessels. Related support infrastructure, warehousing, and a control room may also be located near the SOV O&M base. In addition to the SOV O&M base, the Proponent has worked with its local partner, Vineyard Power, and the communities of Martha's Vineyard with the intention to base certain O&M activities on Martha's Vineyard. Current plans anticipate that crew transfer vessels (CTVs) and/or SOV's daughter craft may operate out of Vineyard Haven and/or New Bedford Harbor during O&M. Although the Proponent plans to operate Phase 1 O&M facilities in Bridgeport, New Bedford Harbor, and/or Vineyard Haven, the Proponent may use other ports described above to support O&M activities. In support of O&M activities for Phase 2, the Proponent will likely use O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor. Similar to Phase 1, the Proponent may also use other ports to support O&M activities for Phase 2, such as refueling, restocking supplies, sourcing parts for repairs, vessel repairs, vessel mobilization/demobilization, and potentially some crew transfer.

[99] Some refueling could also occur offshore.

Once operational, the O&M facilities will operate with a staff of technicians and engineers responsible for long-term O&M of each Phase of New England Wind. Additional workforce may be required for planned periodic maintenance of the onshore facilities, including the onshore export and grid interconnection cables, and periodic maintenance and repairs to offshore facilities.

7.1.2.2.1 Workforce Impacts (Phases 1 and 2)

Overview – Phases 1 and 2

The O&M phase will create a number of job opportunities within and beyond the marine trades and affiliated industries and will have a positive impact on those sectors throughout the anticipated life of New England Wind. The operations phase will create a number of well-paying, long-term jobs and generate tens of millions of dollars per year in economic development opportunities. Job opportunities will be created that increase employment stability, particularly within those sectors now heavily influenced by seasonal hiring. Additional service providers will be necessary during planned inspection, maintenance, and repair of the in-water facilities. Maintenance, repairs, and upgrades to the onshore facilities will also be required during New England Wind's O&M period.

Job Creation—Phase 1

As shown in Table 7.1-67, the O&M facility that will likely be established in Bridgeport for Park City Wind will create a number of well-paying, long-term jobs and generate tens of millions of dollars per year in local economic development in Connecticut over the life of the project. Park City Wind is estimated to result in 70 direct FTEs annually for a total of 2,100 FTE job years assuming a 30-year operational life for the project. The Proponent estimates approximately 80% of these jobs will be located in Bridgeport. Direct and indirect impacts are expected to support an additional 90 indirect and induced jobs annually (2,700 FTE job years) during operations. Statewide, the estimated direct, indirect, and induced impacts of Park City Wind will result in Annual Labor Income of $16.4 million and Annual Expenditures of $17 million during operations.

Table 7.1-67 Phase 1 (Park City Wind) Jobs and Economic Impact During O&M

Category		Park City Wind 804 MW
Annual Jobs (FTE)[1]	Direct	70
	Indirect and Induced	90
	Total	160
Annual Labor Income	Direct	$7,208,000
	Indirect and Induced	$9,267,000
	Total	$16,475,000
Annual Expenditures[2]	Direct	$7,459,000
	Indirect and Induced	$9,590,000
	Total	$17,049,000

Notes:

1. One FTE job is the equivalent of one person working full time for 1 year (2,080 hours). Thus, two half-time employees would equal one FTE.
2. Amount to be spent procuring materials and services from suppliers in Connecticut to support the operations and maintenance of the offshore wind facility, excluding labor costs.

Job Creation—Phase 2

As shown in Table 7.1-68, O&M of the offshore wind energy facilities in Phase 2 are projected to generate at least 61 direct FTEs annually for a total of 1,830 FTE job years assuming a 30-year operational life. Direct and indirect impacts are expected to support at least 149 indirect and induced jobs annually (4,470 FTE job years) during operations. Offshore wind development in Phase 2 is also estimated to generate Annual Labor Income of approximately $19 million and Annual Expenditures of approximately $23 million in this period.

Table 7.1-68 Phase 2 (Commonwealth Wind) 1,232 MW Buildout Jobs and Economic Impact During O&M

Category		Commonwealth Wind 1,232 MW
Annual Jobs (FTE)[1]	Direct	61
	Indirect and Induced	149
	Total	209
Annual Labor Income	Direct	$11,807,000
	Indirect and Induced	$6,773,000
	Total	$18,580,000
Annual Expenditures[2]	Direct	$10,707,000
	Indirect and Induced	$12,104,000
	Total	$22,811,000

Notes:

1. One FTE job is the equivalent of one person working full time for 1 year (2,080 hours). Thus, two half-time employees would equal one FTE.
2. Amount to be spent procuring materials and services from suppliers to support the operations and maintenance of the offshore wind facility, excluding labor costs.
3. These values are derived from Table 23 in the Daymark Economic Impact Analysis included as Appendix III-L. The values in the Daymark Economic Impact Analysis were provided for the 30-year operational period and thus were divided by 30 to derive average annual outputs, so it is likely that values will vary from year to year.

7.1.2.2.2 Economic Impacts (Phases 1 and 2)

Overview—Phases 1 and 2

Overall, economic impacts from New England Wind are expected to yield benefits in the Onshore Development Region and Offshore Development Region for the duration of the O&M period. The Proponent anticipates opportunities for area marine trades industries including: tug and other vessel charters, dockage, fueling, inspection/repairs, provisioning, and other port and harbor services.

A number of ancillary services will also be required during O&M. These functions include day-to-day workflow management, facilities monitoring, data analysis, and performance optimization services. Logistics management, including maintenance vessel and crew operations, materials storage and handling, tooling, and engineering and fabrication services will be required during O&M. Additionally, the Proponent anticipates sourcing many goods and services throughout the multi-decade O&M period from local and regional providers.

In other locations where offshore wind has already been developed, vessel and sightseeing operators provide excursions to the in-water facilities. The Proponent anticipates that similar operations may occur in the SWDA, with economic benefits from increased tourism and vessel staffing.

Finally, the new economic activity generated by offshore wind development in the SWDA can reasonably be expected to result in a substantial positive impact on state and local tax receipts. Impacts include increased personal income tax, payroll tax, sales tax, property tax, corporate tax and other fee and tax revenues paid by the Proponent, its employees, and contractors (direct impacts) and taxes generated through the economic activities created in other areas of the economy through indirect and induced impacts.

Economic Impacts—Phase 1

The new economic activity generated by Phase 1 will have a substantial positive impact on state and local tax receipts in Connecticut. Impacts include increased personal income tax, payroll tax, sales tax, property tax, corporate tax, and other fee and tax revenues. The CCEA analysis estimates that state and local tax payments for Phase 1 can be expected to reach $238 million in Connecticut during the operations phase. As noted by CCEA, Phase 1's overall tax impacts would "strengthen Connecticut's fiscal capacity, and total fiscal benefits increase with the size of the [p]roject."

CCEA's tax revenue impact estimate for Park City Wind is highly conservative since it does not include positive tax revenue impacts that would be realized in Connecticut during the pre-construction and construction period. The estimate also does not account for potential tax revenue impacts in other states, which was beyond the scope of the analysis. This is relevant for

Phase 1 since Park City Wind's onshore facilities will be constructed and maintained in Massachusetts. As with Connecticut, tax revenue generated by Park City Wind in Massachusetts would include those paid by the Proponent, its employees, and contractors (direct impacts) and taxes generated through the economic activities created in other areas of the economy through indirect and induced impacts.

Economic Impacts—Phase 2

The new economic activity generated by Phase 2 can reasonably be expected to result in a substantial positive impact on state and local tax receipts. Impacts include increased personal income tax, payroll tax, sales tax, property tax, corporate tax, and other fee and tax revenues paid by the Proponent, its employees, and contractors (direct impacts) and taxes generated through the economic activities created in other areas of the economy through indirect and induced impacts.

The Daymark Economic Impact Analysis estimated state, county, and municipal taxes during construction and operations and maintenance.[100] Commonwealth Wind is expected to generate $98.8 million in tax benefits to governments within Massachusetts over the capital expenditure and 30-year operation period for the 1,232 MW Project size. This includes approximately $36.8 million in direct tax benefits, $23.3 million in indirect tax benefits, and $38.9 million in induced tax benefits. Partner projects may result in additional tax benefits.

7.1.2.2.3 Other Impacts (Phases 1 and 2)

A joint research study of the University of Connecticut and Lawrence Berkeley National Laboratory found no net effects from wind turbine generators on property values in Massachusetts (Atkinson-Palombo and Hoen 2014). Specifically, the study found no evidence of a "'scenic vista stigma,' the possible concern that homes might be devalued because of the view of a wind facility" (Atkinson-Palombo and Hoen 2014). This research, combined with the limited visibility of New England Wind from any residence (see Appendix III-H.a), indicates that operation of New England Wind would have negligible impacts on property values.

7.1.2.2.4 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Proponent is committed to working with the Bureau of Ocean Energy Management, the State of Connecticut, the Commonwealth of Massachusetts, local and regional officials, and other stakeholders to realize the tremendous potential economic benefits of the rapidly emerging offshore wind industry in Connecticut, Massachusetts, and elsewhere the Northeastern US. Any impacts associated with the O&M period will largely be beneficial to the Onshore Development

[100] See Table 13 of the Daymark Economic Impact Analysis included in Appendix L of COP Volume III.

Region and Offshore Development Region. Temporary impacts will be mitigated through best management practices, where practicable. Monitoring, outreach, and communication plans are expected to be implemented, as necessary, to assess and address impacts resulting from O&M of New England Wind. Additional coordination with federal, state, and local authorities and other stakeholders will be undertaken in advance of O&M.

7.1.2.3 Decommissioning

As currently envisioned, decommissioning New England Wind is largely the reverse of the construction and installation process as described in COP Volume I. Impacts associated with decommissioning are similar to those described in Section 7.1.2.1.

7.1.2.3.1 Workforce Impacts (Phases 1 and 2)

The Proponent anticipates that the workforce necessary for decommissioning will be approximately the same composition and size of the workforce needed for construction and installation. Personnel may temporarily relocate to the Onshore Development Region, including vessel crews and those with specialized technical skills or project-specific management experience. Because regional growth of the offshore wind sector is anticipated by that time, a larger local share of decommissioning labor may be available. Impacts associated with decommissioning activities are anticipated to have a minor stimulating effect on the Onshore Development Region's economy.

7.1.2.3.2 Economic Impacts (Phases 1 and 2)

Economic impacts of the decommissioning period are anticipated to be consistent with the construction and installation impacts described in Section 7.1.2.1.

7.1.2.3.3 Avoidance, Minimization and Mitigation Measures (Phases 1 and 2)

Any impacts associated with the decommissioning period will largely be beneficial to the Onshore Development Region and Offshore Development Region. Temporary impacts will be mitigated through best management practices, where practicable. Monitoring, outreach, and communication plans are expected to be implemented, as necessary, to assess and address impacts resulting from the decommissioning process. Additional coordination with federal, state, and local authorities and other stakeholders will be undertaken in advance of the decommissioning process.

7.2 Environmental Justice Assessment

This section assesses whether New England Wind activities would cause disproportionally high and adverse health or environmental effects on certain populations groups that have historically borne a disproportionate share of risk and harm from industrial development.

Executive Order No. 12898, issued in 1994, requires federal agencies to take steps to identify and address disproportionately high and adverse health or environmental effects of federal actions (including proposed projects requiring federal permits) on certain population groups of potential concern, including primarily minority and low-income population groups. These demographic groups are reported to have historically borne a disproportionate share of environmental harms and risk from industrial development (EPA 2016a).

The intent of Executive Order No. 12898 has come to be known as environmental justice (EJ). EJ is defined by the Environmental Protection Agency (EPA) as:

> *The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or policies.*

An EJ assessment generally follows this process:

1. Study area(s) are identified in which a proposed project's activities may result in high and adverse health or environmental effects;

2. Demographic information is compiled to determine whether potentially affected minority and/or low-income population groups (or other susceptible populations) residing in the study area(s) exceed certain thresholds when compared to the populations in the greater geographic or jurisdictional area within which the study area(s) is located. If not, these population groups in the study area(s) are not disproportionally larger than the surrounding population, and no potential EJ concerns for this population group are raised; and

3. If potentially affected minority and/or low-income population groups in the study area(s) are disproportionately larger than the comparison population groups, the EJ assessment advances to consider whether high and adverse human health or environmental effects will be experienced by those minority and/or low-income groups. If so, potential EJ concerns are raised and should be addressed through avoiding, minimizing, or mitigating those impacts.

In the 25+ years since the Executive Order, a number of state and federal guidance processes and varying terminologies have evolved to identify potential EJ concerns. This assessment was conducted in general accordance with:

- The EJ process utilized by BOEM in Section 3.4.2 of its Draft Environmental Impact Statement for the Vineyard Wind Offshore Wind Energy Project (known as Vineyard Wind 1) in Lease OCS-A 0501 (BOEM 2018);

- Methodologies in the EPA's EJSCREEN: Environmental Justice Screening Tool, EJSCREEN Technical Documentation (EPA 2019a; EPA 2019b);

- EPA's Technical Guidance for Assessing Environmental Justice in Regulatory Analysis (EPA 2016b); and

- The Commonwealth of Massachusetts' Environmental Justice Policy (EJ Policy) (Executive Office of Energy and Environmental Affairs [EOEEA] 2021).

This section includes:

- Identification of the onshore study areas for potential EJ concerns that may be affected by New England Wind activities, primarily in Massachusetts. Onshore and offshore facilities for Phases 1 and 2 of New England Wind will be located in Massachusetts (or federal waters). The Proponent is considering utilizing suitable United States (US) ports in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey.

- Study areas around the possible port facilities in the US are also assessed herein by state for potential EJ concerns related to New England Wind;

- EJ assessments within these study areas was conducted using federal EJSCREEN criteria for all states other than Massachusetts. Massachusetts has promulgated a more rigorous state-wide EJ assessment process, and therefore meets and/or exceeds the federal EJSCREEN criteria. This dual EJ assessment process was utilized by BOEM in its 2018 Draft Environmental Impact Statement of Vineyard Wind 1 in Lease Area OCS-A 0501;

- Consideration of environmental effects unique to certain population groups that may raise EJ concerns;

- The Proponent's significant planned outreach efforts to potentially affected populations, to provide opportunities for meaningful involvement in decision-making about New England Wind; and

- The Proponent's commitments to avoid, minimize or mitigate impacts to EJ populations of concern, where identified.

The locations of the New England Wind onshore facilities, offshore facilities, possible port facilities, and possible O&M facilities are shown on Figures 7.2-1 through 7.2-21.

New England Wind's clean energy will help displace electricity generated by fossil fuel power plants that have operated near neighborhoods for over a century, affecting air, water, soil, and human health, prompting attention to EJ. The Proponent's outreach to and interaction with neighborhoods and local industries, described in Section 7.2.3, will meet or exceed the intent of EJ policies to involve the public in decision-making about development.

New England Wind is not anticipated to cause any adverse impacts on human health to any population groups. As described herein, temporary impacts typical of large construction projects will occur, such as traffic, emissions from support vehicles and vessels, and noise. Only negligible impacts are anticipated from the O&M facilities, which will provide employment opportunities within the Onshore Development Region. Avoidance, minimization, and mitigation measures are presented in Section 7.2.2.

7.2.1 Description of the Affected Environment

The affected environment for the EJ assessments is within the Onshore Development Region. With respect to EJ, the Onshore Development Region is the broader onshore geographic region comprising of the cities, towns, and communities surrounding New England Wind's onshore facilities, O&M facilities, port facilities, and construction staging areas that could be affected by New England Wind-related activities (see Table 7.0-1). The broader Offshore Development Region encompasses the Onshore Development Areas. For each Phase, the Onshore Development Area consists of the areas where the onshore facilities could be physically located, which includes the landfall sites, the Onshore Export Cable Routes, the onshore substation sites, the Grid Interconnection Routes, and the grid interconnection point.

New England Wind's facilities and activities are described in detail in Volume I of the COP. Potential impacts from New England Wind activities relevant to EJ are primarily construction-related, and will include traffic, emissions from support vehicles and vessels, and noise produced by heavy construction equipment at a site. These construction impacts will be short-term and temporary. Because construction impacts are typically proximal to the construction site itself, for purposes of this assessment, study areas for potential New England Wind impacts to EJ populations, if identified, are delineated as a 1.6 kilometer (km) (1 mile) radius around the sites where construction will occur. The 1.6 km (1 mile) radial study areas are shown as yellow dashed lines on Figures 7.2-1 through 7.2-22.

Because New England Wind will produce clean energy far offshore, few operational impacts that could adversely affect the health of any human population are expected. O&M activities will include remote monitoring of New England Wind components, preventive maintenance and proactive inspections of New England Wind facilities, workforce training, component repairs, warehousing of replacement parts, and crew and equipment transfers. Because impacts from these activities are expected to be minimal, the study areas for potential O&M impacts to EJ populations, if identified, are also delineated as 1.6 km (1 mile) around each facility. Decommissioning activities are expected to be the reverse of construction activities, and therefore the study areas are also 1.6 km (1 mile) around each location where New England Wind decommissioning occurs. Other types of effects on EJ populations that may extend outside a 1.6 km (1 mile) radius are considered in Section 7.2.1.4.

In Massachusetts, including possible Massachusetts port facilities, EJ communities were mapped and assessments conducted under Massachusetts's EJ process. Within study areas around possible US ports outside of Massachusetts, EJ communities were mapped and assessments conducted under the federal EJSCREEN process. If no mapped EJ communities were found in a study area, no assessment of impacts was conducted for that facility or port facility.

Datasets and key terminology used in these EJ assessments are described below.

7.2.1.1 US Census Bureau Datasets and EJ Terminology

EJ assessments rely on various statistics in US Census Bureau datasets. These datasets can be the last full-count Census (currently dated 2020, re-done every decade, and utilized in MassGIS for the Massachusetts' EJ Policy), the rolling five year American Community Survey (ACS) estimates from smaller annual survey samplings (utilized by EJSCREEN), or one-year smaller survey estimates.

ACS data utilized in EJSCREEN are collected throughout each year in stratified random samples of more than 200,000 households each month. Some of this information is aggregated and provided in yearly summaries, others in three-year summaries, and others in five-year summaries. Only the five-year summaries provide information down to the small block group resolution. The result is an evolving picture of demographics, utilizing demographic data collected in different census years (EPA 2017) from smaller surveys which are then used to generate estimates. This assessment utilized data from ACS version (v) 2019, which includes ACS five year summary file data from years 2013 through 2017, based upon 2017 Census boundaries (EPA 2020b).

Block Groups: Both EJSCREEN and MassGIS provide demographic data down to the Census block group level. Block groups are statistical divisions of larger Census tracts and generally contain between 600 and 3,000 people (US Census Bureau 2020). Block group level data is helpful to identify potential EJ concerns within a small area such as the 1.6 km (1 mile) study area around New England Wind activities.

Key Demographics: Although some EJ guidance has broadened to incorporate more types of demographic indicators for susceptible populations, this assessment focuses primarily on the two demographics reported in Census data that are specifically named in the authorizing Executive Order 12898: low-income and minority. Low-income and minority population groups identified by Census Bureau information are each generally reported in an EJ assessment area as a percent and are compared to their state-wide percentages as a reference. Percent low-income and/or minority population groups above certain thresholds when compared to that larger geographic area can trigger potential EJ concerns.

Percent Low-Income: The term "percent low-income" is currently defined in EJSCREEN's online glossary as the percent of individuals whose ratio of household income to poverty level in the past 12 months was less than two, as calculated from the Census Bureau's ACS five-year summary estimates (EPA 2020a). In other words, percent low-income refers to the percent of individuals whose annual household income is less than twice the poverty level, as set by the Census Bureau.

Percent Minority: The term "percent minority" is currently defined in EJSCREEN's online glossary as a fraction of population, where minority is defined as all but Non-Hispanic White Alone, as calculated from the Census Bureau's ACS five-year summary estimated (EPA 2020a). In other words, the term minority is considered to be comprised of all racial and ethnic groups other than those self-reporting in Census Bureau surveys as non-Hispanic white alone. The term "alone" in this case indicates that the person is of a single race, since multiracial individuals are tabulated in another category. For example, a non-Hispanic individual who self-reported as half white and half American Indian would be counted as a minority by this definition.

7.2.1.2 Federal EJSCREEN EJ Criteria

The Council on Environmental Quality's (CEQs) Environmental Justice Guidance Under the National Environmental Policy Act (CEQ 1997) defines a minority population (or community) as one where either: (1) the minority population of the affected area (in this case the study areas for potential impacts due to New England Wind activities) exceeds 50%, or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

The term "meaningfully greater" was not defined by CEQ. The federal EJ assessments herein utilize EJSCREEN's criteria of minority populations greater than 50% to identify EJ communities, as well as EJSCREEN's key 80th percentile demographic indicator as a proxy for the term "meaningfully greater." The 80th percentile indicator can be understood using an example. If all the block groups within a given state were placed on a spectrum from zero to 100 in terms of households with low-income status, with zero being the block groups with the lowest percentage of low-income status households in the state and 100 being the block groups with the highest percentage of low-income status households in the state, then a block group at or above the 80th percentile for low-income status means that the percentage of low-income households in that block group is equal to or greater than 80% of all other block groups in the state.

The 80th percentile demographic indicator is also used for minority populations identified using EJSCREEN. These will be shown on possible port facility study areas outside of Massachusetts.

7.2.1.3 Massachusetts EJ Policy Criteria

The Commonwealth of Massachusetts identifies a potential environmental justice "community" as one or more US Census block groups that meet one or more of the following criteria (MA EOEEA 2021):

- 25 percent of households within the Census block group have a median annual household income at or below 65 percent of the statewide median income for Massachusetts (considered low-income by the Policy); or

- 40 percent or more of the residents are minority; or

- 25 percent or more of the residents have English Isolation; or

- Minorities comprise 25 percent or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150 percent of the statewide annual median household income; or

- Is a geographic portion of a neighborhood designated by the Secretary as an environmental justice population in accordance with law.

The term English Isolation refers to household that are English Language Isolated according to federal census forms, or do not have an adult over the age of 14 that speaks only English or English very well (MA EOEEA 2021). Massachusetts EJ Policy relies on the full count Census (currently 2020), not estimates extended to larger populations from small sample sizes.

7.2.1.4 Other Environmental Effects

A potential project's effects on EJ populations are typically a result of impacts on other resources, such as air or water quality, visual resources, recreation, and socioeconomics (BOEM 2018). EJ guidance also considers that a project's potential environmental effects could be unique to certain population groups, including EJ population groups. These environmental effects could include ecological, aesthetic, historic, cultural, economic, social, or health effects on a population. Potentially affected EJ populations could include fishermen who subsist on their catch. Minority groups could include Native American tribes who consider certain views or natural features to be important parts of their traditional cultural practices. These types of environmental effects are considered in Sections 7.2.2.1 and 7.2.2.2.

7.2.1.5 Massachusetts Facilities, Possible Port Facilities, and Potential EJ Concerns

7.2.1.5.1 Massachusetts Facilities

New England Wind facilities in Massachusetts include the Offshore Export Cable Corridor (OECC) in state waters, the landfall sites where the offshore export cables transition to shore, the onshore export cables (expected to be primarily within public roadway layouts and utility rights-of-way [ROWs]), the onshore substations, and the grid interconnection routes to the existing West Barnstable Substation. All New England Wind onshore facilities will be located within the Town of Barnstable in Barnstable County, Massachusetts unless technical, logistical, grid interconnection, or other unforeseen issues arise. The presence or absence of areas of potential

EJ concern within 1.6 km (1 mile) of New England Wind activities in the Town of Barnstable, as identified by MassGIS, are shown in Figure 7.2-1. Potential impacts to these communities, and measures to avoid, minimize, or mitigate those impacts are described in Section 7.2.2.

Offshore, construction and operation of the offshore cable system will occur in state waters offshore of Barnstable County, Dukes County, and Nantucket County. New England Wind components within the southern portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]), such as wind turbine generators (WTGs), electrical service platforms (ESPs), and inter-array or inter-link cables, will be located in federal waters, well seaward of both state waters and US Territorial Seas. Other potential effects of these structures in federal waters on EJ communities are considered in Sections 7.2.2.1 and 7.2.2.2.

New England Wind Facilities in the Town of Barnstable

As shown on Figure 7.2-1, portions of the Phase 1 Onshore Export Cable Routes and Grid Interconnection Routes (from the proposed landfall site to the onshore substation site near Route 6 in the Town of Barnstable and from the onshore substation site to the grid interconnection point at West Barnstable, respectively) would pass within 1.6 km (1 mile) of the westernmost portion of one EJ community that meets minority criteria under the Massachusetts EJ Policy. This area is located between Route 28/West Main Street and Phinney's Lane to the east of the Phase 1 Routes.

With the exception of the area identified above, no additional EJ communities are mapped by MassGIS in the Phase 1 and Phase 2 Onshore Development Areas.

7.2.1.5.2 Massachusetts Possible Port Facilities

No possible port facilities are located in the Town of Barnstable or on Cape Cod. Several Massachusetts port facilities are under consideration for both Phases of New England Wind construction and installation or O&M activities. These are:

- New Bedford Marine Commerce Terminal and possible locations on New Bedford Harbor
- Brayton Point in Somerset and possible Fall River locations along the Taunton River
- Vineyard Haven, Martha's Vineyard
- Salem Harbor

Detailed descriptions of these port facilities are included in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. A summary of each port facility is provided below, with an associated figure showing the site location, and the presence or absence of EJ populations, as identified by MassGIS, within the 1.6 km (1 mile) study area.

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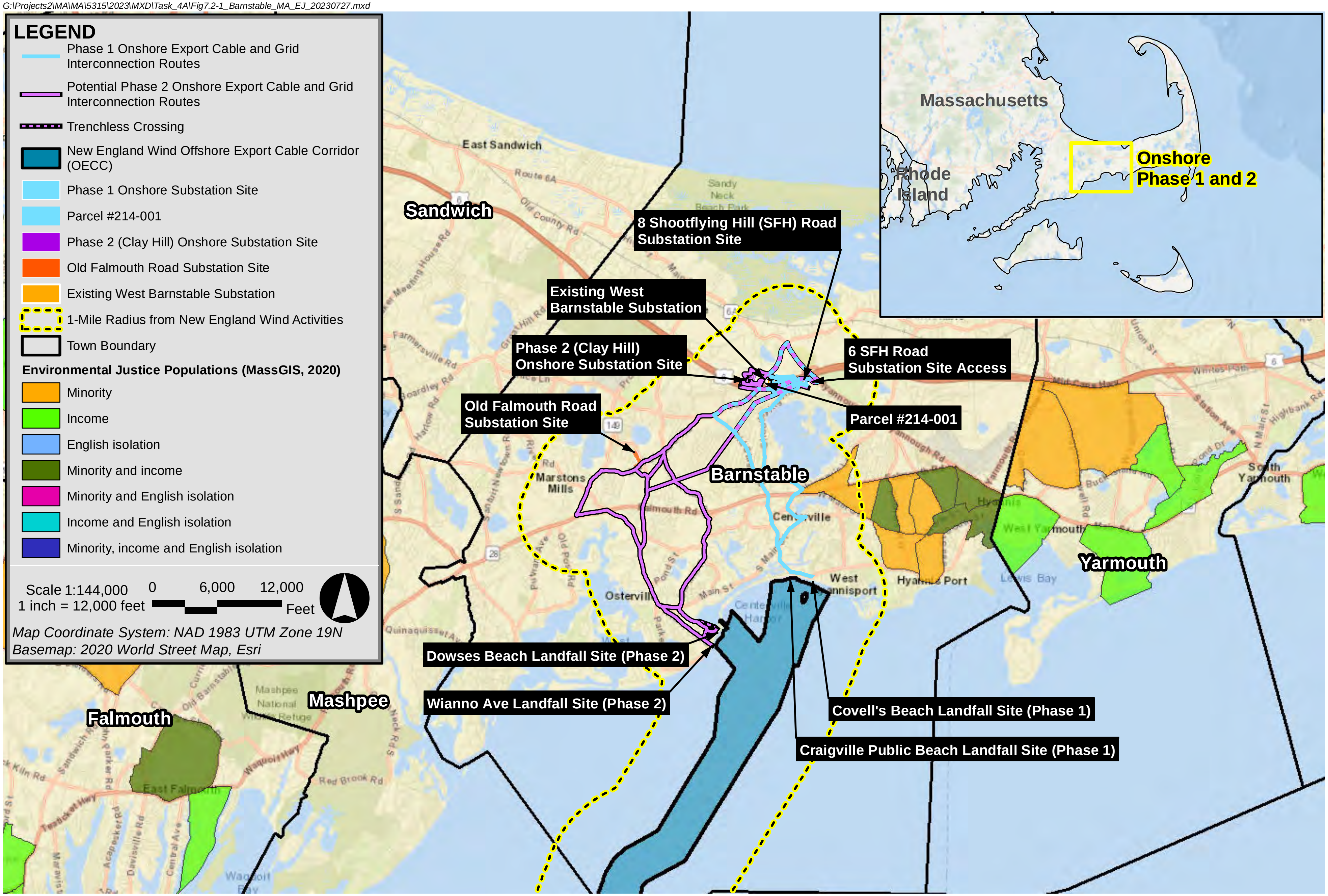

New England Wind
AVANGRID RENEWABLES

Figure 7.2-1

State Criteria: EJ Communities in Study Areas Around Phase 1 Onshore Facilities, Phase 2 Envelope, and OECC - Town of Barnstable, Barnstable County, Massachusetts

- **New Bedford Marine Commerce Terminal:** The New Bedford Marine Commerce Terminal, located in the City of New Bedford's extensive industrial waterfront on New Bedford Harbor, is owned by the Massachusetts Clean Energy Center (MassCEC), and was purpose-built to support offshore wind. The site also has ready access to interstate highways. As shown in Figure 7.2-2, the western half of the study area around the site on the New Bedford side of the waterfront contains minority and/or low-income EJ populations. There is also an EJ population that includes English isolation along with minority and income categories just south of New Bedford Marine Commerce Terminal. Fewer EJ populations are mapped on the eastern side of the Harbor in Fairhaven, with the exception of one mapped low-income area south of Route I-195 and a minority population on the north edge of Route I-195.

- **Other Areas in New Bedford Harbor:** The Proponent may use other areas in the Port of New Bedford, including, but not limited to, those identified by MassCEC as potentially viable offshore wind ports, if necessary upgrades are made by the owner/lessor. The 1.6 km (1 mile) radial study area has been extended northward along the Harbor, to map EJ populations in this overall area. These populations include a minority, income, and English isolation EJ population just north of Route I-195 on the western side of the harbor in New Bedford with a few groups in the income and minority categories on the eastern side of the area, as shown on Figure 7.2-2.

- **Brayton Point Commerce Center, Somerset:** The Brayton Point Commerce Center located on the site of the former coal-fired Brayton Point Power Plant, located on Mount Hope Bay and the Taunton River, less than 1.6 km (1 mile) from Interstate 195. The site is planned for redevelopment in part to service the offshore wind industry. As shown on Figure 7.2-3, the 1.6 km (1 mile) radial study area around the possible port facility contains no mapped EJ communities in Somerset or Swansea on the west side of the Taunton River. There is one mapped location in Swansea just outside of the radial study area. The former mill city of Fall River on the eastern side of the river contains numerous contiguous minority and/or low-income EJ block groups with a couple of English isolation communities specifically towards the southern side of the Fall River portion of the study area. These EJ communities were long affected by air pollution from coal and other fossil fuels burned at the former Brayton Power Plant, and its closure will likely lower health risks to these communities. Redevelopment of Brayton Point to support a clean energy industry would be an improvement over former uses and provide job opportunities, leading to economic benefits to the local workforce.

- **Fall River Possible Port Facilities:** Other possible port facilities in Fall River identified by MassCEC as potentially viable offshore wind ports are under consideration by the Proponent, if the necessary upgrades are made by the owners/lessors. The 1.6 km (1

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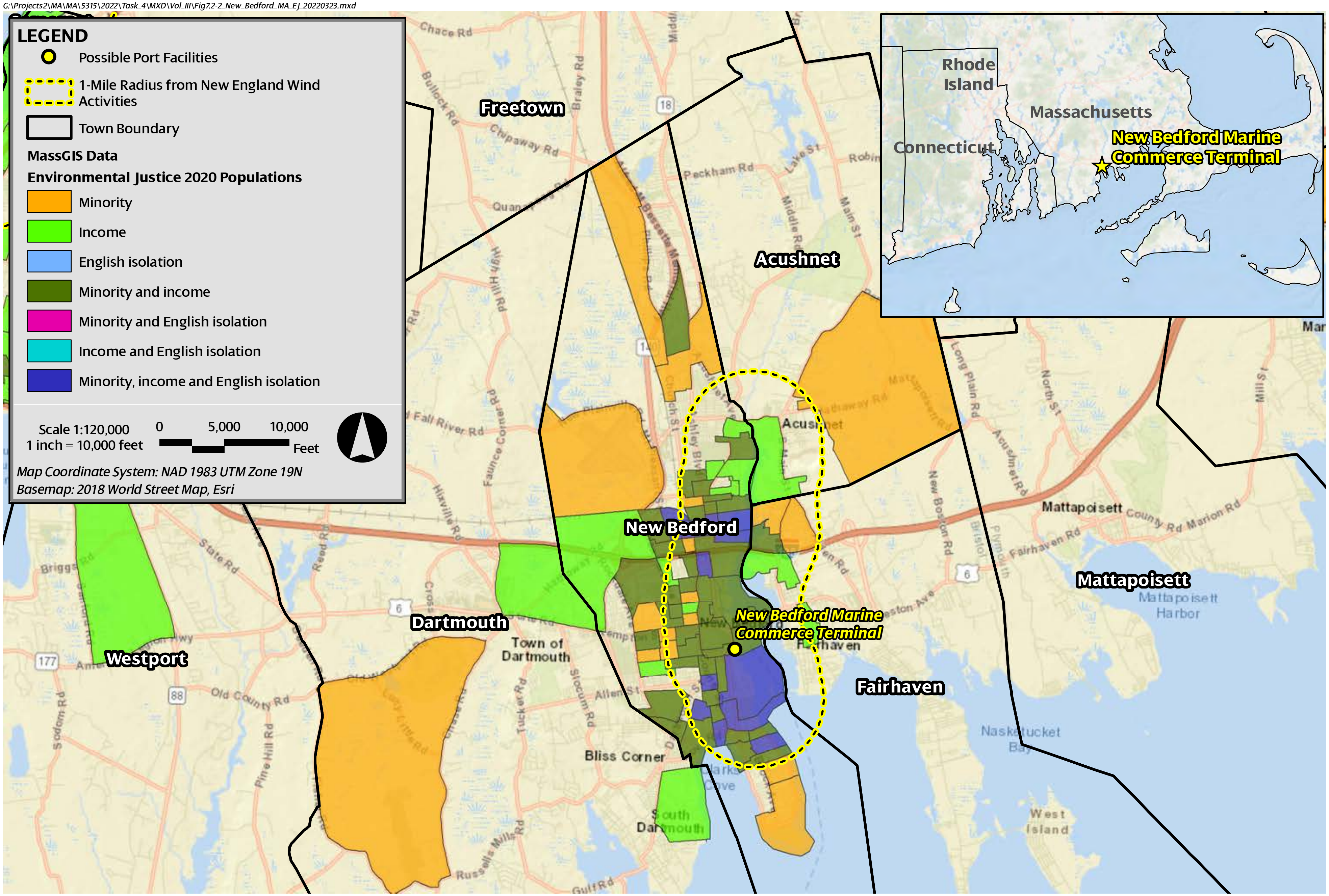

New England Wind

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Figure 7.2-2

State Criteria: EJ Communities in Study Area Around Possible Port Facilities

New Bedford Marine Commerce Terminal on New Bedford Harbor - New Bedford, Bristol County, Massachusetts

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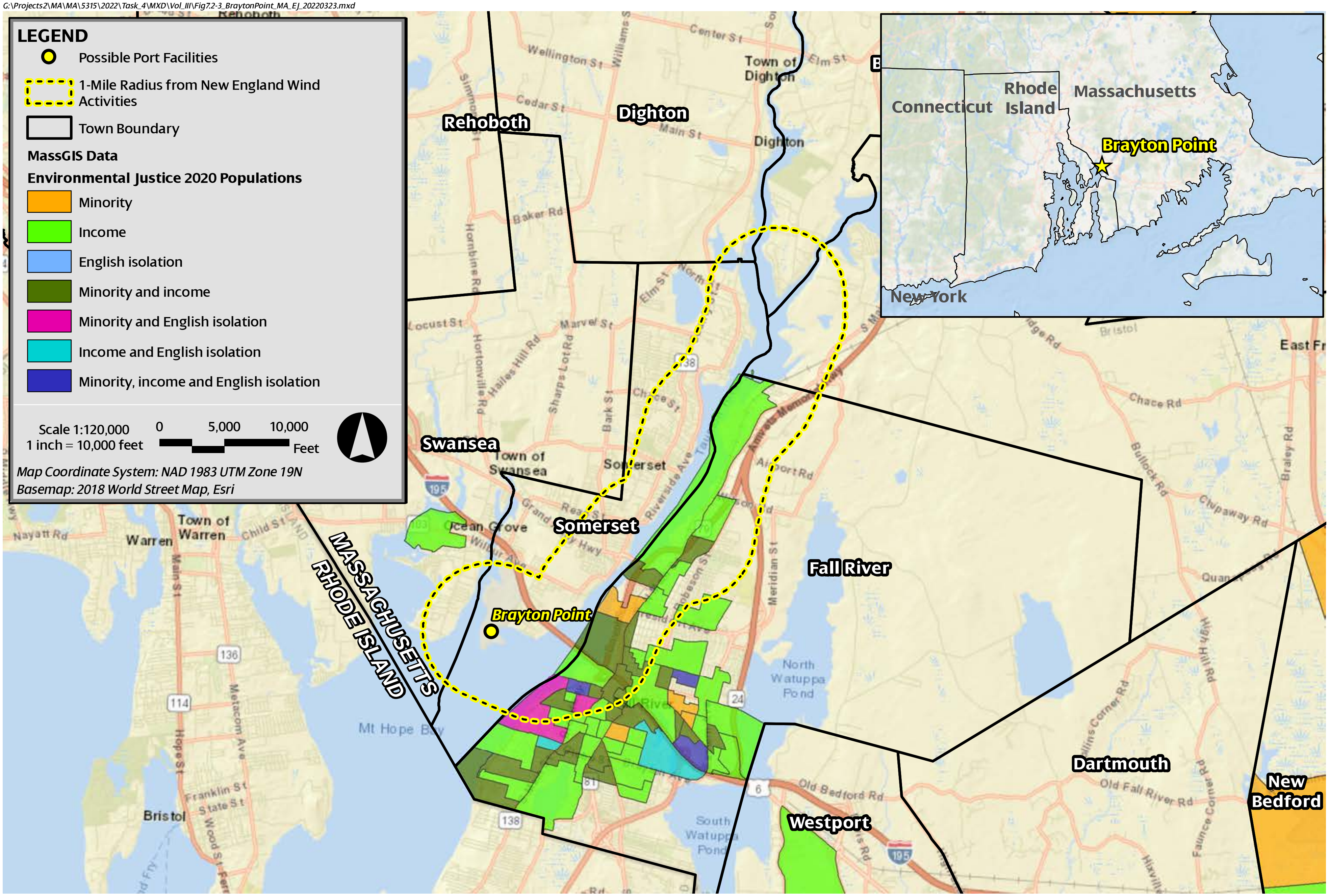

New England Wind

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Figure 7.2-3

State Criteria: EJ Communities in Study Area Around Possible Port Facilities
Brayton Point on the Taunton River - Somerset, Bristol County, Massachusetts

mile) radial study area has been extended northward around the Taunton River to included potential locations. No EJ communities are mapped on the west side of the Taunton River in Somerset, Berkley, and Freetown. The northern part of Fall River contains an EJ community in the income designation located adjacent to the east side of the Taunton River.

Vineyard Haven, Martha's Vineyard: Vineyard Haven already provides a number of services to vessels as large as 84 meters (275 feet) in length and has onshore facilities that house multiple business entities. The owner of a marina has existing plans (irrespective of the Proponent) to upgrade the facilities to accommodate additional marine industrial uses as well as to increase the existing facility's protection from storms. As shown in Figure 7.2-4, low-income EJ communities are mapped on the western side of the radial study area, located north, west, and south of Vineyard Haven. An additional EJ community mapped on Martha's Vineyard is a minority community in Aquinnah, on the southwest tip of the island. Many members of the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) reside in this area. Potential impacts to this community are addressed in Sections 7.2.2.1 and 7.2.2.3.

Nantucket Island: Though no onshore facilities or possible port facilities are planned for Nantucket, Figure 7.2-5 has been produced for completeness, since portions on the OECC will traverse coastal waters. As shown on the figure, the OECC is located far west and outside of a 1-mile radius from of an area in southwestern Nantucket mapped as containing a minority EJ community. No EJ communities on Nantucket will be affected by the development of New England Wind.

Salem Harbor: When the recently commissioned Salem Harbor Power Station natural gas power plant replaced a coal and oil plant in 2018 along the Salem waterfront, it opened 0.17 km2 (42 acres) for development. The Salem Harbor Power Station mostly bisects the area available for development; the north side of the site is approximately 0.06 km2 (13.7 acres) and the south side is approximately 0.12 km2 (29 acres). The site 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 approximately 700 m (2,300 ft) of frontage on Salem Harbor, which hosts active commercial, recreational, and water transportation facilities. The site is located approximately 35 km (22 miles) northeast of Boston. As shown in Figure 7.2-6, there are EJ populations in the northwestern and southwestern portions of the radial study area. The northwestern portion of the study area has minority and income designations, while the southwestern portion has minority, income, and English isolation designation.

7.2.1.6 Rhode Island Possible Port Facilities

While no physical components of New England Wind will be located in Rhode Island, several port facilities are under consideration for both Phases of New England Wind construction and installation or O&M activities. These are:

- Port of Davisville on Narragansett Bay, North Kingstown
- ProvPort on the Providence River, Providence
- South Quay Terminal on the Providence River, East Providence

Detailed descriptions of these port facilities are included in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. A summary of each port facility is provided below, with an associated figure showing the site location, and the presence or absence of EJ populations, as mapped by EJSCREEN, within the 1.6 km (1 mile) study area. Potential impacts from New England Wind activities and measures to avoid, minimize and mitigate those potential impacts to EJ communities, if present in the study areas, are described in Section 7.2.2.

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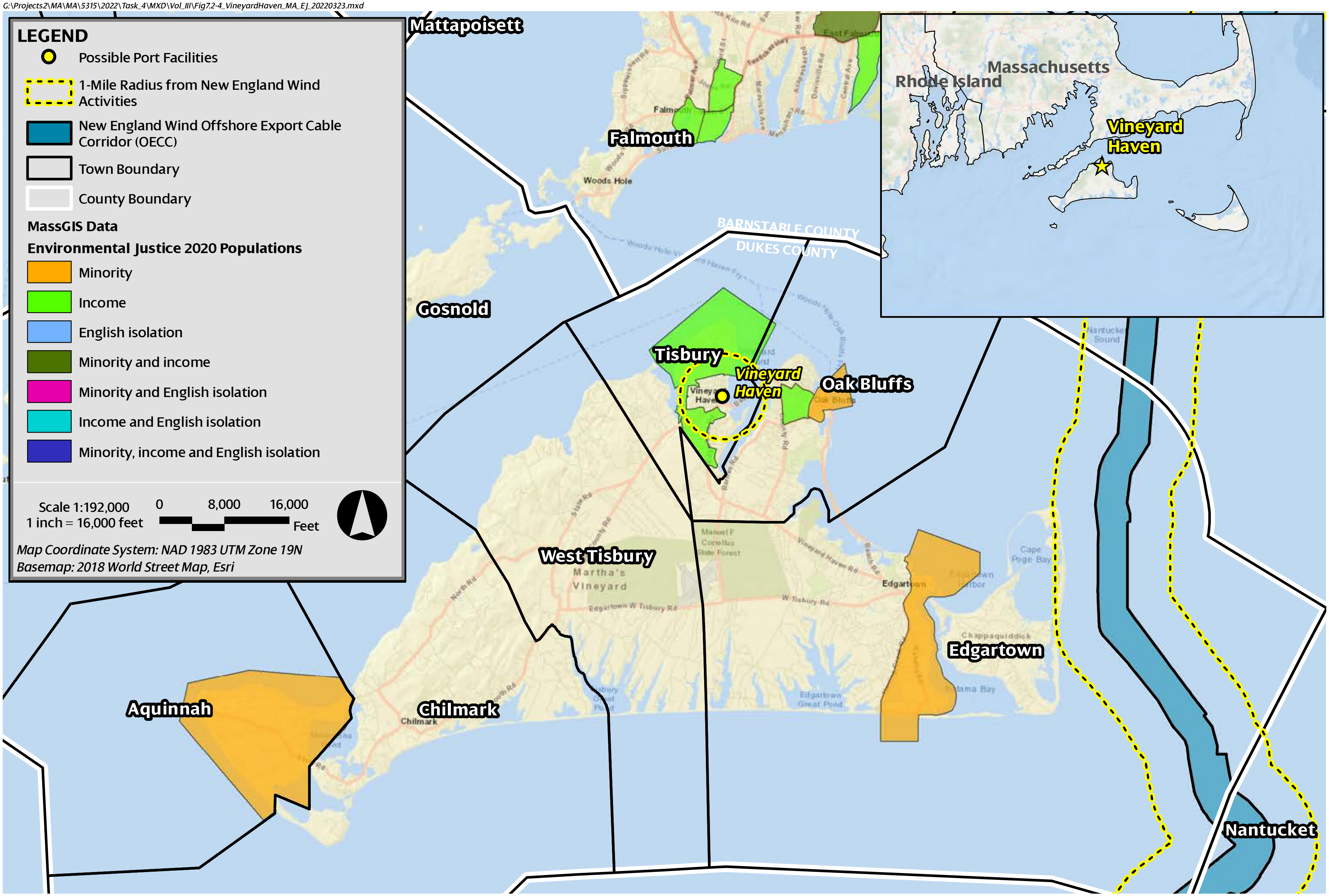

New England Wind
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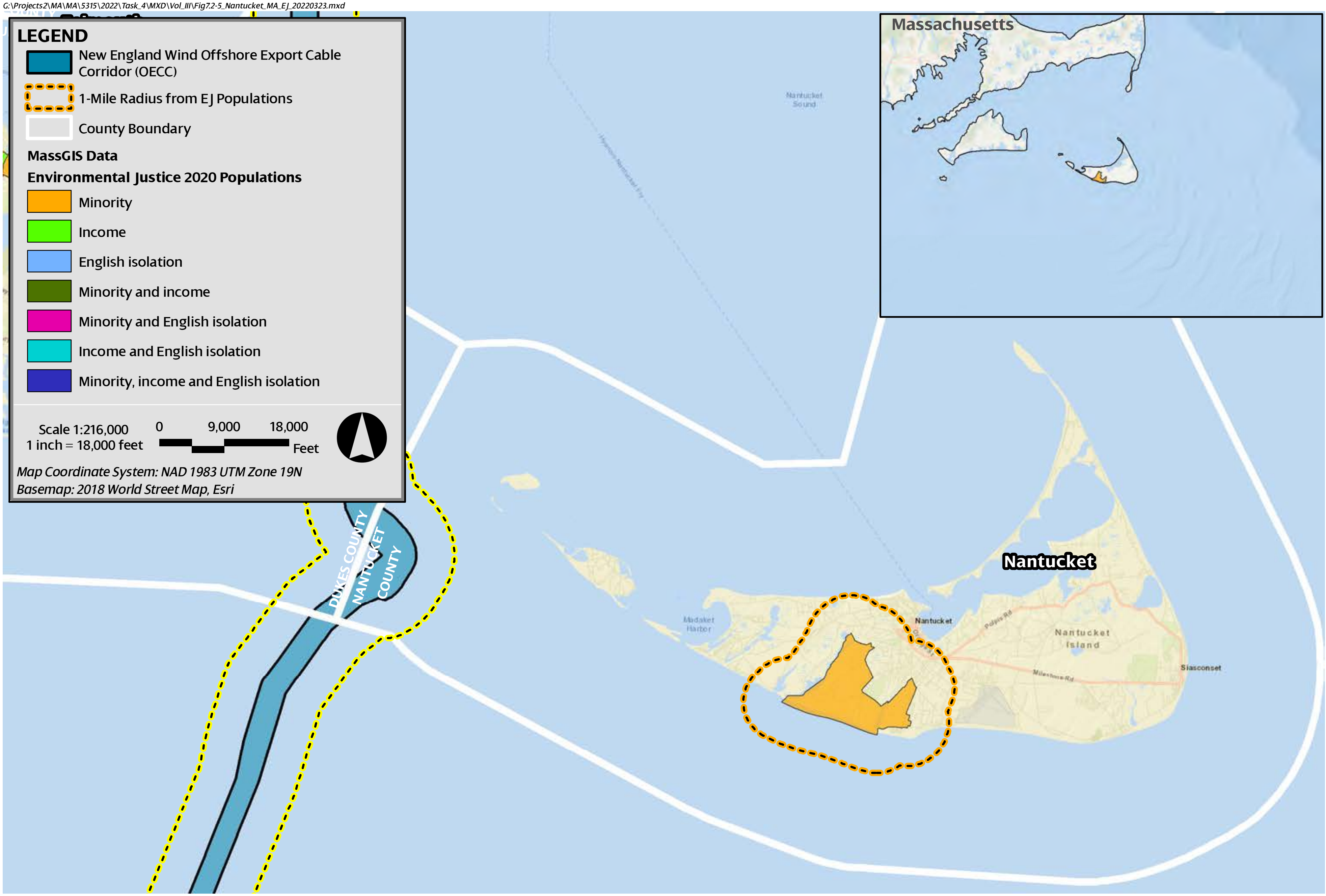
Figure 7.2-4

State Criteria: EJ Communities in Study Area Around Possible Port Facilities
Vineyard Haven on Vineyard Haven Harbor - Martha's Vineyard, Dukes County, Massachusetts



New England Wind
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Figure 7.2-5

State Criteria: EJ Communities on Nantucket
Nantucket Island, Nantucket County, Massachusetts

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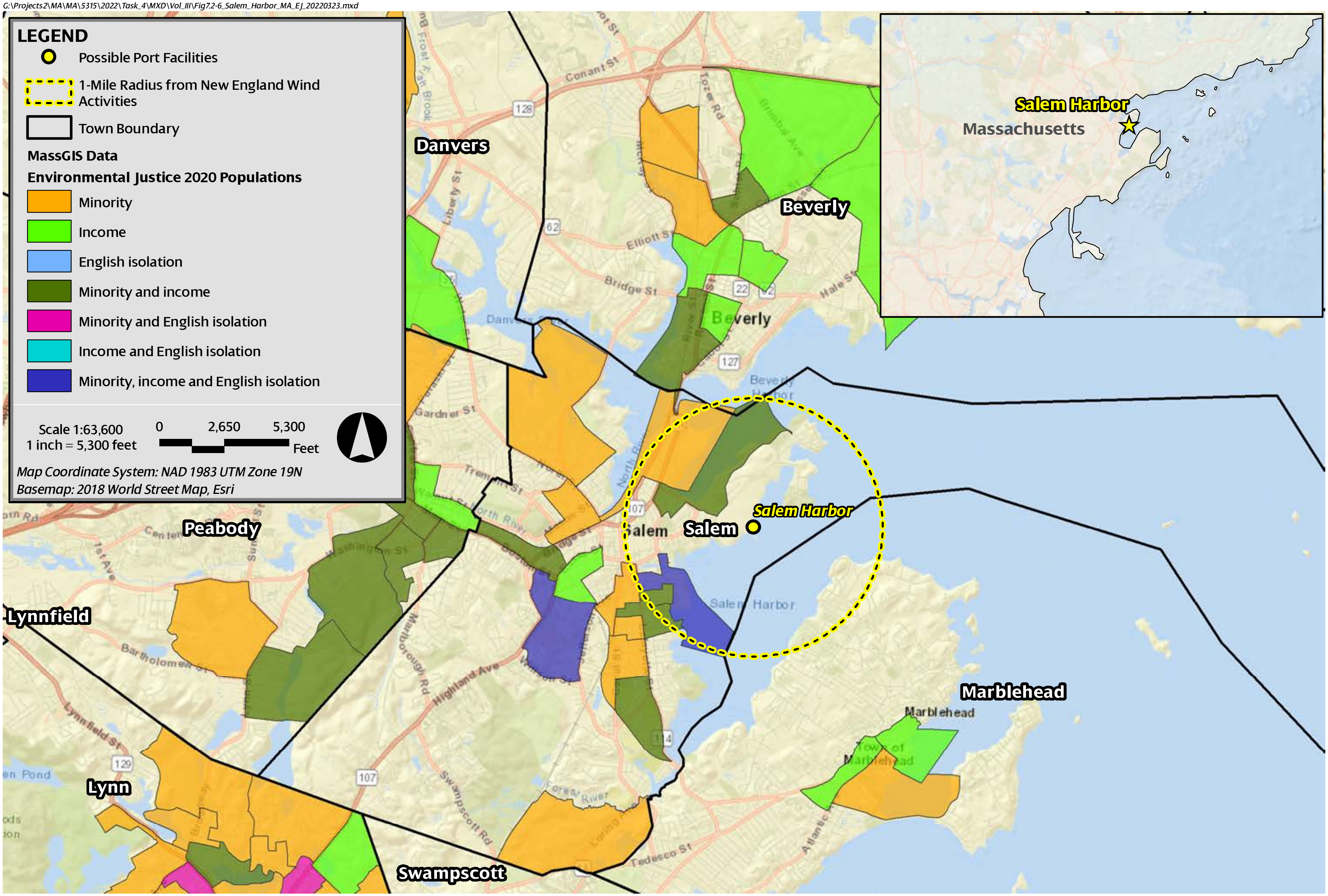

New England Wind

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Figure 7.2-6

State Criteria: EJ Communities in Study Area Around Possible Port Facilities Salem Harbor

Port of Davisville, North Kingstown: During World War II, Quonset Point on the west side of Narragansett Bay was occupied by a major US naval facility. The largely industrial area is now used for large-capacity industrial water-dependent purposes (such as hull fabrication for General Dynamic's Electric Boat) and is under redevelopment, in part to support the growing offshore wind industry. Figure 7.2-7 below shows that low-income EJ communities in the 80th percentile and higher for the state are present within most of onshore portions of the study area around the possible port facility location. Potential impacts from New England Wind activities and measures to avoid, minimize and mitigate those potential impacts to EJ communities are described in Section 7.2.2.

ProvPort, Providence: The Port of Providence (ProvPort) is a privately-owned marine terminal located within the City of Providence that occupies approximately 0.47 square kilometers (km^2) (115 acres) along the Providence River. ProvPort provides berthing space, covered storage, and more than 0.08 km^2 (20 acres) of open lay down area. ProvPort also has on-dock rail service and is located close to the interstate. Marine transportation into ProvPort is facilitated by a federally-maintained navigational channel, which can accommodate deep-draft vessels.

Figure 7.2-8 below indicates that low-income EJ communities are present within 1.6 km (1 mile) of the possible port facility location, exceeding EJSCREEN criteria for greater than 50% minority, 80th percentile or higher minority and 80th percentile or higher low-income status for percent minority compared to the State. Potential impacts from New England Wind activities and measures to avoid, minimize and mitigate those potential impacts to EJ communities are described in Section 7.2.2.

South Quay Terminal, East Providence: The South Quay Terminal is a greenfield site located on the Providence River in East Providence, planned for redevelopment as a staging area for offshore wind construction as well as other mixed uses.

Figure 7.2-9 below indicates a small portion of the coast within the 1.6 km (1 mile) study area on the East Providence side of the Providence River is mapped as an EJ community. The mapping indicates EJ communities are located within the study area on west and north sides of the river in the City of Providence. These EJ communities exceed the criteria for percent minority at greater than or equal to 50%, and 80th percentile or higher for minority and low-income communities

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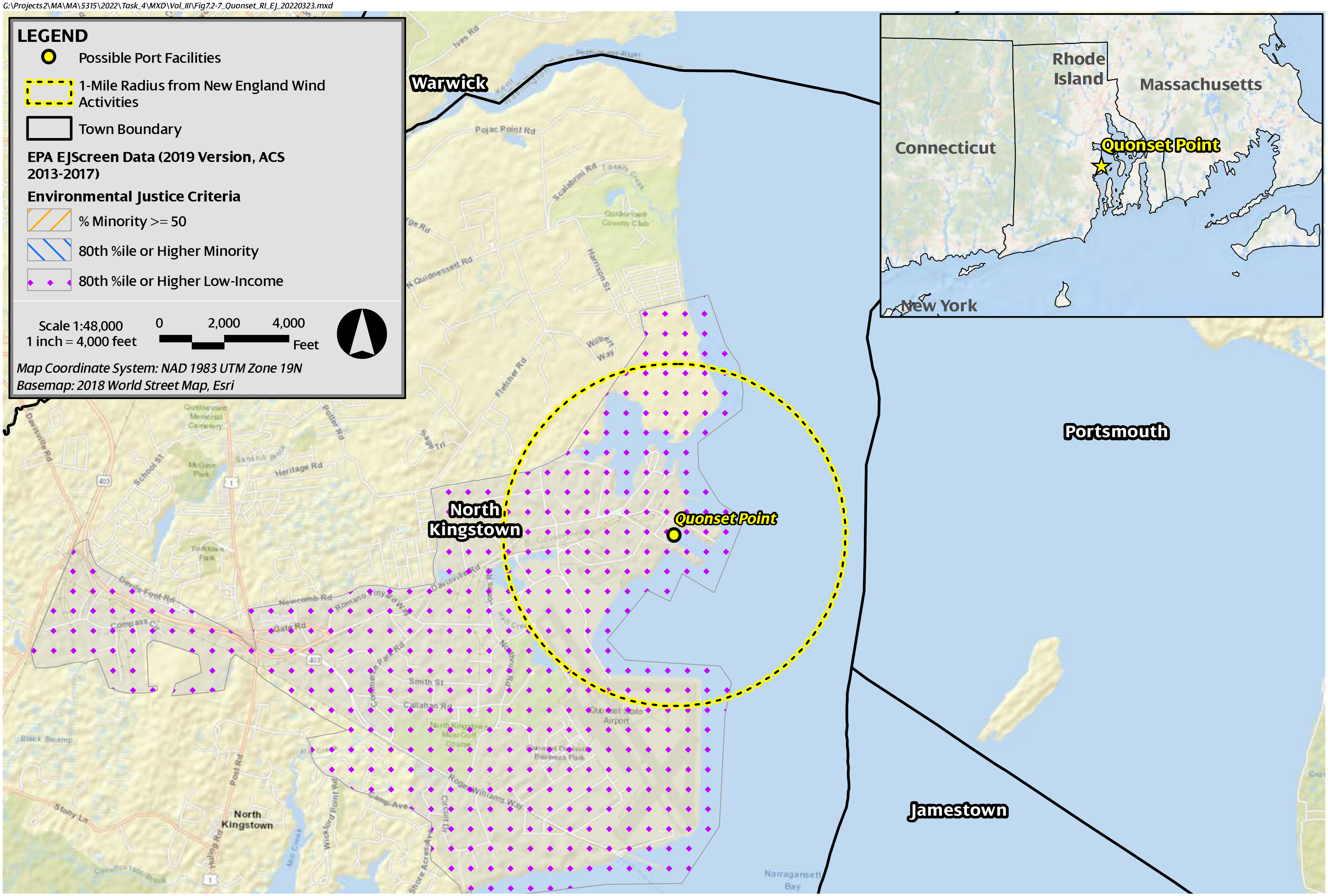

New England Wind

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Figure 7.2-7

EJ Communities in Study Area Around Possible Port Facilities

Quonset Point, Port of Davisville on Narragansett Bay - North Kingston, Washington County, Rhode Island

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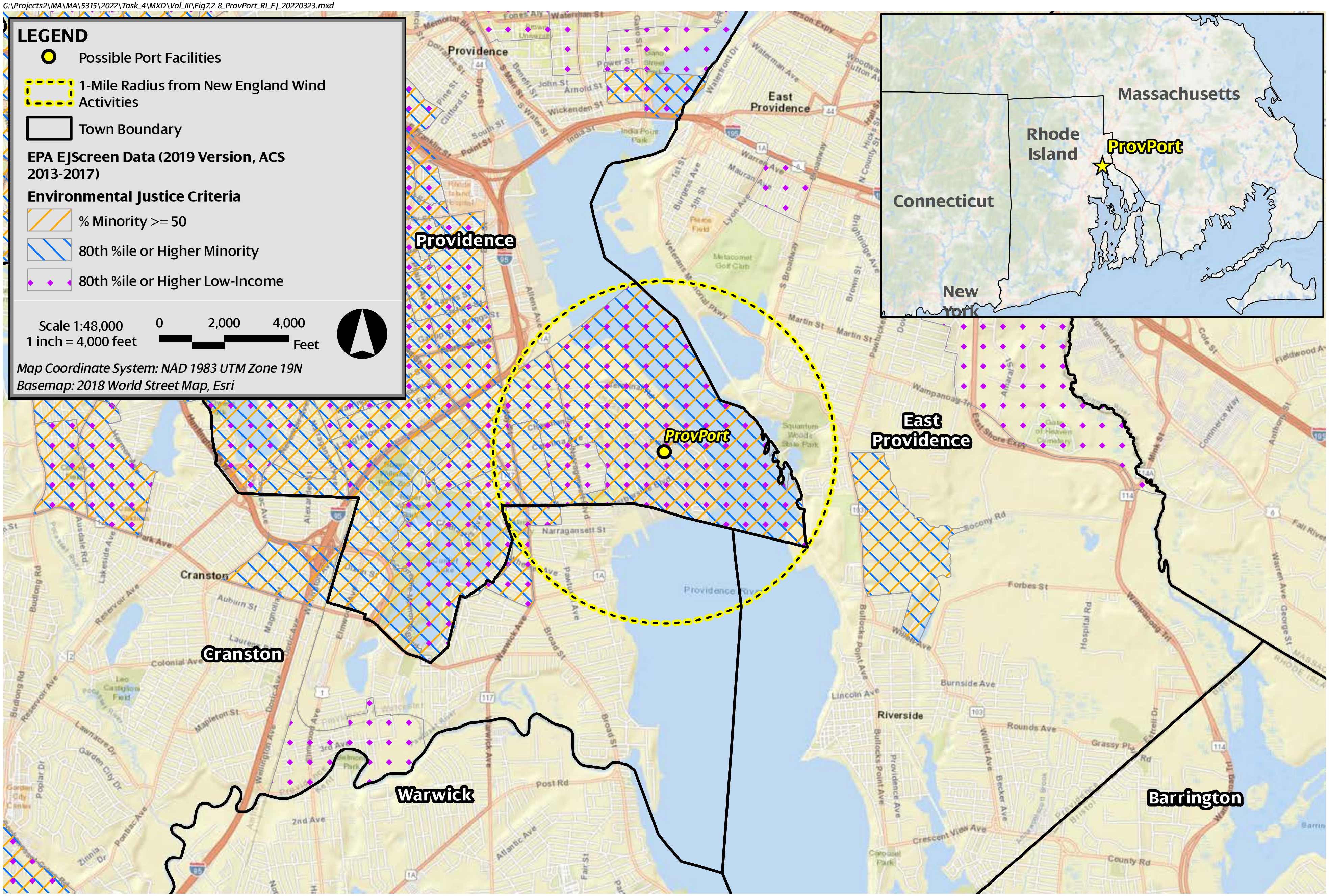

New England Wind

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Figure 7.2-8

EJ Communities in Study Area Around Possible Port Facilities
ProvPort on the Providence River - Providence, Providence County, Rhode Island

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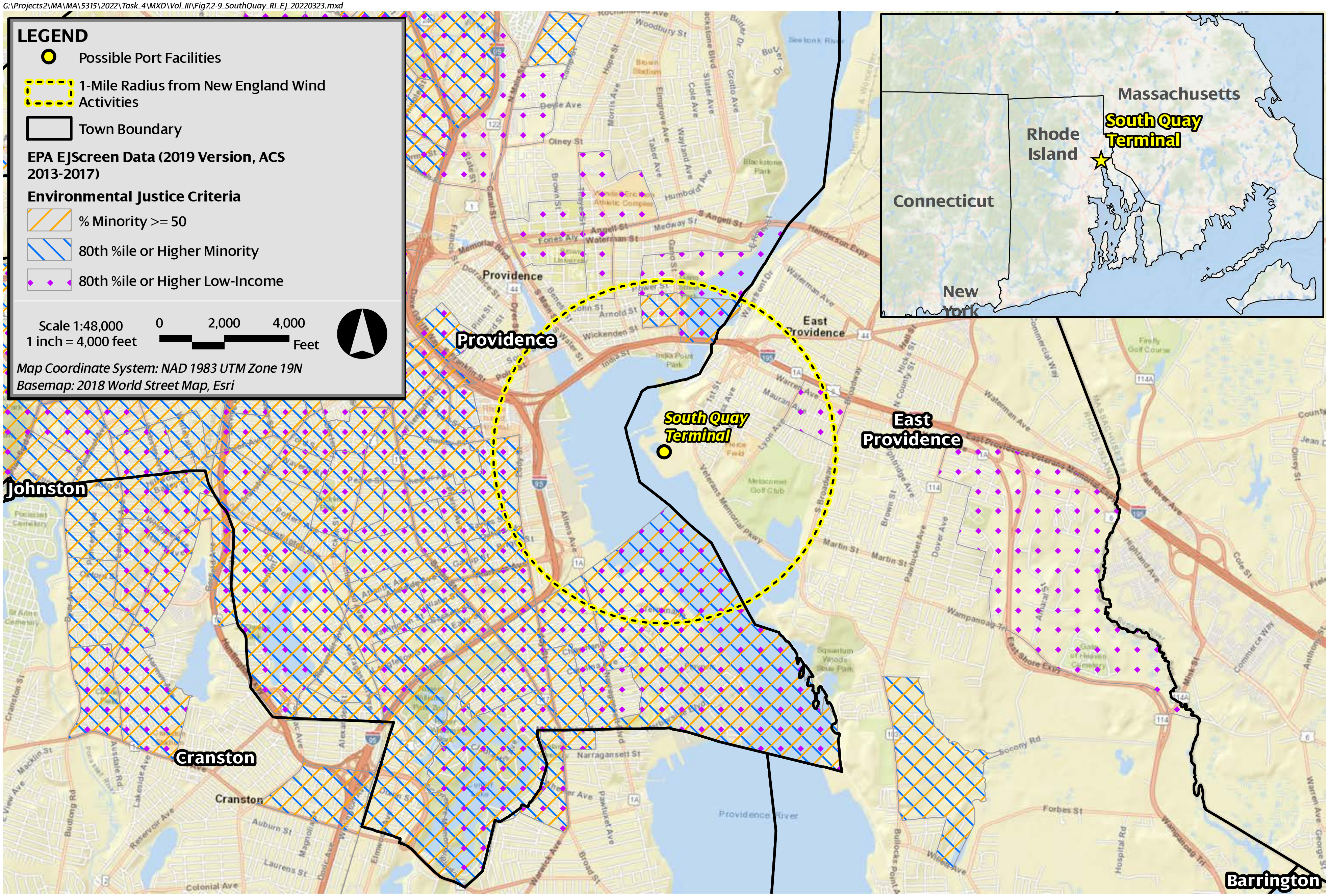

New England Wind
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Figure 7.2-9

EJ Communities in Study Area Around Possible Port Facilities
South Quay Terminal on the Providence River - East Providence, Providence County, Rhode Island

compared to the State. Potential impacts from New England Wind activities and measures to avoid, minimize and mitigate those potential impacts to EJ communities are described in Section 7.2.2.

7.2.1.7 Connecticut Possible Port Facilities

While no physical components of New England Wind will be located in Connecticut, several port facilities are under consideration for both Phases of New England Wind construction and installation and/or O&M activities. These are:

- Barnum Landing on Bridgeport Harbor, Bridgeport
- Seaview Avenue on Bridgeport Harbor, Bridgeport
- New London State Pier, New London

Detailed descriptions of these port facilities are included in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. A summary of each port facility is provided below, with an associated figure showing the site location, and the presence or absence of EJ populations, as mapped by EJSCREEN, within the 1.6 km (1 mile) study area. Potential impacts from New England Wind activities and measures to avoid, minimize and mitigate those potential impacts to EJ communities, if present in the study areas, are described in Section 7.2.2.

Barnum Landing, Bridgeport: The Barnum Landing site owned by the McAllister Towing and Transportation Company consists of approximately 0.06 km^2 (15 acres) of industrial waterfront property along Bridgeport Harbor. The Proponent may use the site to accommodate secondary steel fabrication and final outfitting and storage of transition pieces and as well as a long-term O&M base. Figure 7.2-10 indicates nearly the entire 1.6 km (1 mile) study area around this site contains EJ communities exceeding both the 50% criteria for minority, and is in the 80^{th} percentile or higher for minority and low-income compared to the state. These could benefit the EJ communities in this city.

Seaview Avenue, Bridgeport: Another port facility in the industrial waterfront area just north of Barnum Landing may be used for Phase 2 if the necessary upgrades are made by the owner/lessor. Figure 7.2-11 indicates nearly the entire 1.6 km (1 mile) study area around this site contains EJ communities exceeding the 50% criteria for minority and is in the 80^{th} percentile or higher for minority and low-income compared to the state. The Proponent has offered significant community benefits to the State of Connecticut (see Appendix III-O of COP Volume I). These could benefit the EJ communities in this city.

New London State Pier, New London: There are plans to redevelop the New London State Pier, located on the Thames River, for offshore wind as specified in the Harbor Development Agreement between the Connecticut Port Authority, Gateway New London LLC, and North East Offshore LLC. The approximately 0.12km^2 (30 acre) site has no air draft restrictions, direct access

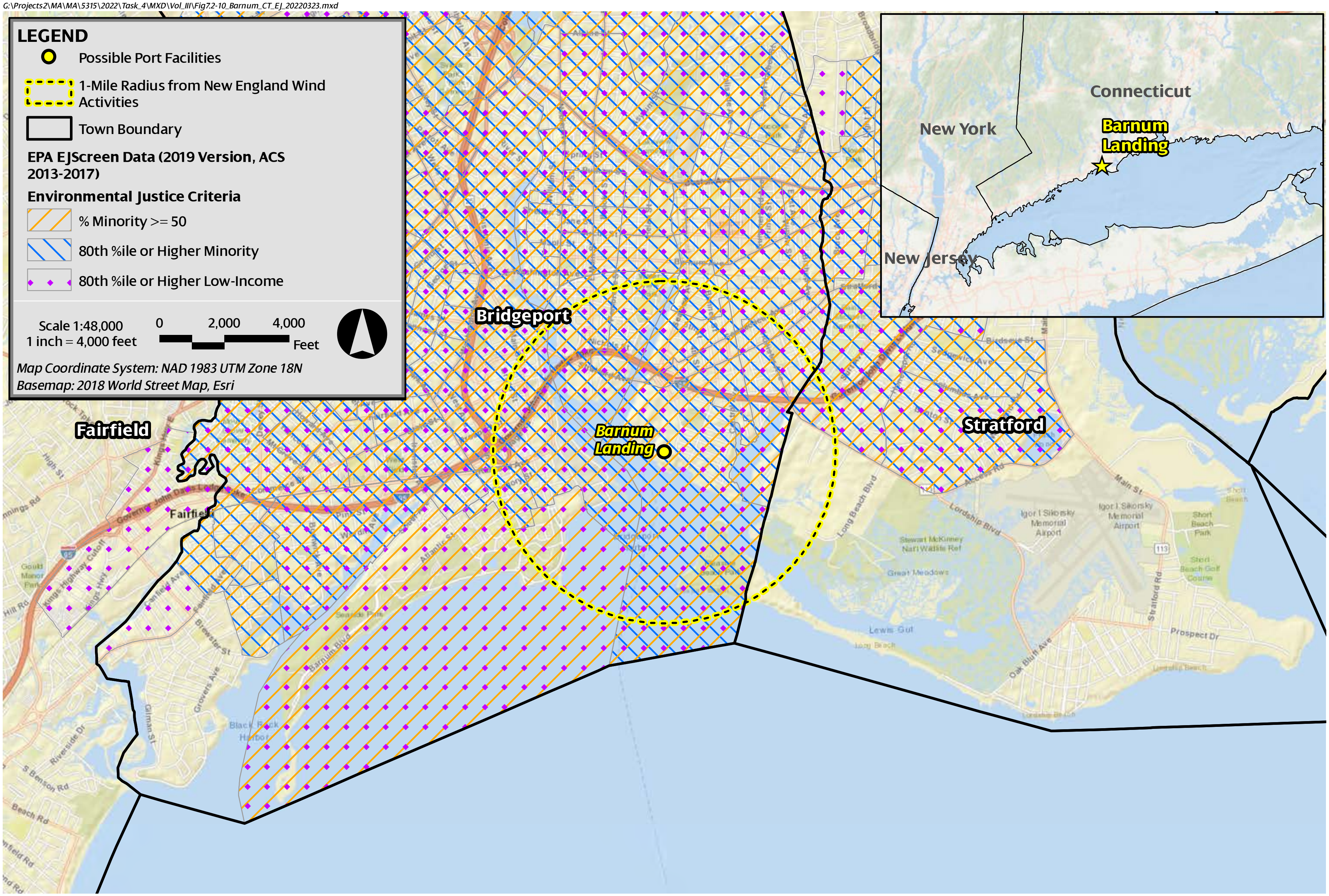

Figure 7.2-10

EJ Communities in Study Area Around Possible Port Facilities
Barnum Landing on Bridgeport Harbor - Bridgeport, Fairfield County, Connecticut

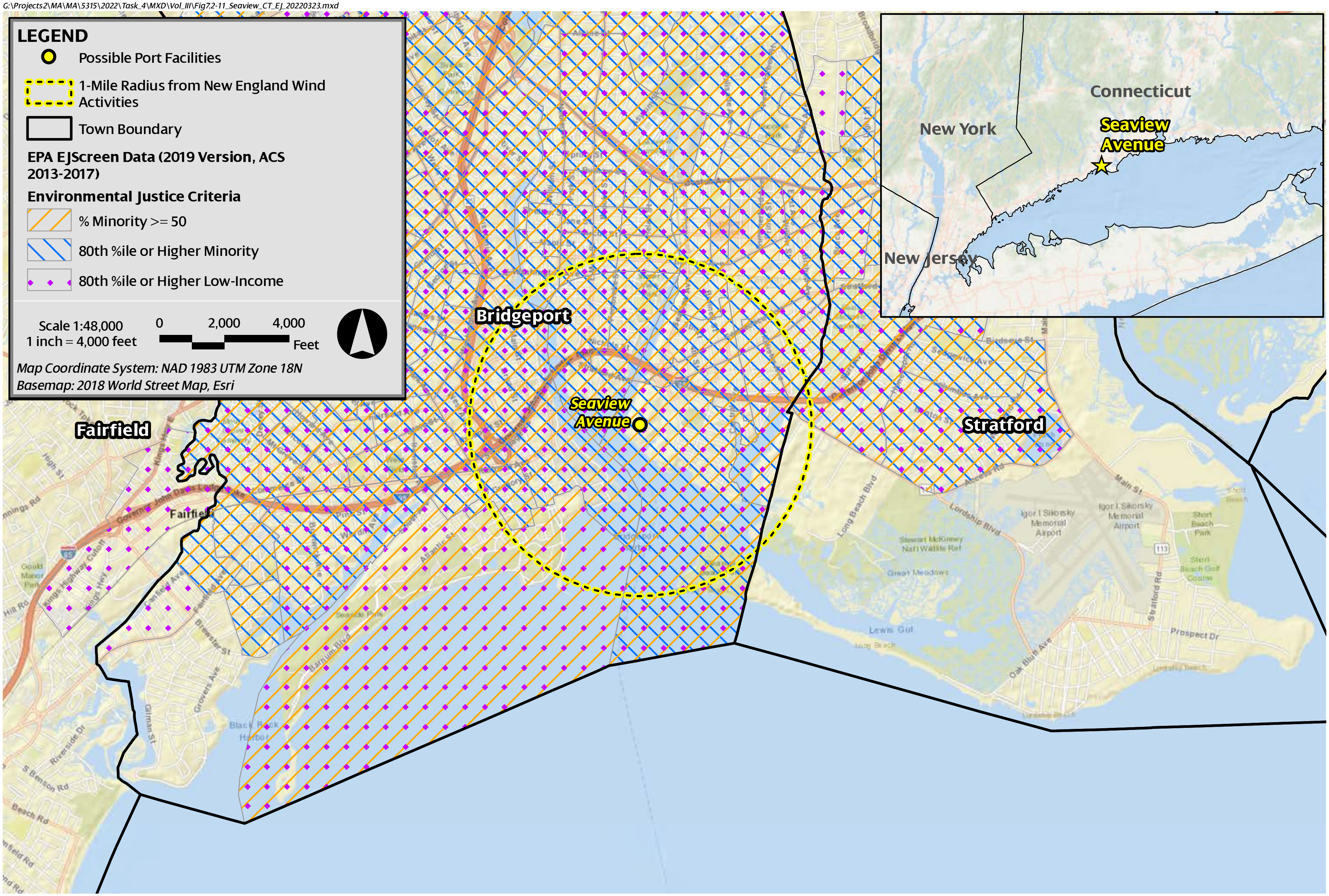

Figure 7.2-11

EJ Communities in Study Area Around Possible Port Facilities
Seaview Avenue on Bridgeport Harbor - Bridgeport, Fairfield County, Connecticut

to a federally-maintained deep water channel, and access to rail and highway. The Proponent may use the state-owned New London State Pier for Phase 1 and/or Phase 2 if the site developed and available at the time it is needed. Figure 7.2-12 shows EJ communities within much of the 1.6 km (1 mile) study area surrounding the pier, exceeding the three EJ criteria mapped by EJSCREEN.

7.2.1.8 New York Possible Port Facilities

While no physical components of New England Wind will be located in New York State, several port facilities are under consideration for both Phases of New England Wind construction and installation and/or O&M activities. These are:

- Port of Coeymans on the mid-Hudson River
- Port of Albany, Glenmont on the mid-Hudson River
- New York Offshore Wind Port in East Greenbush on mid-Hudson River
- GMD Shipyard in Brooklyn Navy Yard on East River
- South Brooklyn Marine Terminal on Upper Bay of New York Harbor
- Homeport Pier on Staten Island
- Proposed Arthur Kill Terminal on Staten Island
- East Shoreham on Long Island Sound
- Greenport Harbor, east tip of Long Island

Detailed descriptions of these port facilities are included in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. A summary of each port facility is provided below, with an associated figure showing the site location, and the presence or absence of EJ populations, as mapped by EJSCREEN, within the one-mile study area. Potential impacts from New England Wind activities and measures to avoid, minimize and mitigate those potential impacts to EJ communities, if present in the study areas, are described in Section 7.2.2.

Port of Coeymans on the West Side of the Mid-Hudson River: This port contains a large privately-owned marine terminal south of Albany that is used for large-scale construction projects. The marine terminal has a 660 ton crawler crane that can be used to lift offshore wind farm components. Figure 7.2-13 shows no mapped EJ communities within 1.6 km (1 mile) of the possible port facility.

Port of Albany, Glenmont on the West Side of the Mid-Hudson River: Just north of Coeymans, the Albany Port District Commission is proposing to expand the Port of Albany by developing approximately 0.33 km^2 (81.5 acres) of riverfront property which could be used as an assembly and staging area for offshore wind development.

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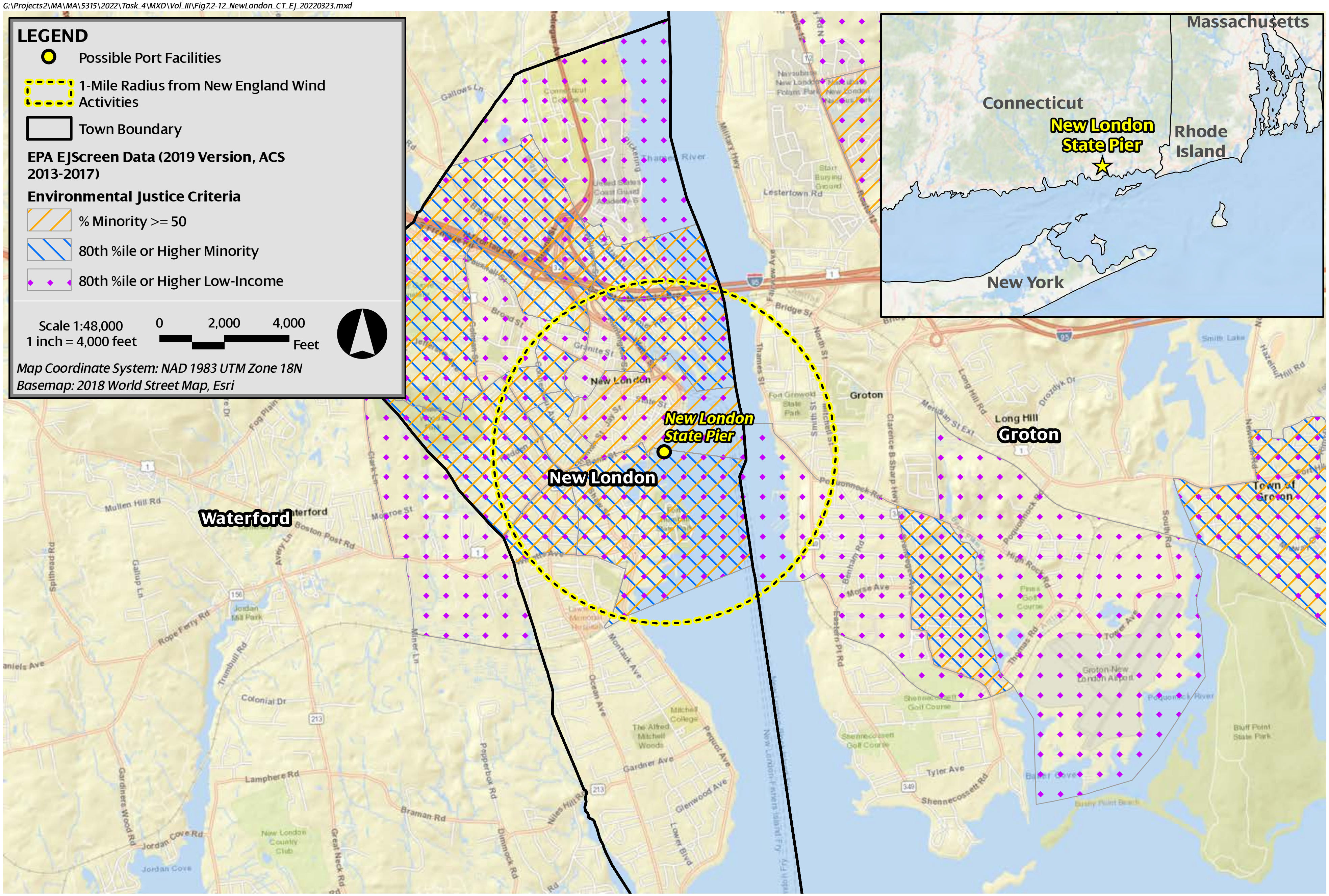

New England Wind
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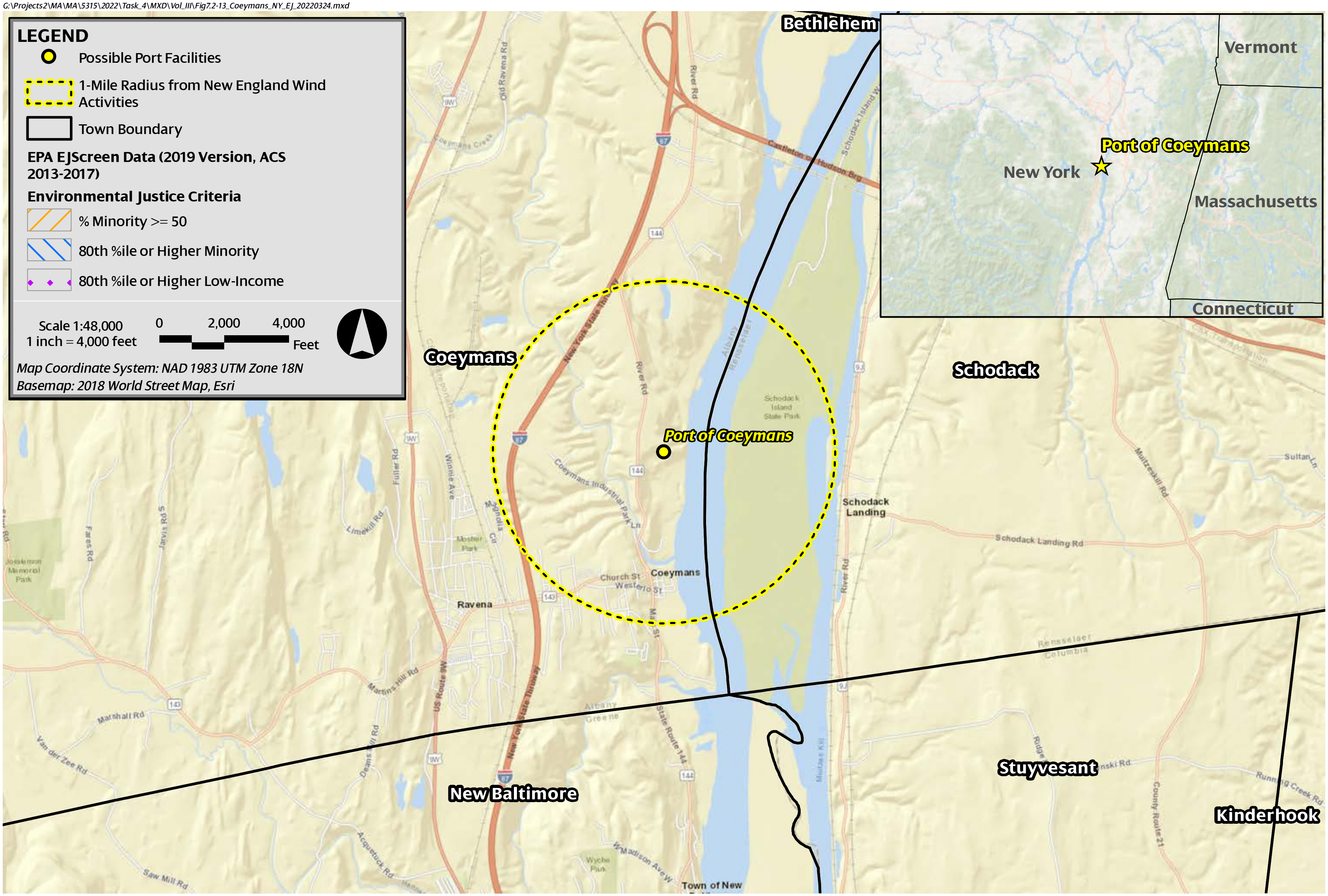
Figure 7.2-12

EJ Communities in Study Area Around Possible Port Facilities
New London State Pier on the Thames River - New London, Connecticut



New England Wind

Figure 7.2-13

EJ Communities in Study Area Around Possible Port Facilities
Port of Coeymans on Mid-Hudson River - Coeymans, Albany County, New York

Figure 7.2-14 indicates a small portion of the northernmost area within the study area meets EJ criteria for greater than 50% minority and 80th percentile or greater low-income communities. This area is on the western side of the river and is contiguous with mapped EJ communities extending south from Albany.

New York Offshore Wind Port, East Greenbush, on the East Side of the Mid-Hudson River: This approximately 0.45 km^2 (111 acre) port facility is being proposed for development to support the needs of the offshore wind industry, with over 1,188 meters (3,900 linear feet) of riverfront. The site may be utilized for New England Wind activities if the necessary upgrades are made in time by the owner/lessor.

This site is nearly directly east and across the Hudson River from the Port of Albany in Glenmont (see Figure 7.2-14). The same small portion of a minority and low-income EJ community mapped on Figure 7.2-14 is located within the study area for this site, as shown on Figure 7.2-15. No EJ communities are mapped on the east side of the river.

GMD Shipyard at Brooklyn Navy Yard: The GMD Shipyard at the Brooklyn Navy Yard on the East River has the largest dry dock facility in New York City, numerous cranes, and approximately 335 m (1,100 ft) of wet berth. Figure 7.2-16 indicates the northeast, southeast, and southwest quadrants of this largely industrial study area around the possible port facility contain minority and low-income EJ communities under three EJSCREEN criteria. The remaining quadrant to the northwest is water.

South Brooklyn Marine Terminal on the Upper Bay of New York Harbor: This possible port facility along a highly industrialized waterfront has two piers with substantial water frontage. The port is proposed to be upgraded to support staging, installation, and maintenance of offshore wind farms. Figure 7.2-17 indicates approximately one-half of the study area contains mapped EJ communities meeting EJSCREEN criteria for minority and to a lesser extent low-income. The remaining third of the study area contains water bodies, a large cemetery, and parks.

Homeport Pier on Staten Island: This possible port facility just north of the Verrazano-Narrows Bridge is a former 0.14 km^2 (35 acre) naval base with a pier. The New York City Economic Development Corporation has requested expressions of interest to re-develop the port facility to support the offshore wind industry. As shown on Figure 7.2-18, the eastern half of the study area around this possible port facility is waterbody. Much of the onshore study area meets EJSCREEN criteria for low-income and minority EJ communities.

Proposed Arthur Kill Terminal, Western Side of Staten Island: This proposed terminal on a largely undeveloped site would be designed for staging and assembly of offshore wind components, with a quay and a warehouse for equipment and parts storage.

Figure 7.2-19 indicates no mapped EJ communities on the Staten Island side of the study area. In New Jersey across the Arthur Kill water body from the proposed terminal, EJSCREEN maps minority EJ communities.

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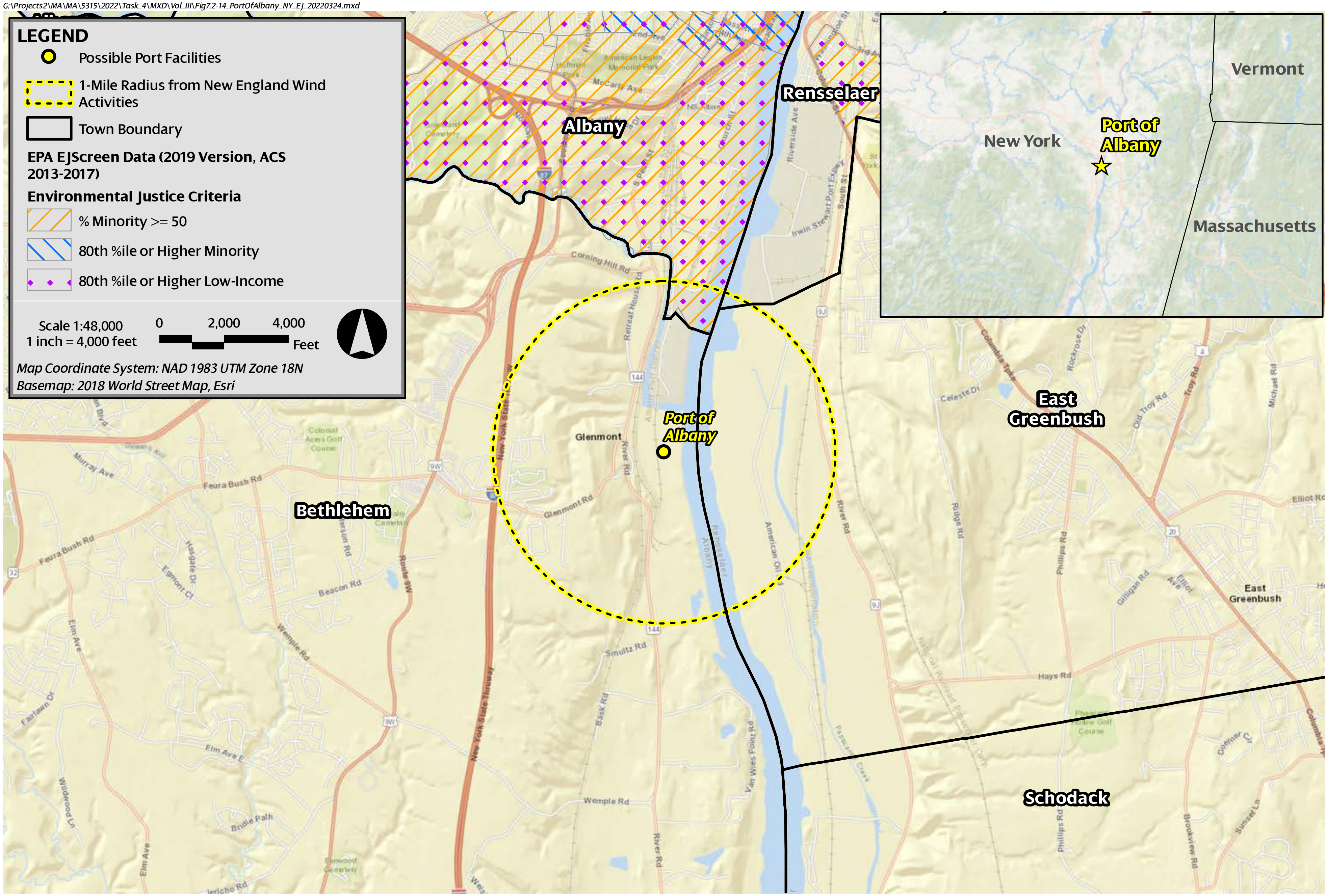

Figure 7.2-14

EJ Communities in Study Area Around Possible Port Facilities

Port of Albany on Mid-Hudson River - Glenmont, Albany County, New York

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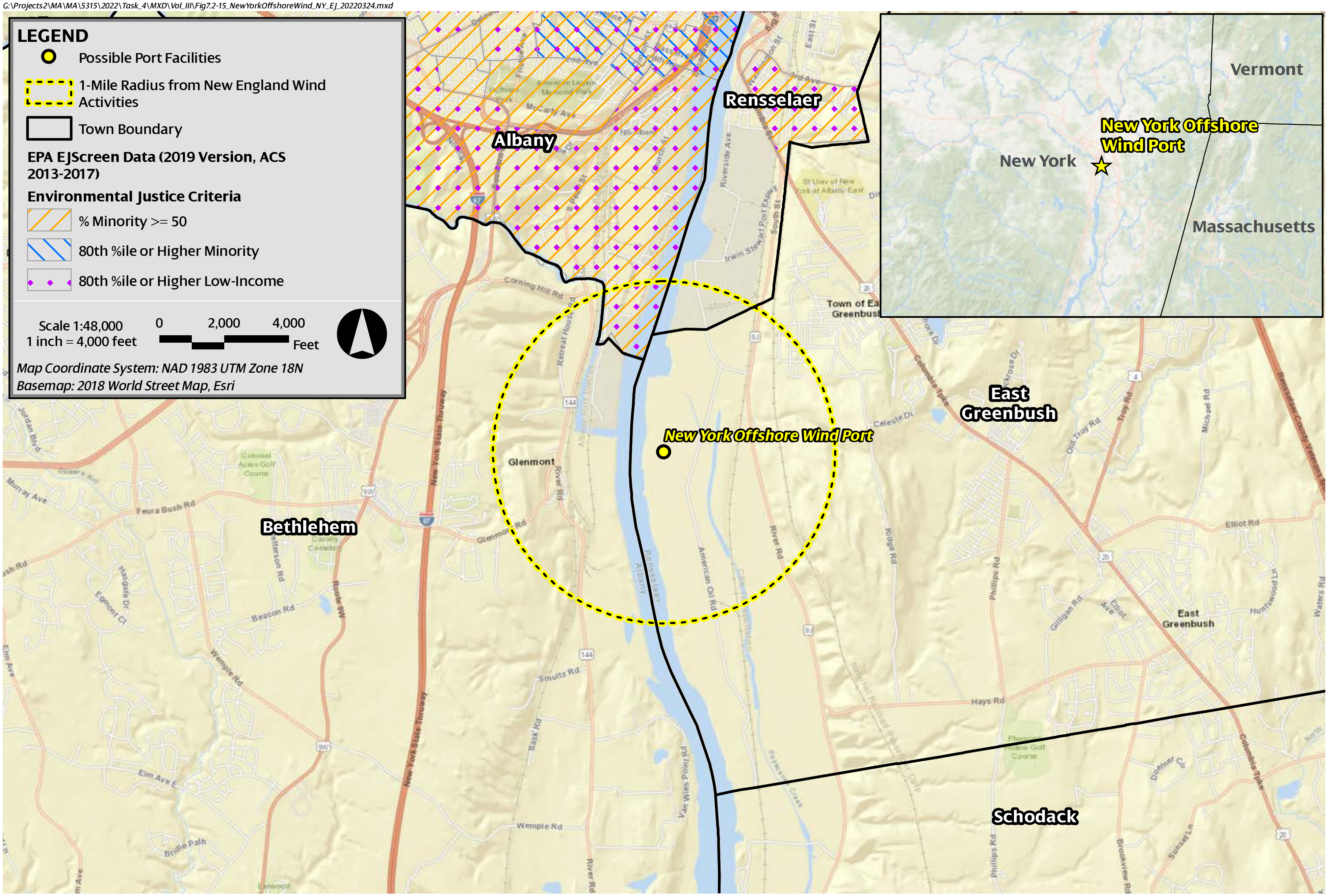

New England Wind

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Figure 7.2-15

EJ Communities in Study Area Around Possible Port Facilities

New York Offshore Wind Port on Mid-Hudson River - East Greenbush, Rensselaer County, New York

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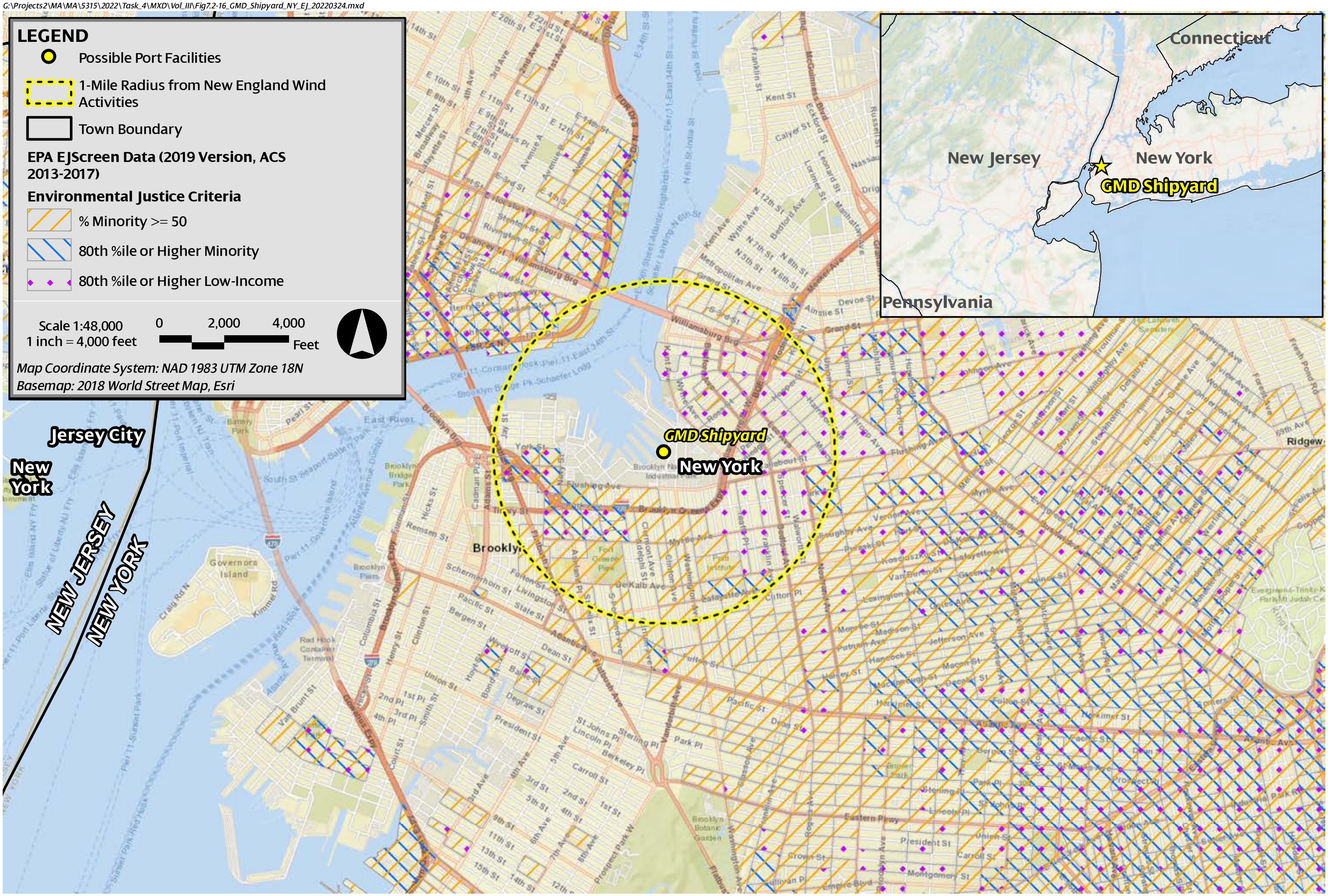

Figure 7.2-16

EJ Communities in Study Area Around Possible Port Facilities
GMD Shipyard at Brooklyn Navy Yard on the East River - New York City, Kings County, New York

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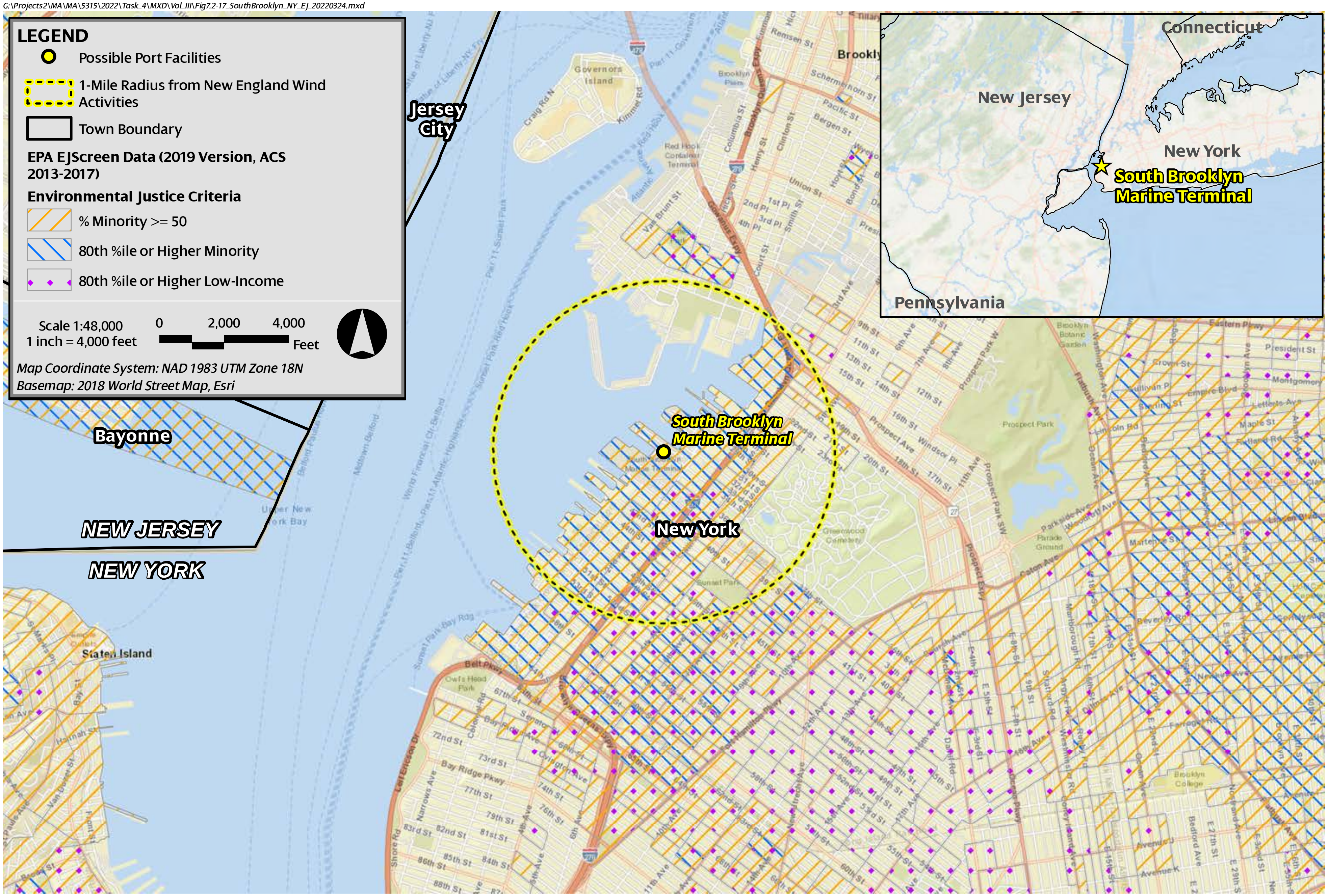

New England Wind

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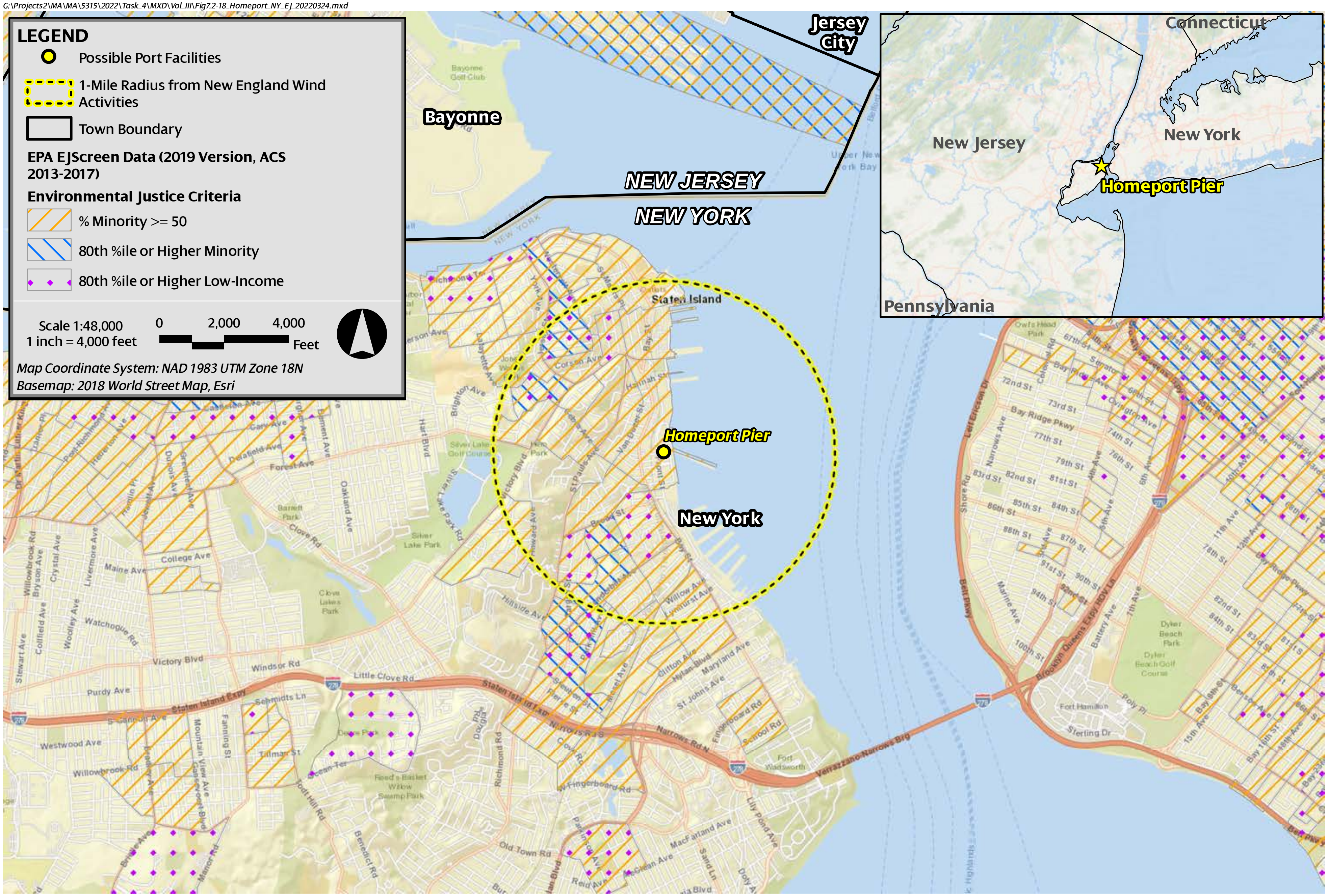
Figure 7.2-17

EJ Communities in Study Area Around Possible Port Facilities

South Brooklyn Marine Terminal on the Upper Bay of New York Harbor - New York City, Kings County, New York



New England Wind

Figure 7.2-18

EJ Communities in Study Area Around Possible Port Facilities

Homeport Pier on Staten Island on the Upper Bay of New York Harbor - New York City, Kings County, New York

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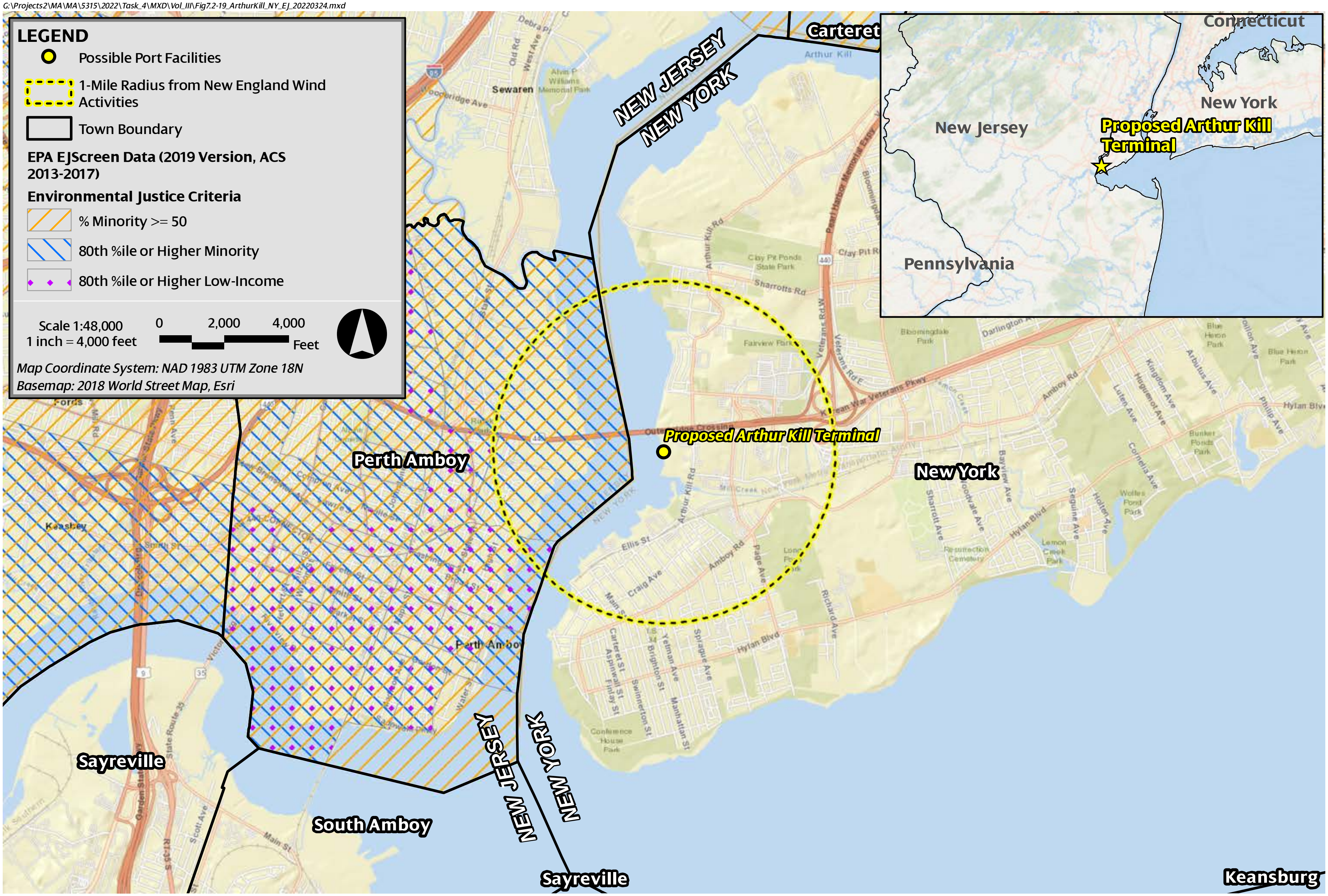

New England Wind

AVANGRID RENEWABLES

Figure 7.2-19

EJ Communities in Study Area Around Possible Port Facilities

Proposed Arthur Kill Terminal on Arthur Kill - Richmond County, Kings County, New York

Former Shoreham Nuclear Power Plant, North Side on Long Island: This 2.8 km^2 (700 acre) decommissioned site has been identified by the New York State Energy and Research Development Authority as a potential site for offshore wind port facilities. The site does not currently have a functioning waterfront terminal and would require significant investment and upgrades. This site would only be used if these improvements were made by the owner/lessor.

Figure 7.2-20 indicates no EJ communities are mapped within the study area of this possible port facility.

Greenport, Near Northeast Tip of Long Island: Greenport Harbor contains numerous commercial docks that could be used by the offshore wind industry for operations and maintenance activities, including provisioning, crew changes, weather standby, repairs, and possible fuel and water delivery.

Figure 7.2-21 indicates no EJ communities are mapped within the study area around the possible Greenport port facility.

7.2.1.9 New Jersey Possible Port Facility

While no physical components of New England Wind will be located in New Jersey, the Proponent is aware of plans by others to develop a monopile foundation factory at a site in Paulsboro, New Jersey. Paulsboro is located on the Delaware River and Pennsylvania is across the river. The Proponent may use port facilities located in the vicinity of the proposed factory at this port if those port facilities were developed by the owner/lessor in time for either Phase of New England Wind.

Figure 7.2-22 shows that a small portion of the study area to the southwest of the Paulsboro site is in the 80^{th} percentile or higher for low-income, thereby meeting EJSCREEN criteria as an EJ community. No EJ communities are mapped in the small portion of the study area extending into Pennsylvania.

7.2.2 Potential Impacts of New England Wind

As shown in Section 7.2.1, most of the study areas around New England Wind Phase 1 and Phase 2 activities contain communities that meet criteria for EJ concerns, especially around the possible port facilities in highly urban areas. Existing ports in the Northeast with the capacity to serve large-scale projects have spurred that urbanization and experienced pulses of development (such as World War II mobilization). These have often been followed by periods of neglect, obsolescence, and abandonment as industries, technologies, and transit requirements change. New England Wind activities may create impacts to proximal communities, particularly during construction and installation, but these will be temporary, short-term, and not adverse due to best management practices and other measures to avoid, minimize, and mitigate. Detailed descriptions of New England Wind's construction, operation, and decommissioning activities, potential impacts, and mitigation measures are presented in Sections 3 (for Phase 1) and 4 (for Phase 2) of COP Volume I; those relevant to EJ communities are presented in the sections below.

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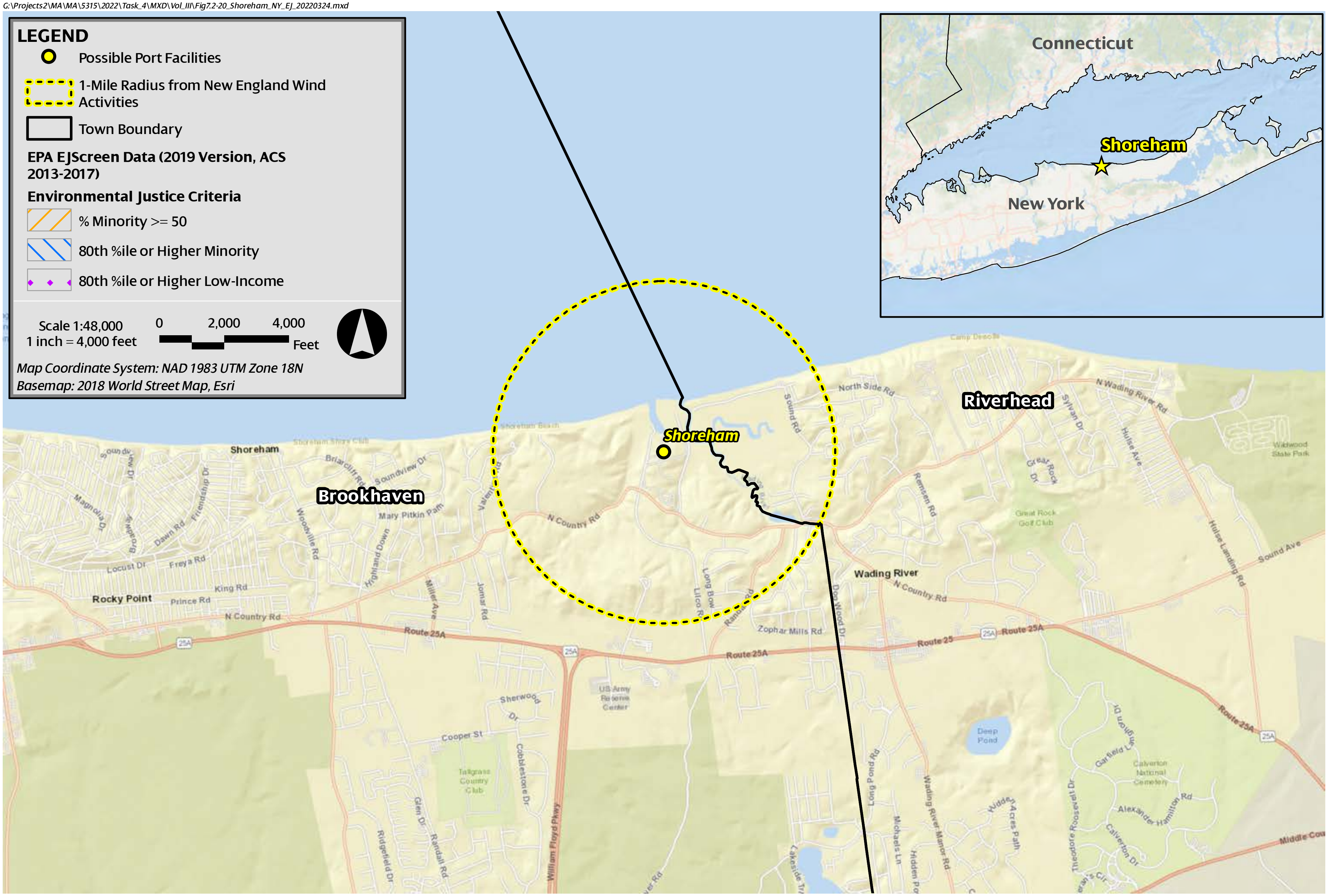

New England Wind
AVANGRID RENEWABLES

Figure 7.2-20

EJ Communities in Study Area Around Possible Port Facilities
Former Shoreham Nuclear Power Plant on Long Island Sound - East Shoreham, Suffolk County, Long Island, New York

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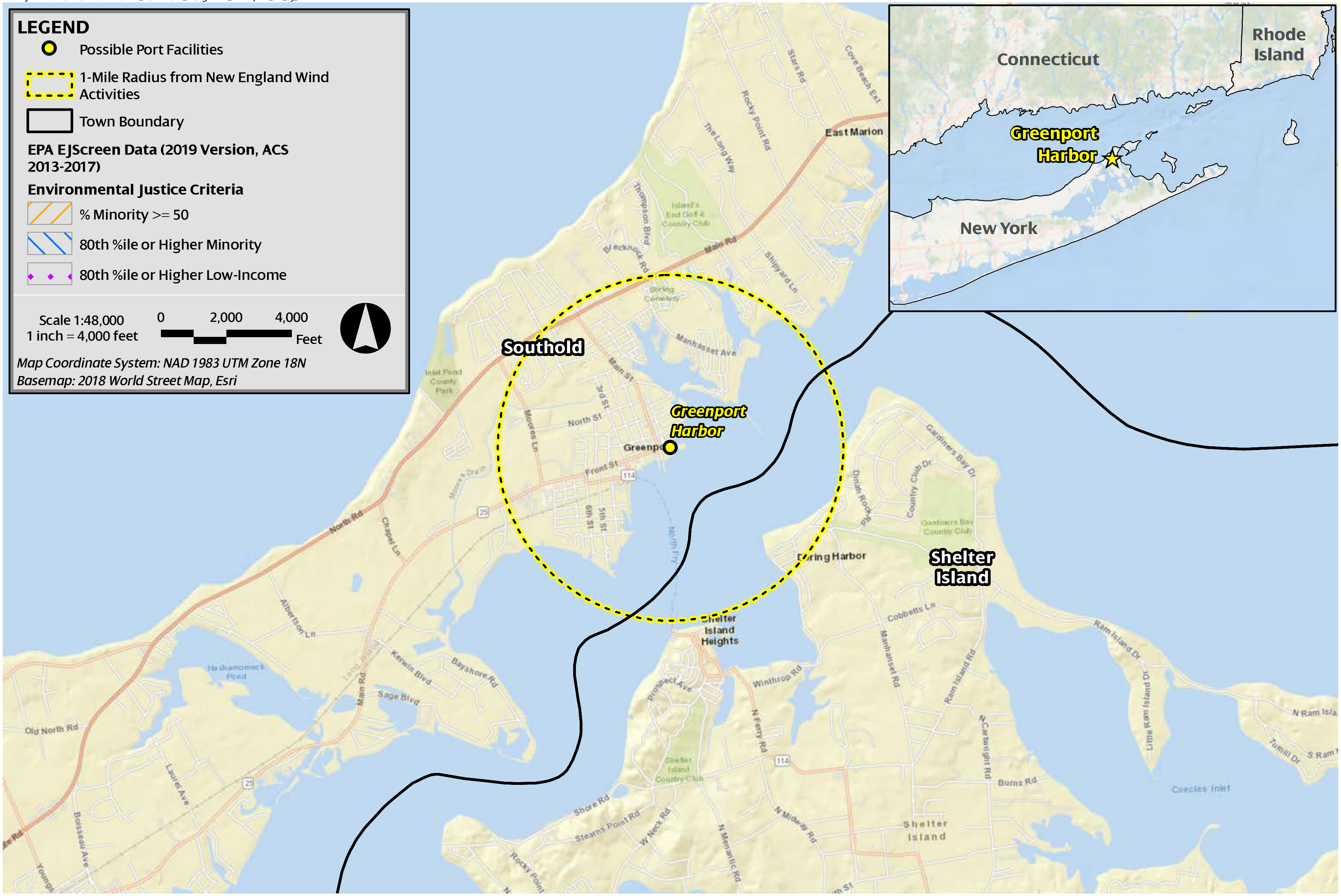

New England Wind
AVANGRID RENEWABLES

Figure 7.2-21

EJ Communities in Study Area Around Possible Port Facilities
Greenport Harbor on Long Island Sound - Greenport, Suffolk County, New York

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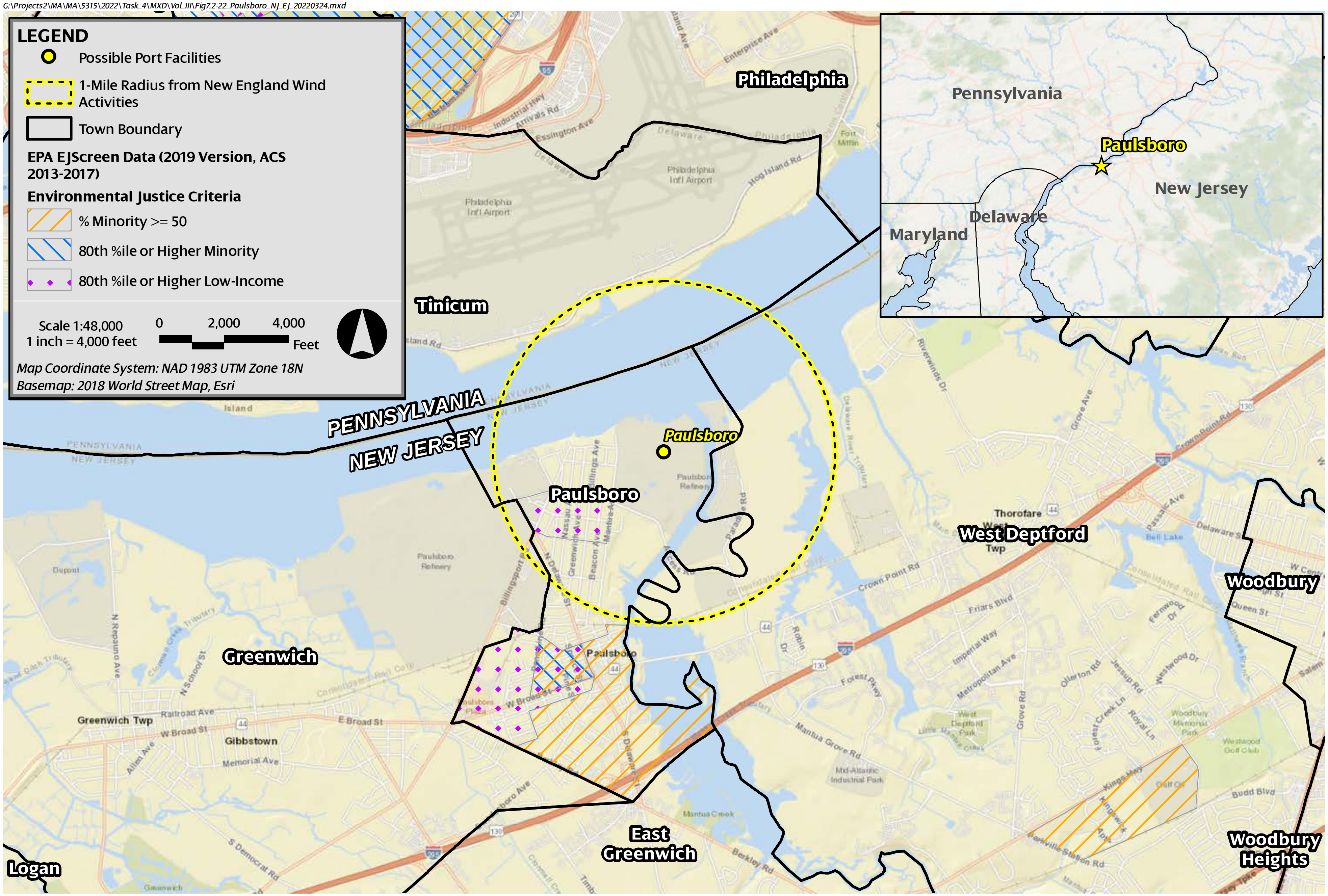

New England Wind

AVANGRID RENEWABLES

Figure 7.2-22

EJ Communities in Study Area Around Possible Port Facilities
Paulsboro on the Delaware River - Gloucester County, New Jersey

In perspective, development of New England Wind will produce emission-free power and introduce a proven offshore industry to the Northeastern US, which will provide environmental and economic benefits to EJ communities. New England Wind will require skilled and unskilled workers, which will be drawn from local areas as available. Development of New England Wind is expected to spur significant direct and indirect local economic growth while coordinating with existing industries, such as commercial fisheries, to minimize impacts (see Section 7.1). The generation portion of this utility will be located well offshore to minimize effects to all human populations, including EJ populations, and will provide electricity to all users.

Potential impacts of Phases 1 and 2 to EJ communities by activity type and measures to avoid, minimize, or mitigate those impacts are presented below.

Anticipated impacts of each Phase of New England Wind are listed in Table 7.2-1.

Table 7.2-1 Impact Producing Factors for Environmental Justice Communities

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Temporary onshore construction, including onshore traffic, noise, air emissions, and cable installation			•	•		•
Vessel traffic	•	•		•	•	•
Viewshed	•	•		•	•	•
Port utilization	•	•		•	•	•
Workforce initiatives	•	•	•	•	•	
Community benefits	•	•	•	•	•	

7.2.2.1 Construction and Installation (Phases 1 and 2)

7.2.2.1.1 Temporary Onshore Construction Impacts (Phases 1 and 2)

Impact producing factors (IPFs) for environmental justice from onshore construction and installation activities are expected to be traffic, noise, and air emissions due to cable installation and construction of onshore facilities in the Town of Barnstable. As shown on Figure 7.2-1, portions of the Phase 1 Onshore Export Cable Routes from the proposed landfall sites at Craigville Public Beach or Covell's Beach to the onshore substation site near Route 6 in the Town of Barnstable, and portions of the Grid Interconnection Routes from the substation to the grid interconnection point, would pass within 1.6 km (1 mile) of the westernmost portion of an EJ community that meets minority criteria under the Massachusetts EJ Policy. None of the Phase 2 Onshore Export Cable and Grid Interconnection Routes would be located within 1.6 km (1 mile) of this EJ community.

During construction and installation of onshore facilities for Phases 1 and 2, residents, tourists, and businesses proximal to these activities, including EJ and non-EJ populations, will experience temporary inconveniences and increased traffic primarily at the landfall sites, along the Onshore Export Cable Routes (which are expected to be primarily within public roadway layouts and utility ROWs), at the onshore substation sites, along the Grid Interconnection Routes to the grid interconnection point at the West Barnstable Substation, and adjacent to the existing West Barnstable Substation on Assessor Map Parcel #214-001 (where a segment of the grid interconnection cables may be located).

Construction and installation activities along the Onshore Export Cable Routes and Grid Interconnection Routes will temporarily disturb neighboring land uses through construction noise, vibration, dust, emissions, and traffic impacts (such as delays in travel along the impacted road). However, any disruption to normal and routine functions will cease upon conclusion of the construction and installation activities. EJ populations and non-EJ populations would equally experience these temporary and short-term effects, and access to neighborhoods would be maintained. From a traffic management perspective, there are no road segments of the Phase 1 or Phase 2 Onshore Export Cable Routes or Grid Interconnection Routes that are considered unique or unusual for this type of construction. Onshore construction impacts will be temporary, minor, and proximal to the construction zone.

7.2.2.1.2 Vehicular and Vessel Traffic (Phases 1 and 2)

IPFs for environmental justice could include increased vehicular and marine vessel traffic during offshore construction and installation. During construction and installation of offshore facilities, EJ and non-EJ populations may experience temporary inconveniences and increased onshore traffic to and from supply ports. Commercial and recreational fisherman may experience increased marine traffic along vessel routes between the ports, SWDA, and OECC. Marine traffic impacts could increase travel times and temporarily restrict fishing activities in some areas, affecting commercial and recreational fishermen, both of which contribute to local economies (for further discussion, see Sections 7.5 and 7.6).

Impacts of increased marine traffic and short-term routing restrictions during construction and installation of Phases 1 and 2 may affect members of EJ populations that depend on commercial fishing or subsistence fishing. These impacts would be temporary.

An EJ population has been identified under state criteria in south central Nantucket (see Figure 7.2-5). No New England Wind facilities or activities are proposed on the Island of Nantucket, and therefore this EJ population will not be affected. A segment of the OECC will pass through the westernmost portion of Nantucket state waters, but it is located outside of the 1.6 km (1 mile) radial study area around EJ populations. No disproportionately high and adverse effects will occur to this EJ population on Nantucket from New England Wind activities.

7.2.2.1.3 Viewshed (Phases 1 and 2)

IPFs for environmental justice could include viewshed impacts during offshore construction and installation. Construction and installation of New England Wind's WTGs and ESPs may affect certain existing views of the seascape. The WTGs will be located more than 32 km (20 miles) from the southwest corner of Martha's Vineyard. Potential visual impacts are summarized in Section 7.4 and assessed in Appendix III-H.a. Visual impacts associated with construction and installation would be limited to vessels carrying components and equipment and partially built structures depending on the phase of construction. Such impacts in general would be negligible as the construction and decommissioning periods will be temporary.

Figure 7.2-4 shows a minority EJ population in the southwest portion of Martha's Vineyard, in and around the Town of Aquinnah. The tribal headquarters of the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) (the Tribe) are located in Aquinnah, and many members reside in this area. The Tribe values certain offshore views as part of their ceremonial practices and cultural heritage (BOEM 2018). If BOEM determines, in consultation with the Tribe, that the visual impacts of construction and installation will be adverse to this mapped EJ population, BOEM will consult with the involved parties to develop mitigation measures that will be formalized in a Memorandum of Agreement, if necessary, under Section 106 of the National Historic Preservation Act.

7.2.2.1.4 Port Utilization (Phases 1 and 2)

IPFs for environmental justice include those associated with port utilization. As described in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I, each port facility under consideration to support Phase 1 and Phase 2 offshore construction and installation activities is either: (1) already located within an industrial waterfront area with sufficient existing infrastructure, or (2) identified as an area where other entities intend to develop infrastructure with the capacity to host construction activities under the Phase 1 and Phase 2 schedules. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.

As indicated on the EJ figures for possible port facilities (see Figures 7.2-2 through 7.2-22), EJ communities have been identified within the 1.6 km (1 mile) radial study area around each possible port facility, with the exception of three in New York. The three exceptions are the former Shoreham Nuclear Power Plant on Long Island, Greenport near the eastern tip of Long Island, and the Port of Coeymans on the west side of the mid-Hudson River as shown on Figures 7.2-20, 7.2-21, and 7.2-13, respectively).

Activities that may occur at the port facilities include construction staging; offloading/loading shipments of components; storage of components; component fabrication and assembly; transport of crews, structural components, and equipment to the SWDA; repairs; refueling; and restocking of supplies. As noted above, these activities would occur at industrial ports with sufficient existing infrastructure or where other entities intend to develop infrastructure suitable for such uses. Primary impacts may include increased traffic, emissions from support vehicles and vessels, and increased noise proximal to these activities. These impacts will be temporary.

7.2.2.1.5 Workforce Initiatives and Community and Environmental Benefits (Phases 1 and 2)

IPFs for environmental justice associated with construction and installation include workforce initiatives and community and environmental benefits.

Workforce Initiatives (Phases 1 and 2)

During the construction and installation of Phases 1 and 2, the Proponent anticipates directly hiring a workforce spanning a diverse range of professions for fabrication, construction, and/or assembly of components at locations selected to support this phase of development (see Section 7.1.2.1.1). The Proponent expects that most of the jobs that New England Wind creates will be located within the Onshore Development Region. EJ communities are located in the vicinity of many of the ports in the Onshore Development Region, as shown on Figures 7.2-2 through 7.2-22. This increase in job opportunities, as well as the related growth in local businesses serving this rapidly emerging industry, are expected to benefit area EJ communities.

Section 7.1.2.1 and Appendix III-L detail job creation and other positive economic impacts, including tax revenues, which the offshore renewable wind energy facilities in the SWDA can be expected to produce through the pre-construction, construction, installation, and operations phases of New England Wind.

Community and Environmental Benefits (Phases 1 and 2)

In addition to creating jobs, economic opportunities, and supporting local and regional suppliers, New England Wind will deliver substantial community and environmental benefits, as described in Section 4.1 and Appendix III-O.

7.2.2.1.6 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

Although an EJ population group under state criteria is mapped in one area near Route 6 that is near the Phase 1 Onshore Export Cable Route, onshore construction of New England Wind Phase 1 is not anticipated to cause disproportionately high and adverse health or environmental effects on minority or low-income populations. EJ population groups are also mapped in the vicinity of a number of ports considered for construction and installation support activities for Phases 1 and 2. As described herein, temporary impacts typical of large construction projects will occur, such as traffic, emissions from support vehicles and vessels, and noise.

These short-term impacts will be minimized by adherence to construction best management practices. The Proponent will assemble a Construction Management Plan (CMP) that will be used by the Proponent and its contractors during construction. The CMP will be developed to guide contractors during construction, and the document will be an integral part of the Proponent's effort to ensure that environmental protection and sound construction practices are implemented.

Under Section 106 of the National Historic Preservation Act, if BOEM determines, in consultation with the federally recognized Wampanoag Tribe of Gay Head (Aquinnah), that visual impacts due to construction and installation of New England Wind will be adverse to the EJ population mapped in Aquinnah on Martha's Vineyard, BOEM will consult with the involved parties to develop mitigation measures that will be formalized in a Memorandum of Agreement, if necessary.

The long-term impacts of New England Wind will include increased jobs and direct and indirect economic opportunities, all of which are expected to benefit area EJ communities. As discussed in Section 7.1.2, overall workforce and economic impacts are expected to be beneficial due to the increased workforce needed to support New England Wind development activities, the workforce training opportunities the Proponent has committed to, and the associated economic growth both to businesses directly related to offshore wind and those that will indirectly benefit (e.g. supply chain and area services industries).

The Proponent will execute a Diversity, Equity, and Inclusion (DEI) Plan for Commonwealth Wind that includes $15 million to fund DEI, workforce, and supply chain initiatives to support local content, increase diversity in the industry, and provide Environmental Justice (EJ) Population residents and other underrepresented populations real opportunities to join the offshore workforce and supply chain. To execute the DEI Plan, the Proponent has partnered with a diverse group of nonprofit partners located throughout Massachusetts.

In conclusion, New England Wind is not anticipated to cause any adverse impacts on human health to any population groups. In accordance with the provisions of Executive Order No. 12898 (1994), no specific mitigation measures are necessary for EJ communities.

7.2.2.2 Operations and Maintenance (Phases 1 and 2)

7.2.2.2.1 Maintenance of Onshore and Offshore Facilities

IPFs for environmental justice associated with operations and maintenance (O&M) include vessel traffic, viewshed, port utilization, workforce initiatives, and community benefits. The Proponent expects to use one or more facilities in support of O&M activities for Phases 1 and 2. The O&M facilities may include management and administrative team offices, a control room, office and training space for technicians and engineers, and/or warehouse space for parts and tools. The O&M facilities are also expected to include pier space for crew transfer vessels and/or other larger support vessels, such as service operation vessels. O&M facilities will function for the operational life of each Phase, which is anticipated to extend up to 30 years after construction and installation is completed.

For Phases 1 and 2, O&M activities may occur at any of the ports identified in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I, though it is expected that Phase 1 O&M activities will be primarily staged from port facilities located in Connecticut and/or Massachusetts.

Only negligible impacts are anticipated from the O&M facilities, which will provide employment opportunities within the Onshore Development Region. During the O&M period of New England Wind, goods, services, and other items are expected to be sourced from the surrounding community.

Periodic planned and unplanned maintenance of onshore facilities in the Town of Barnstable may cause minor, temporary, short-term impacts to communities in the immediate vicinity of these activities. Such activities may include limited clearing of vegetation along utility ROWs, inspections, planned replacement of equipment and materials, and the operation of equipment. Any disruption to normal and routine functions of the affected area will be eliminated upon conclusion of the construction and installation activity.

Periodic inspections, maintenance and repairs to offshore facilities are expected to occur during O&M. Such activities are only expected to result in negligible and temporary impacts.

7.2.2.2.2 Vehicular and Vessel Traffic (Phases 1 and 2)

IPFs for environmental justice could include increased vehicular and marine vessel traffic during O&M. Vehicular and marine vessel traffic will be less during typical O&M operations than during construction and installation, as the offshore operation of Phases 1 and 2 will be largely automated. Maintenance will be regular and ongoing and may require some crew and equipment transit along roadways to dockside at the appropriate port as well as vessel transits to and from the SWDA.

7.2.2.2.3 Viewshed (Phases 1 and 2)

IPFs for environmental justice could include viewshed impacts during offshore O&M. O&M of the offshore generation facilities may affect certain existing views of the seascape from the introduction of the numerous vertical lines of the WTGs into a strongly horizontal landscape defined by the horizon line at sea. Potential visual impacts are summarized in Section 7.4 and assessed in detail in the Visual Impact Assessment (VIA) in Appendix III-H.a. The nearest New England Wind WTG will be located 32 km (20 mi) off the coast of Martha's Vineyard (Squibnocket Point).

As described in Section 7.0 of the VIA in Appendix III-H.a, overall, New England Wind will result in minimal change to landscape conditions for viewers along the Martha's Vineyard and Nantucket coastlines, and will be virtually undetectable from Cape Cod. Viewers on the islands will have limited visibility of the WTGs when weather conditions allow. However, at distances 32 km (20 mi) or greater and viewed within the context of the ocean that includes the vast expanse of water, extended beach views and dunes, as well as the sights and sounds of breaking surf and wind, New England Wind would likely be considered visually subordinate to the wider landscape.

Figure 7.2-4 shows a minority EJ population mapped in the southwest portion of Martha's Vineyard, in and around the Town of Aquinnah. The tribal headquarters of the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) (the Tribe) are located in Aquinnah, and many members reside in this area. The Tribe values certain offshore views as part of their ceremonial practices and cultural heritage (BOEM 2018). If BOEM determines, in consultation with the Tribe, that the visual impacts of operation and maintenance will be adverse to the mapped EJ population in Aquinnah, BOEM will consult with the involved parties to develop mitigation measures that will be formalized in a Memorandum of Agreement, if necessary, under Section 106 of the National Historic Preservation Act.

7.2.2.2.4 Port Utilization (Phases 1 and 2)

IPFs for environmental justice associated with offshore O&M include those associated with port utilization. Impacts would include vehicular and vessel transit and associated air emissions (see Section 7.2.2.2.2) and intermittent noise at maintenance facilities. For Phase 1, the Proponent will likely establish a long-term SOV O&M base in Bridgeport, Connecticut, which is expected to provide direct and indirect economic opportunities for nearby EJ communities. In addition to the SOV O&M base, the Proponent has worked with its local partner, Vineyard Power, and the communities of Martha's Vineyard with the intention to base certain O&M activities on Martha's Vineyard. Current plans anticipate that crew transfer vessels (CTVs) and/or SOV's daughter craft would operate out of Vineyard Haven and/or New Bedford Harbor during O&M. For Phase 2 O&M, the Proponent will likely use facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor (see Section 4.2.2.6 of COP Volume I). For either Phase, the Proponent may use other ports to support O&M activities, as necessary (see Sections 3.2.2.6 and 4.2.2.6 of COP Volume I). Economic activity at O&M ports is expected to benefit area EJ communities.

7.2.2.2.5 Workforce Initiatives and Community and Environmental Benefits (Phases 1 and 2)

IPFs for environmental justice associated with O&M include workforce initiatives, and community and environmental benefits.

Workforce Initiatives (Phases 1 and 2)

Section 7.1.2.1 and Appendix III-L detail job creation and other positive economic impacts, including tax revenues, which the offshore renewable wind energy facilities in the SWDA can be expected to produce throughout the O&M phase of New England Wind.

Community and Environmental Benefits (Phases 1 and 2)

In addition to creating jobs, economic opportunities, and supporting local and regional suppliers, New England Wind will deliver substantial community and environmental benefits, as described in Section 4.1 and Appendix III-O. As described in Appendix III-O, for Phase 1 of New England Wind, the Proponent has committed up to $5 million to educate, recruit, mentor, and train residents of Connecticut, particularly Bridgeport, for careers in the offshore wind industry. Additionally, Phase 2 includes an investment of up to $35 million in local partnerships and programs. These programs include a robust Diversity, Equity, and Inclusion (DEI) Plan aimed at building a diverse, equitable, and inclusive offshore wind sector as well as a range of community benefits, environmental benefits, and innovation initiatives.

7.2.2.2.6 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

An EJ population group under state criteria is mapped in one area near Route 6 in the Town of Barnstable, Massachusetts that is near the Phase 1 Onshore Export Cable Route. EJ population groups are also mapped in the vicinity of a number of ports considered for O&M activities for Phases 1 and 2.

Only negligible impacts are anticipated from the O&M facilities, which will provide employment opportunities within the Onshore Development Region. The long-term impacts of New England Wind will include increased jobs, direct and indirect economic opportunities, and upgraded port conditions, all of which are expected to benefit area EJ communities.

In conclusion, onshore O&M activities of New England Wind Phases 1 and 2 are not anticipated to cause disproportionately high and adverse health or environmental effects on minority or low-income populations. In accordance with the provisions of Executive Order No. 12898 (1994), no specific mitigation measures are necessary for EJ communities.

Under Section 106 of the National Historic Preservation Act, if BOEM determines, in consultation with the federally recognized Wampanoag Tribe of Gay Head (Aquinnah), that visual impacts due to O&M of New England Wind will be adverse to the EJ population mapped in Aquinnah on Martha's Vineyard, BOEM will consult with the involved parties to develop mitigation measures that will be formalized in a Memorandum of Agreement, if necessary.

No specific mitigation is necessary to avoid and minimize effects. However, if needed based on the final proposed O&M activity, additional outreach to EJ populations will be coordinated by New England Wind and/or its contractors as necessary. No disproportionately high and adverse effects are anticipated to EJ populations from any O&M activities.

7.2.2.3 Decommissioning (Phases 1 and 2)

7.2.2.3.1 Overall Impacts (Phases 1 and 2)

Decommissioning activities would be similar to those associated with construction (see Sections 3.3.3 and 4.3.3 of COP Volume I). Decommissioning of the offshore components includes removal of WTG/ESP foundations below the mudline. Scour protection would also be removed. The offshore export cables, inter-array cables, and inter-link cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies and stakeholders on the preferred approach to minimize environmental impacts. The onshore facilities could be retired in place or retained for future use. The extent of onshore decommissioning is subject to discussions with the Town of Barnstable on the approach that best meets the Town's needs and has the fewest environmental impacts.

7.2.2.3.2 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

Avoidance, minimization, and mitigation measures applicable to potential EJ communities in the study areas during decommissioning activities are expected to the same as discussed previously for construction and installation. Decommissioning activities for New England Wind Phases 1 and 2 are not anticipated to cause disproportionately high and adverse health or environmental effects on minority or low-income populations. In accordance with the provisions of Executive Order No. 12898 (1994), no specific mitigation measures are necessary for EJ communities.

7.2.2.4 Opportunities for Public Involvement (Phases 1 and 2)

The Proponent has provided numerous opportunities for meaningful public involvement across the Onshore Development Region. The Proponent has conducted, and will continue to conduct, an extensive community outreach effort to provide opportunities across many media for all affected parties to learn about New England Wind, express concerns and participate in the environmental review process. A full description of the Proponent's outreach efforts is provided in Sections 5.2 and 5.3 of COP Volume I.

The outreach has included multiple community open houses publicized via advertisements in area newspapers, postings on municipal websites, postings on the Proponent's website, and emails to the New England Wind newsletter list. The Proponent also holds regular office hours.

The Proponent has undertaken diligent efforts to identify EJ communities in the vicinity of New England Wind and will continue to undertake extensive community outreach efforts to facilitate meaningful opportunities for all affected parties to participate.

New England Wind's outreach and public participation efforts are consistent with federal criteria and the Massachusetts EJ Policy. This consistency is based on the Proponent's community engagement and public information process, which has and will facilitate opportunities for all interested parties to participate.

7.2.2.5 Summary of EJ Assessments for New England Wind

New England Wind is consistent with federal and the Massachusetts EJ policy (where applicable) objectives of providing opportunities for "meaningful public engagement" by the public, including potential EJ population groups. This consistency is based on the Proponent's community engagement and public information process, which has facilitated and will continue to facilitate opportunities for all interested parties in the different parts of the Onshore Development Region to participate and is also based on the fact that New England Wind is not expected to not exceed any human health-based environmental impact thresholds.

Based on the foregoing assessment, New England Wind activities are not anticipated to cause disproportionately high and adverse health or environmental effects on minority or low-income populations in accordance with the provisions of Executive Order No. 12898 (1994).

Rather, New England Wind is expected to provide economic improvements and overall health benefits to EJ populations. Therefore, no additional measures to avoid, minimize, or mitigate impacts to EJ communities, beyond those proposed in this COP, are necessary.

7.3 Cultural, Historical, and Archaeological Resources

This section summarizes the studies conducted to identify and assess recorded and potential terrestrial and marine archaeological resources in the Onshore Development Area and Offshore Development Area, which are the respective onshore and offshore areas where New England Wind's facilities are physically located. Historic architectural resources are addressed in Appendix III-H.b and summarized in Section 7.4.

7.3.1 Terrestrial Archaeology

Terrestrial archaeology surveys have been conducted for each Phase of New England Wind. Survey reports are included in Appendix III-G.

Phase 1

- In May 2020, an archaeological reconnaissance survey was conducted for the Phase 1 Onshore Development Area (as shown on Figure 3.1-2). The reconnaissance survey included the (1) landfall sites, (2) Onshore Export Cable Routes, (3) onshore substation site, (4) Grid Interconnection Routes, which connect the onshore substation to the grid interconnection point, and (5) the grid interconnection point at the West Barnstable Substation. An archaeological sensitivity assessment was prepared for the Phase 1 Onshore Development Area and zones of low, moderate, and high archaeological sensitivity were identified. [redacted]

[redacted]

- In October 2021, an intensive archaeological survey was conducted [redacted]

Phase 2

- In June 2020, a due diligence review was completed for the Phase 2 Onshore Routing and Substation Envelope in Barnstable, MA. This review was completed prior to the identification of specific landfall sites and Onshore Export and Grid Interconnection Cable Routes for Phase 2, so the review was focused on a broad area in Barnstable. The due diligence report includes an inventory of recorded pre-contact, contact, and post-contact period archaeological sites (grouped by physiographic setting) and provides information about the types, nature, and distribution of archaeological resources located within the study area. [redacted]

[redacted]

[redacted] Further consultation with the MHC and local federally recognized Tribes regarding the potential for New England Wind to affect both known and un-recorded cultural resources that may be present within the study area was recommended.

- In November 2021, an archaeological reconnaissance survey was conducted for the Phase 2 Onshore Development Area (as shown on Figure 3.1-2). The reconnaissance survey included the: (1) landfall sites, (2) Onshore Export Cable Routes and Grid Interconnection Routes, and (3) the grid interconnection point at the West Barnstable Substation. The exact location of the Phase 2 onshore substation sites had not yet been determined, but the sites would be located generally along the onshore routes included in these studies. An archaeological sensitivity assessment was prepared for the Phase 2 Onshore Development Area and zones of low, moderate, and high archaeological sensitivity were identified. In April 2022 an additional due diligence study was conducted for Phase 2 for two potential onshore substation sites. [redacted]

- Archaeological monitoring is recommended for Phase 2 onshore construction activities [redacted] within the identified zones of high and moderate archaeological sensitivity in the in the Phase 2 Onshore Development Area. Additional details are further provided in Appendix III-G.

During the design phase of New England Wind, avoidance and minimization of potential adverse effects to terrestrial archaeological resources were considered and implemented through measures such as sighting the Onshore Export Cable Routes and Grid Interconnection Routes within existing ROWs and along existing roadway layouts to the extent feasible. The archaeological surveys conducted for Phase 1 and Phase 2 Onshore Development Areas identified areas of moderate and high archaeological sensitivity and, as recommended, the Proponent plans to conduct monitoring during construction in these areas. No further investigations are recommended for those areas subjected to an intensive survey. If needed, additional avoidance, minimization, or mitigation measures will be determined in consultation with the Bureau of Ocean Energy Management (BOEM), the Massachusetts Historical Commission (MHC), which contains the State Historic Preservation Office (SHPO), federally-recognized tribes, and other relevant consulting parties through the Section 106 and National Environmental Policy Act (NEPA) processes.

7.3.2 Marine Archaeology

A marine archaeological resources assessment (MARA) was conducted for both Phases of New England Wind. The MARA is provided in Volume II-D and consists of one report for the Southern Wind Development Area (SWDA) and a second report for the Offshore Export Cable Corridor (OECC) (including the Western Muskeget Variant). Gradiometer, side-scan sonar, bathymetry, seismic, sub-bottom profiler, and vibracores data were reviewed to assess the presence or absence of potential submerged cultural resources within the preliminary area of potential effects (PAPE). [redacted]. Submerged ancient landforms that may have the potential to contain archaeological materials were also identified within the SWDA and OECC (including the Western Muskeget Variant). Avoidance is recommended for each of these features located within the PAPE during bottom-disturbing activities for New England Wind to the extent feasible. If avoidance of these features is not possible, further geotechnical investigations may be warranted to better characterize their full archaeological sensitivity. Other mitigation measures, agreed to by BOEM and consulting parties during the Section 106 process, may also be appropriate. Potential mitigation measures for unavoidable impacts are provided in Appendix O of the MARA for the OECC included in Volume II-D.

7.4 Visual Resources

To address potential visual impacts of New England Wind, a Visual Impact Assessment (VIA) and a Historic Properties VIA are presented in Appendix III-H.a and Appendix III-H.b, respectively.

The VIA (Appendix III-A.a) delineates the proposed Zone of Visual Influence, describes the landscape character and visual settings within the Zone of Visual Influence, and identifies viewer groups. Other factors such as distance zones, points of visual extinction, the effects of curvature of the Earth, and meteorological visibility are considered. Visually sensitive resources were identified through desktop research and field reconnaissance. Baseline photographs from key observation points representative of the visually sensitive resources were taken under clear weather conditions. Daytime photographic simulations were then developed to show how New England Wind's offshore structures—principally, the wind turbine generators (WTGs) located in Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA])—would look from the simulation locations. The photographic simulations also model one ESP for Phase 1. At this time, the Proponent does not intend to develop the two positions located in the separate aliquots located along the northeastern and northwestern boundary of Lease Area OCS-A 0501 as part of New England Wind. The Historic Properties VIA (Appendix III-H.b) assesses visual impacts of New England Wind on historic properties.

New England Wind is in the Massachusetts Wind Energy Area (MA WEA) identified by BOEM as suitable for offshore wind energy development, sited far from shore to minimize visual impacts. The nearest potential New England Wind WTG is 34 kilometers (km) (21.2 miles [mi]) off the coast of Martha's Vineyard (Squibnocket Point) and 40 km (25.1 mi) off the coast of Nantucket (Madaket).[102] Due to the curvature of the earth, the foundations will fall partially or completely below the horizon from many land-based vantage points and there are no land-based vantage points from which a WTG or ESP can be viewed in its entirety. Some portion of the structures will always fall below the visible horizon. When viewed from ground level vantage points, the off-white/light grey color of the WTGs generally blends well with the sky at the horizon. The upper portion of the ESP(s) will also be a grey color which would appear muted and indistinct. Additionally, atmospheric conditions reduce visibility, sometimes significantly, and the presence of waves obscure objects very low on the horizon. Furthermore, limits to human visual acuity reduce the ability to discern objects at great distances.

The meteorological analysis concludes that due to atmospheric conditions (such as haze, fog, rain, smog, or snow), New England Wind WTGs/ESP(s) will not be visible approximately 82% of the time from Gay Head Lighthouse at Martha's Vineyard and approximately 86% of the time from the closest location from the Nantucket Historic District (see Appendix III-H.a, Appendix D).[103] Given the distance of the WTGs, and ESP(s) from shore, earth's curvature, and atmospheric conditions, visual impacts to onshore viewers of WTGs and ESP(s) in daylight would be expected to be minor.

Although aviation obstruction lights may be visible at night from beaches and coastal bluffs during clear weather conditions, it should be noted that recreational beaches are primarily visited during daytime hours, minimizing the number of affected viewers. To substantially reduce the amount of time the lights are visible, the Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent would expect to use the same or similar approaches to reduce lighting used for Vineyard Wind 1 and/or Phase 1, including the use of an ADLS. An assessment of the activation frequency of an ADLS indicates that it would be activated less than one hour per year (see Appendix III-K). Marine navigation lights are expected to have a designed visual range of 5 nautical miles (NM) or less and are therefore not likely to be discernible from coastal vantage points.

Overall, New England Wind will result in minimal change to landscape conditions for viewers along the Martha's Vineyard and Nantucket coastlines. Viewers on the islands will have limited visibility of the WTGs and ESP(s) when weather conditions allow. Moreover, with WTG distances greater than 34 km (21.2 mi) and when viewed within the context of the ocean that includes the vast expanse of water, extended beach views and dunes, as well as the sights and sounds of breaking

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102 The COP reports distances both to the SWDA boundary and to the closest WTG within the SWDA. At its closest point, the boundary of the SWDA (excluding the two separate aliquots that are closer to shore) is just over 32 kilometers (km) (20 miles [mi]) from the southwest corner of Martha's Vineyard and approximately 38 km (24 mi) from Nantucket.

103 The Nantucket Historic District boundary is from the MassGIS Data: Massachusetts Historical commission (MHC) Historic Inventory. This boundary extends slightly offshore and thus is not coincident with the shoreline of Nantucket.

surf and wind, New England Wind would likely be considered visually subordinate to the wider landscape. New England Wind will be virtually undetectable from Cape Cod. In fact, all of Cape Cod's south coast (excluding a small area of shoreline at Woods Hole, which is screened from New England Wind by the landform of Martha's Vineyard in the foreground) and all of mainland Massachusetts, Rhode Island (including Block Island), Connecticut and New York's Long Island are not expected to be affected by views of New England Wind.

Further, the VIA includes cumulative panorama views that show New England Wind in the context of the expected future development of the MA WEA and the adjacent Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA). When viewed in the context of the theoretical buildout of the MA WEA and RI/MA WEA, New England Wind will fall behind other projects and will be screened to some degree from coastal vantage points.

All offshore cables will be submerged and will not be visible. The Phase 1 onshore export cables and grid interconnection cables will be installed entirely underground and will not be visible, except for possibly at the Phase 1 Centerville River crossing. The Phase 2 onshore cables are also expected to be installed underground. New onshore substations will be constructed in the Town of Barnstable. The Phase 1 onshore substation will include vegetative screening. Views of the Phase 2 Clay Hill onshore substation site are limited and represent a de minimis alteration to the existing visual character of the local landscape. Lower height electrical equipment and buildings associated with the substation will not be directly visible from any off-site vantage point. In areas where lightning masts are predicted to be visible; the lightning masts will be low within the intervening tree line. Land and tree clearing will be minimized to the extent practicable and an existing forested buffer around the substation will be maintained for visual screening.

The Historic Properties VIA in Appendix III-H.b identified a variety of historic properties, including historic buildings and structures, within the Preliminary Area of Potential Effects (PAPE) for New England Wind. These historic properties include properties listed as National Historic Landmarks, properties on or determined eligible for listing on the National Register of Historic Places (including traditional cultural properties) as well as the Massachusetts State Register of Historic Places, and properties included within the Inventory of Historic and Archaeological Assets of the Commonwealth.

As described in Appendix III-H.b, photographic visual simulations combined with existing conditions photographs, maps, and other graphics were used to investigate the potential visual impact of New England Wind on historic properties within the PAPE. New England Wind, when viewed in isolation, may have an adverse visual effect on the Gay Head Lighthouse on Martha's Vineyard (listed on the National Register) and the Vineyard Sound and Moshup's Bridge Traditional Cultural Property (TCP) due to the introduction of new elements to the maritime settings of these resources. However, it should be noted that the potential adverse effect to these resources is inconsistent and weather dependent as the vast majority of the time the SWDA will not be visible. Further, the adverse effect is also mitigated by the future proposed offshore wind developments in the MA WEA and RI/MA WEA that will, at a minimum, partially screen the SWDA from view. Once offshore wind projects are constructed in other lease areas that are closer to Gay

Head Lighthouse and the Vineyard Sound and Moshup's Bridge TCP (not related to Vineyard Wind 1 or New England Wind), the SWDA (if visible at all) will likely be indistinguishable from these other proposed projects and, as a result, the potential adverse effect will be greatly diminished. Proposed measures to mitigate adverse visual effects on Gay Head Lighthouse and the Vineyard Sound and Moshup's Bridge TCP are provided in Attachment B of Appendix III-H.b. These measures will be refined in consultation with BOEM, the Massachusetts Historical Commission/State Historic Preservation Office, federally recognized tribes, and other relevant consulting parties through the Section 106 and National Environmental Policy Act processes.

As described in Appendix III-H.b, no other adverse effects findings were made for other historic properties in the PAPE. The proposed off-white/light grey color of the New England Wind WTGs and the expected use of ADLS minimizes potential adverse effects to historic properties by minimizing daytime visibility and nearly eliminating nighttime visibility (by having aviation obstruction lighting remain off unless aircraft approach the SWDA). The upper portion of the ESP(s) will be a grey color which would appear muted and indistinct.

Additionally, the Proponent's Good Neighbor Agreement with the Town and County of Nantucket, the Maria Mitchell Association, and the Nantucket Preservation Trust (collectively the "Nantucket Parties") establishes a long-term relationship with the Nantucket Parties and more generally, the Nantucket community, to support and promote the parties' mutual interests in renewable energy development, combating the effects of global climate change, enhancing coastal resiliency, and protecting, restoring, and preserving cultural and historic resources. In accordance with the agreement, the Nantucket Parties will establish the Nantucket Offshore Wind Community Fund, which will support projects and initiatives related to protecting, restoring, and preserving cultural and historic resources, coastal resiliency, climate adaptation, and renewable energy. Phase 1 and Phase 2 of New England Wind will each contribute $3 million to the Nantucket Offshore Wind Community Fund at financial close. The Proponent will also work closely with the Nantucket Parties to further engage the extensive Nantucket community of stakeholders to ensure that residents and other interested parties are informed of its projects and the associated community benefits.

7.5 Recreation and Tourism (Including Recreational Fishing)

This section describes the general characteristics of recreation and tourism activities, including recreational fishing, that may be affected by New England Wind. In general, potential impacts to recreation and tourism may occur in offshore areas where wind energy generation facilities will be constructed and in coastal communities where onshore and offshore facilities for New England Wind will be located. Visual impacts are assessed in Section 7.4 and Appendix III-H.a and commercial and for-hire recreational fishing impacts are assessed in Section 7.6.

7.5.1 Description of the Affected Environment

Offshore facilities for New England Wind will be physically located in the Offshore Development Area. This area is comprised of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501, referred to as the Southern Wind Development Area (SWDA), and Offshore Export Cable Corridor (OECC), which is the corridor identified for routing the offshore export cables. New England Wind will be developed in two Phases with a maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions. The SWDA (excluding the two separate aliquots that are closer to shore) is just over 32 kilometers (km) (20 miles [mi]) from the southwest corner of Martha's Vineyard and approximately 38 km (24 mi) from Nantucket.[104] Offshore export cables for both Phases will be installed within the OECC that travels from the northwestern corner of the SWDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then head northward along the eastern side of Muskeget Channel toward landfall sites in the Town of Barnstable. The OECC is located within the waters of Dukes County, Nantucket County, and Barnstable County, as well as within federal waters (see Figure 7.5-1).

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the option to install one or two Phase 2 cables[105] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[106] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

With respect to recreation and tourism, the Offshore Development Region is the broader offshore geographic region surrounding the SWDA and OECC that could be affected by New England Wind-related activities, which includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), and the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA).[107]

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104 Within the SWDA, the closest WTG is approximately 34 km (21 mi) from Martha's Vineyard and 40 km (25 mi) from Nantucket.

105 It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

106 The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

107 The section is focused on recreational and tourist-based activities and so does not consider port facilities, as each port facility being considered for New England Wind is either already located within an industrial waterfront area or is identified as an area where other entities intend to develop infrastructure with the capacity to host construction activities under the New England Wind development schedule.

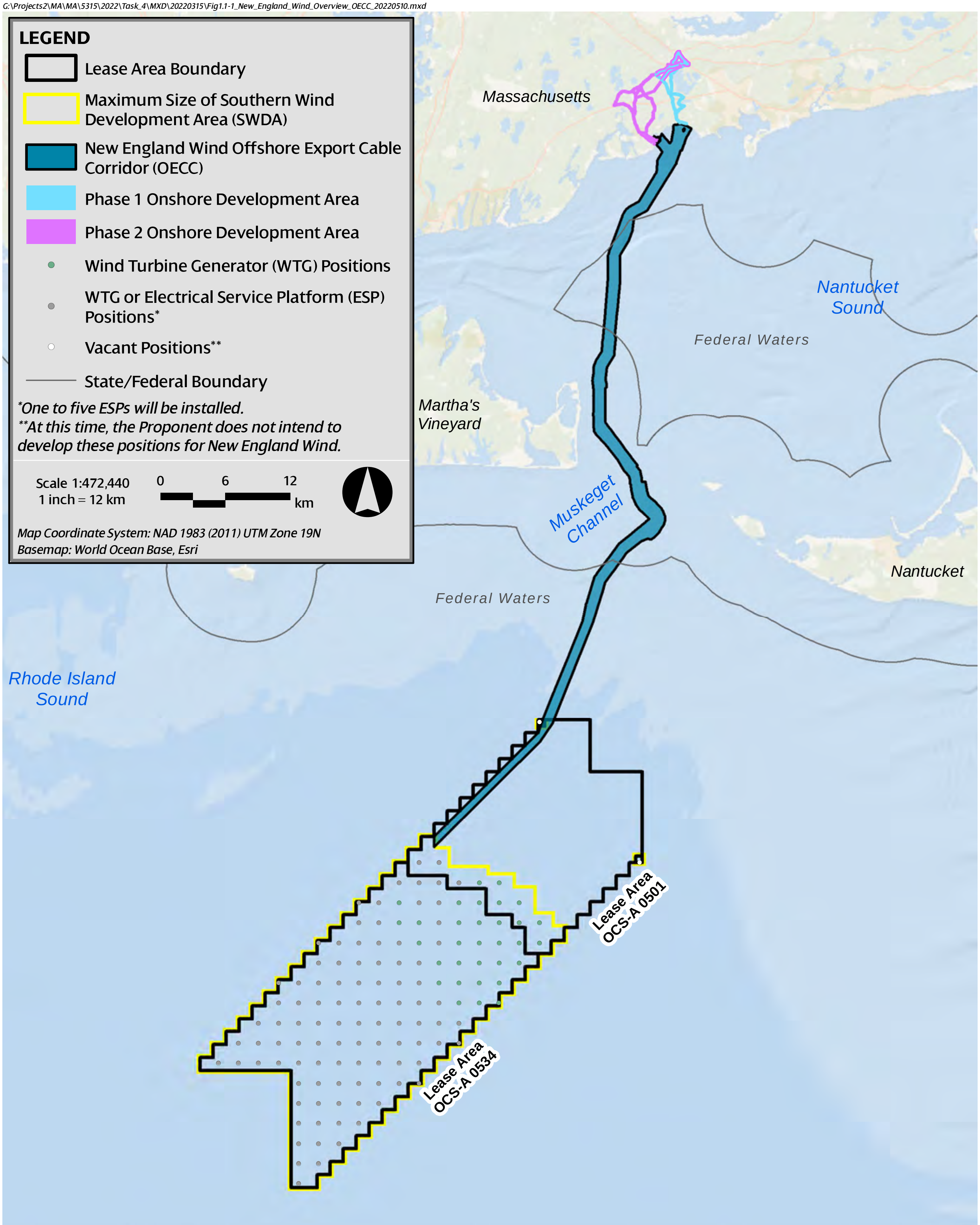

Figure 7.5-1
New England Wind Overview

Onshore activities and facilities for each Phase will be located in the Onshore Development Areas within the Town of Barnstable, Barnstable County. As described further in Sections 3.2.2 and 4.2.2 of COP Volume I, each Phase of New England Wind will have a separate onshore transmission system, but will both connect to the ISO New England electric grid at the same grid interconnection point, Eversource's existing 345 kilovolt West Barnstable Substation. Thus, the Onshore Development Areas for Phases 1 and 2 consist of: (1) landfall sites where the offshore cable system transitions to shore, (2) Onshore Export Cable Routes, within which the onshore export cables will be installed, (3) onshore substation sites, (4) Grid Interconnection Routes, which are the onshore transmission routes that connect the onshore substations to the grid interconnection point, and (5) the grid interconnection point at the West Barnstable Substation. With respect to recreation and tourism, the Onshore Development Region is the broader onshore geographic region comprising of the cities, towns, and communities surrounding New England Wind's onshore facilities that could be affected by New England Wind-related activities.

The Proponent has identified port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for major Phase 1 or Phase 2 construction staging activities. A complete list of the possible ports that may be used for major construction staging activities can be found in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.

Each port facility being considered is either located within an industrial waterfront area with sufficient existing infrastructure or is identified as an area that other entities intend to upgrade or develop to provide the capacity to host construction activities for Phase 1 or Phase 2. As a result, use of ports is not expected to impact recreation and tourism and is not discussed further in this section. Port utilization is discussed further in Sections 7.1 and 7.2.

The Proponent anticipates using one or more facilities to support operations and maintenance (O&M) activities for each Phase of New England Wind. The Proponent expects to locate the Phase 1 and 2 O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor. Additional ports identified in Section 7 may also be used to support O&M activities for one or both Phases.

Similar to the port facilities that will be used for construction, the O&M facilities will be located within an industrial waterfront and are not expected to impact recreation and tourism. O&M facilities are therefore not discussed further in this section.

7.5.1.1 Recreational Resources in Coastal Communities

New England Wind's onshore and offshore facilities will be installed within several coastal communities in the Onshore and Offshore Development Region. As noted above, onshore facilities for New England Wind will be located within the Town of Barnstable, Barnstable County and the OECC is located within the waters of Dukes County, Nantucket County, and Barnstable County, as well as federal waters.

Barnstable County (Cape Cod)

Barnstable County, located in southeastern Massachusetts, is comprised of the entirety of Cape Cod. Much of Barnstable County's 885 km (550 mi) coastline is sandy beach that is ideal for beach going, walking, snorkeling, windsurfing, and, at certain beaches, surfing. The County has more than 150 public beaches, several more private beaches, and limited access coastal areas. There are approximately 30 harbors, 40 marinas and boatyards, and approximately two dozen private boating and yacht clubs in the County (Garcia et al. 2012). Several wildlife sanctuaries in the County, along with the Cape Cod National Seashore, serve as important destinations for onshore wildlife viewing.

Cape Cod is a popular tourist destination and depends on the tourism and recreation industries for significant revenues. For example, approximately one-third of all regional employment in Cape Cod is directly related to tourism (Cape Cod Commission 2019). Based on the most recent Census Bureau data available, Barnstable County's recreation and tourism sectors are supported by an estimated 228 facilities offering lodging and 796 food and drink establishments. Approximately 32% of all residential units in Barnstable County are for seasonal, occupational, or occasional use (US Census Bureau 2010). A detailed description of Barnstable County can be found in Section 7.1.1.1.1.

The Town of Barnstable is the largest of 15 municipalities located within Barnstable County and has approximately 160 km (100 mi) of coastline, more coastline than any other town in Massachusetts. The Town maintains and operates five public beaches in proximity to Hyannis Harbor: Craigville Beach and Covell's Beach, in Centerville Harbor; Sea Street—Keyes Beach and Kalmus Beach in the Outer Harbor; and Veterans Beach in the Middle Harbor. These facilities also include public amenities and may be staffed on a seasonal basis.

Dukes County (Martha's Vineyard and Adjoining Small Islands)

Dukes County, located off the south coast of Massachusetts, has approximately 241 km (150 mi) of coastline consisting almost entirely of remote, sandy beaches. Dukes County has approximately 15 large public beaches, but on Dukes County's largest island, Martha's Vineyard, much of the coast is private access only. There are five harbors, two marinas, and three yacht clubs in Dukes County. The County also has six public boat launch facilities that provide access to coastal waters. Dukes County's only nationally protected land is Noman's Land Island National Wildlife Refuge (Garcia et al. 2012). However, nearly a quarter, or approximately 81 square kilometers (km^2) (20,000 acres), of Martha's Vineyard is conserved open space, which includes substantial recreational areas.

Dukes County's recreation and tourism sectors are supported by an estimated 30 facilities offering lodging, including hotels, motels, inns, and bed and breakfast establishments, as well as 98 food and drink establishments. Approximately 53.4% of all residential units in Dukes County are for seasonal, occupational, or occasional use (US Census Bureau 2010). A detailed description of Dukes County can be found in Section 7.1.1.1.3.

Nantucket County

The island of Nantucket has approximately 177 km (110 mi) of shoreline of which approximately 129 km (80 mi) is sandy beach open to the public. The Nantucket Wildlife Refuge accounts for 0.1 km^2 (25 acres) of nationally-protected land and is the only national refuge on the island. Nantucket's two main harbors, Nantucket Harbor and Madaket Harbor, are popular seasonal destinations for recreational vessels. The Island of Nantucket has two yacht clubs and multiple marinas (Garcia et al. 2012). Nantucket also offers two public access boat ramps in Madaket Harbor.

Nantucket County's recreation and tourism sectors are supported by an estimated 28 facilities offering lodging and 85 food and drink establishments. Approximately 56% of all residential units in Nantucket County are for seasonal, occupational, or occasional use (US Census Bureau 2010). Detailed descriptions of Nantucket County can be found in Section 7.1.1.1.4.

7.5.1.2 Recreational Boating and Fishing

Recreational boating (including paddle sports), sport fishing, swimming, and diving are seasonally important recreational activities within the Offshore Development Region. Offshore whale watching, deep-sea fishing, and other fishing vessel charters are common seasonal activities.

Recreational boating activity varies seasonally, with peak boating season occurring between May and September. Other boat-based recreational activities, including canoeing, kayaking, and paddle boarding, take place close to shore in sheltered waters and predominantly within 1.6 km (1 mi) of the coastline. Along the OECC, these activities are likely to predominantly occur in areas close to shore (i.e. near the landfall sites in Barnstable) and less likely to occur within the SWDA. Potential routes of offshore long-distance sailboat races could transit the SWDA. For example, the Newport Bermuda Sailboat Race involves 150-200 sailboats and departs from Newport, Rhode Island and concludes in Bermuda (Newport Bermuda Race 2019). However, the preferred vessel routing for these events varies based on weather, tide, and other factors.

Recreational fishing vessels operate from nearly every harbor in the Offshore Development Region; in addition, ramp-launched vessels are brought to the Offshore Development Region from other parts of New England. Although recreational fishing occurs on a year-round basis throughout the Offshore Development Region, the intensity of recreational fishing increases substantially in the warmer weather months. The timing of migratory species' "run" through the Offshore Development Region often dictates the intensity of recreational fishing activity.

The Bureau of Ocean Energy Management (BOEM) estimates that, of the nearly two million angler trips occurring in Massachusetts between 2007 and 2012, approximately 4.4% of those trips occurred within 1.6 km (1 mi) of the MA WEA, which is the over 3,000 km^2 (740,000 acre) area designated in Massachusetts by BOEM for offshore wind energy development (Kirkpatrick et al. 2017). Substantially fewer numbers of angler trips originating in New York and Rhode Island occurred within 1.6 km (1 mi) of the MA WEA. During that same time period, recreational angler trips occurring within 1.6 km (1 mi) of the MA WEA most frequently originated from harbors in Tisbury, Nantucket, and Falmouth while fewer than 600 angler trips originated from Rhode Island (Kirkpatrick et al. 2017).

Saltwater fishing tournaments are also held during the summer months in waters throughout the Offshore Development Region. Rhode Island and Massachusetts-based organizations, for example, sponsor upward of 60 fishing tournaments each year. The tournaments target a variety of different species (e.g. Atlantic cod (*Gadus morhua*), black sea bass (*Centropristis striata*), bluefish (*Pomatomus saltatrix*), haddock (*Melanogrammus aeglefinus*), tuna (*Thunnus*), and fluke (*Paralichthys dentatus*) (RICRMC 2010).

Recreational fishing activities have been reported to occur in portions of the MA WEA and the adjacent RI/MA WEA, which is also designated by BOEM for offshore wind energy generation. A recent study by Kneebone and Capizzano (2020) estimates the level of recreational fishing effort within the MA WEA and the adjacent RI/MA WEA. As described in the study, numerous highly migratory fish species, such as tunas, billfish, mahi mahi (*Coryphaena hippurus*), and sharks, are present in the offshore waters in southern New England. Recreational fishing vessels target many of these highly migratory fish species at popular fishing areas throughout southern New England, some of which occur within and adjacent to the MA WEA and RI/MA WEA (see Figure 7.5-2).

Kneebone and Capizzano (2020) collected baseline information on recreational fishing effort by: (1) surveying recreational fishermen from the private (angling category) and charter/headboat sectors on their recreational fishing efforts over the past five years, and (2) analyzing available data on recreational fishing effort over recent decades. The study determined that recreational effort for highly migratory species is widespread throughout southern New England and that the greatest recreational fishing effort occurs west of the MA WEA and RI/MA WEA (i.e. west of the SWDA) in the waters south and east of Montauk Point and Block Island (Kneebone and Capizzano 2020). In particular, large amounts of recreational fishing occur in areas such as The Dump, Tuna Ridge, The Horns, and The Lanes (see Figure 7.5-2). Specifically, the three areas within the MA WEA and RI/MA WEA with the highest levels of recreational fishing activity for highly migratory species were Coxes Ledge, The Fingers, and The Claw (see Figure 7.5-2). Finally, the study indicated that recreational fishermen primarily target bluefin tuna (*Thunnus thynnus)*, shortfin mako (*Isurus oxyrinchus*), and "any tuna species" within Lease Areas OCS-A 0501 and OCS-A 0534, with trips primarily originating from Massachusetts and Rhode Island. Accordingly, while recreational fishing effort occurs within the SWDA, such effort is widespread throughout southern New England and is more highly concentrated in areas to the west of the SWDA.

7.5.2 Potential Impacts of New England Wind

The potential impact producing factors (IPFs) as they relate to Phases 1 and 2 of New England Wind are presented in Table 7.5-1. As the impacts from each Phase of New England Wind are expected to be similar, the following assessment of impacts is applicable to both Phases.

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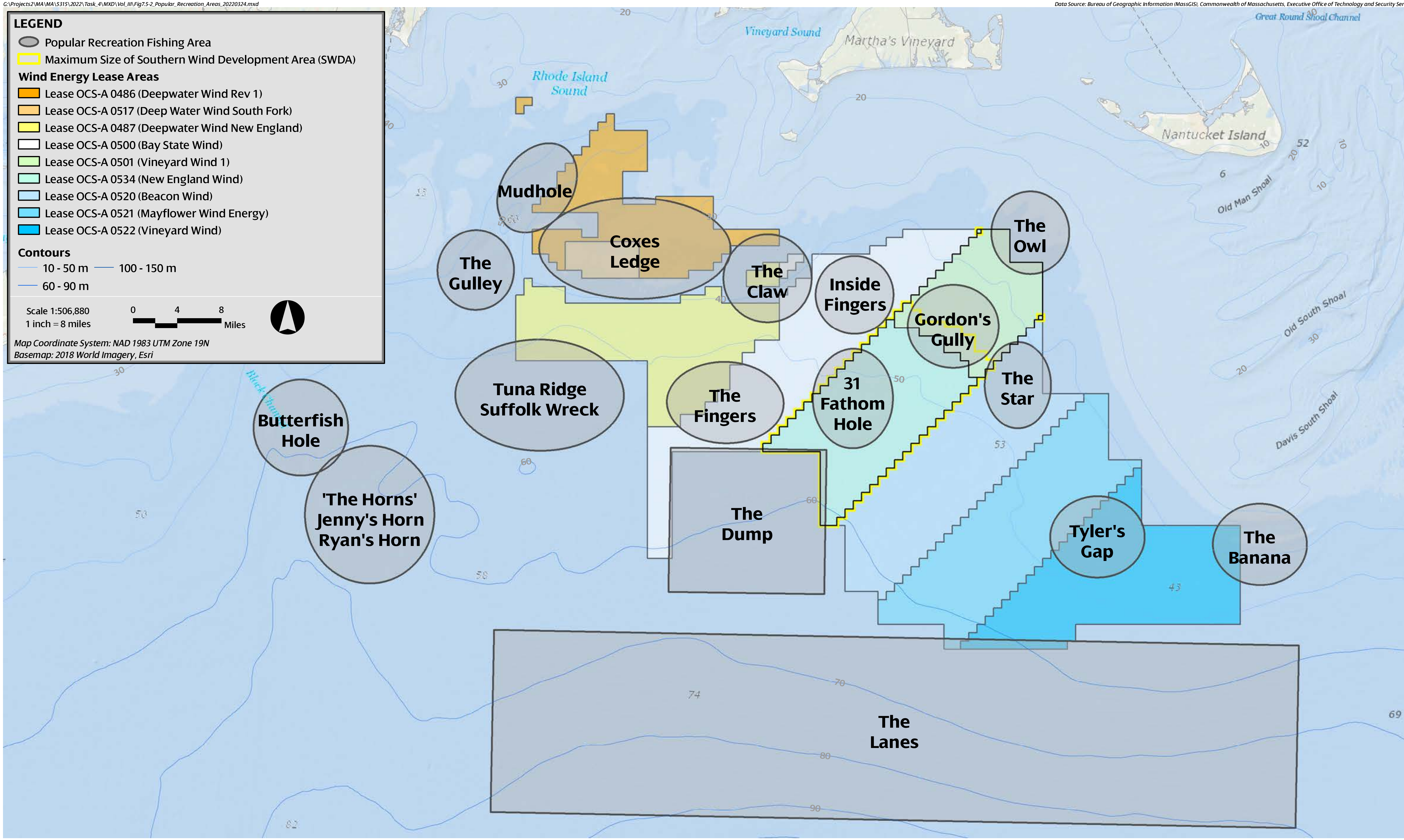
Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



New England Wind
AVANGRID RENEWABLES

Figure 7.5-2
Popular Recreational Fishing Areas

While onshore recreation facilities (such as parks, ponds and rivers, athletic facilities, etc.) may also be present in the Onshore Development Region, potential impacts related to New England Wind are most likely to affect offshore recreational activities. Accordingly, many of the IPFs associated with New England Wind occur offshore and are largely related to the construction and operation of facilities within the SWDA and along the OECC. Onshore IPFs are limited to the Town of Barnstable. In general, effects on recreation and tourism from New England Wind, if any, are expected to be highly localized and largely temporary in nature.

Table 7.5-1 Impact Producing Factors for Recreation and Tourism

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Temporary land use changes			•	•		
Noise			•	•		
Air emissions			•	•		
Vessel traffic	•	•		•	•	•
Temporary habitat alteration	•	•	•	•	•	•
Permanent habitat alteration	•	•			•	
Navigation hazard	•				•	
Fish aggregation	•				•	
Community benefits	•				•	

7.5.2.1 Construction and Installation

As described in COP Volume I, New England Wind facilities will be installed in the onshore and offshore environments.

7.5.2.1.1 Impacts to Recreational Resources (Phases 1 and 2)

Potential IPFs for recreational resources during construction and installation are temporary land use changes, noise, and air emissions. Onshore construction period impacts are expected to be limited to the Town of Barnstable for Phases 1 and 2. For Phase 1, new utility duct bank and splice vaults will be installed and run from the landfall site(s) to the onshore substation(s) and between the onshore substations to the grid interconnection point at the existing West Barnstable Substation. The new Phase 1 duct bank and the associated splice vaults will be located entirely underground (except for possibly at the Centerville River crossing), primarily within public roadway layouts or existing utility rights-of-way. The Phase 2 onshore cables will similarly include installation of new duct bank and splice vaults. The Phase 2 cables are expected to be installed underground within public roadway layouts and utility ROWs along one or two Onshore Export Cable Routes.

Construction activities will also occur at the Phase 1 and 2 landfall sites.

- For Phase 1, as described further in Section 3.3.1.8 of COP Volume I, beach disturbance at the landfall site (either the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site) will largely be avoided through the use of horizontal directional drilling (HDD), which will allow the cables to pass under the beach, intertidal zone, and nearshore areas.

- For Phase 2, as described further in Section 4.3.1.8 of COP Volume I, the offshore export cable(s) will transition onshore at the Dowses Beach Landfall Site, the Wianno Avenue Landfall Site, or both. However, the Proponent only expects to use the Wianno Avenue Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all or some of the Phase 2 offshore export cables. At the Dowses Beach Landfall Site, the ocean-to-land transition will be made using HDD to avoid or minimize impacts to the surrounding nearshore area. The offshore export cables' transition onshore at the Wianno Avenue Landfall Site may be accomplished using open-trenching or HDD. Wianno Avenue is less suited for HDD due to the elevated onshore topography and slope of the parking lot. This landfall site is suitable for open-trenching because the shoreline has already been altered by the installation of a riprap seawall.

- For both Phases, the cables will come ashore in an existing paved parking area or other previously disturbed area and further avoid disturbing the beach.

Installation of the onshore export and grid interconnection cables for both Phases may temporarily restrict access to parks/conservation areas along the routes. Similarly, construction at the Phase 1 and Phase 2 landfall sites may temporarily limits pedestrian access to limited areas of the landfall sites. Short-lived construction period impacts will also occur at the onshore substation sites for each Phase. Construction noise and dust may temporarily disturb nearby recreational users and residents in the area surrounding the onshore facilities for Phases 1 and 2 of New England Wind.

7.5.2.1.2 Impacts to Recreational Boating and Fishing (Phases 1 and 2)

Potential IPFs for recreational boating and fishing related to construction and installation are vessel traffic and temporary habitat alteration. The majority of recreational boating in the Offshore Development Region occurs within 5.5 km (3 nautical miles [NM]) of shore and within state waters (Starbuck and Lipsky 2013). Although recreational boaters may transit the SWDA, there are no known concentrated navigational routes of any significance for recreational boaters in proximity to the SWDA.

The construction and installation vessels operating in the SWDA and along the OECC (including the Western Muskeget Variant) may temporarily preclude recreational boating and fishing activities in the immediate vicinity of construction vessels or cause boaters and recreational fishermen to slightly alter their navigation routes. Temporary safety buffer zones may be established around work areas during construction and installation. Temporary safety buffer zones are expected to improve safety in the vicinity of active work areas and would not affect the entire SWDA or OECC at any given time. Vessel traffic associated with the construction of each Phase of New England Wind is not anticipated to represent a significant increase over the current levels of vessel traffic within the Offshore Development Region. Navigation and vessel traffic are further discussed in Section 7.8 and Appendix III-I. Additionally, shore-based fishing activities near the landfall sites may be temporarily displaced during construction and installation.

Construction activities may affect recreational fishing activities by impacting recreationally-important species. For example, noise from construction and installation activities, including pile driving and low-intensity noise from dredging or increased vessel traffic, may cause recreationally targeted species to temporarily avoid the immediate vicinity of the construction and installation activities (Kirkpatrick et al. 2017). However, any species affected by construction and installation activities are anticipated to return to the area soon after construction and installation noises cease (Bergstrom 2014). Potential water quality, noise, and other impacts as they may relate to species targeted by recreational fishing vessels are described in Section 6.6.

While the SWDA is targeted by recreational fishermen, other areas within and outside the MA WEA and RI/MA WEA have higher concentrations of recreational fishing activity (Kneebone and Capizzano 2020). The proximity of the SWDA and OECC to numerous productive recreational fishing areas suggests that the highly localized impacts of construction and installation activities will result in only minimal impacts to recreational species.

7.5.2.1.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Proponent's onshore construction schedules for Phases 1 and 2 will minimize impacts to recreational uses and tourism-related activities during peak summer months and other times when demands on these resources are elevated. As described in Sections 3.3.1.1.1 and 4.3.1.1.1 of COP Volume I, for the installation of the Phase 1 and Phase 2 onshore duct bank and cables, construction is anticipated to occur during typical work hours (7:00 AM to 6:00 PM) on Monday through Friday, though in specific instances at some locations, or at the request of the Barnstable Department of Public Works (DPW), the Proponent may seek municipal approval to work at night or on weekends. Nighttime work will be minimized and performed only on an as-needed basis, such as when crossing a busy road, and will be coordinated with the Town of Barnstable.

The Proponent will adhere to the general summer limitations on construction activities on Cape Cod for Phases 1 and 2. Activities at the landfall site where transmission will transition from offshore to onshore are not expected to be performed during the months of June through September unless authorized by the Town of Barnstable. Activities along the Onshore Export Cable Route and Grid Interconnection Route (particularly where the route follows public roadway layouts) will also likely be subject to significant construction limitations from Memorial Day through Labor Day unless authorized by Barnstable, but could extend through June 15 subject with consent from the DPW. The Proponent will also consult with the Town of Barnstable regarding the construction schedules for both Phases.

Further, potential impacts from construction and installation of onshore facilities will be temporary and carefully mitigated. The Proponent will assemble a Construction Management Plan (CMP) that will be used by the Proponent and its contractors during construction. The CMP will be developed to guide contractors during construction, and the document will be an integral part of the Proponent's effort to ensure that environmental protection and sound construction practices are implemented.

To minimize hazards to navigation offshore, all New England Wind-related vessels and equipment will display the required marine navigation lighting and day shapes. The Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the US Coast Guard (USCG) to provide Notices to Mariners to notify recreational and commercial vessels of their intended operations within the Offshore Development Area.

Mitigation of potential water quality and other impacts as they may relate to species targeted by recreational fishing vessels are described in Section 6.6.

Finally, the Proponent has developed and is implementing a Fisheries Communication Plan (FCP) to facilitate regular and productive communication with fishermen, including recreational fishermen. The FCP is a living document and will be updated, as needed, as development proceeds for each Phase of New England Wind. The current FCP is included as Appendix III-E.

7.5.2.2 Operations and Maintenance

For Phases 1 and 2, onshore and offshore facilities are expected to be monitored and controlled remotely. In the event monitors determine a repair is necessary, a crew would be dispatched to the identified location to complete any needed repairs and restore normal operations.

7.5.2.2.1 Impacts to Recreational Resources (Phases 1 and 2)

For each Phase, upon completion of construction at the landfall sites and along the Onshore Export Cable Routes and Grid Interconnection Routes, all areas will be restored to pre-existing conditions. Accordingly, no restrictions on recreational activities or use are anticipated at the landfall sites or along the Onshore Export Cable Routes and Grid Interconnection Routes. If repairs are needed in any of these areas, impacts would be localized to the repair area and would be temporary. Such work would typically involve the onshore export cables and grid interconnection cables, which are accessed through manholes at the installed splice vaults or within the fenced perimeter of the onshore substation. This allows repairs to be completed within the installed onshore facilities and without additional impacts.

A potential IPF during O&M is community benefits, as the SWDA may provide additional recreational opportunities by creating sightseeing interest. A study of Delaware beachgoers found that 45% of respondents would likely take a tour boat to see an offshore wind facility (Lilley et al. 2010). Hy-Line Cruises, based in Hyannis, has expressed interest in operating sightseeing vessels to other offshore projects with the expectation that such facilities will be popular tourist destinations (Cape Cod Times 2011). As noted in Section 7.1.2.2.2, vessel and sightseeing operators may provide excursions to the SWDA. A 2019 study examined potential impacts from the Block Island Wind Farm on the vacation rental market in Block Island, Rhode Island. The study's findings indicate that Block Island vacation rental rates increased in the summer relative to other Southern New England tourist destinations and concluded that offshore wind farms may attract tourists (Carr-Harris and Lang 2019).

Visible offshore components, such as WTGs and ESPs, will be installed in the SWDA which, at its closest point, is located just over 32 km (20 mi) from the southwest corner of Martha's Vineyard and approximately 38 km (24 mi) from Nantucket.[104] At this distance, as noted by Parsons and Firestone (2018), the disamenity effect of offshore wind projects decreases considerably, but the amenity effect does not. The modest visual impacts of New England Wind may, at certain beaches, attract more visitors than those who are dissuaded from visiting, thereby creating a net positive effect for visitation. The results described by Parsons and Firestone (2018) indicate varied reactions by beach visitors to offshore wind projects located up to 32.2 km (20 miles) offshore. Some beach visitors reported a beach-going experience would be worsened, primarily due to the visual disruption of the seascape. Other beach visitors indicated a preference for beaches providing views of WTGs and, separately, some study respondents indicated they would visit a beach primarily for the purpose of seeing WTGs. Therefore, New England Wind is likely to have little disamenity effect and may attract additional visitors, particularly in the short-term when few WTGs have been installed in the offshore environment. Additional information regarding visual impacts resulting from New England Wind is provided in Appendix III-H.a of COP Volume III.

7.5.2.2.2 Impacts to Recreational Boating and Fisheries (Phases 1 and 2)

Potential IPFs for recreational boating and fisheries during O&M include potential navigation hazards due to the presence of structures in the Offshore Development Area and fish aggregation. The WTGs and ESPs in the SWDA will be oriented in an east-west, north-south grid pattern with one nautical mile (1.85 km) spacing between WTG/ESP positions, which will facilitate vessel navigation through the SWDA. The WTGs and ESPs will also provide additional Private Aids to Navigation (PATONs). The Proponent is not proposing any vessel exclusions around the WTGs or ESPs or along the OECC (including the Western Muskeget Variant) during O&M.

Given the typically smaller size of recreational vessels, navigation impacts through the SWDA are not anticipated. Although the majority of recreational vessel traffic occurs within 5.5 km (3 NM) of shore, there is some recreational vessel activity within the SWDA. As the USCG stated in the final Massachusetts and Rhode Island Port Access Route Study (MARIPARS) for the entire WEA, "These [recreational] vessels leave from of a variety of ports and transit in many directions. Given their size and maneuverability, recreational vessels are more likely than other classes of vessels to transit within the turbine arrays, and less likely to use any designated routing measure." (USCG 2020). Further details on navigation impacts to recreational vessels are provided in Section 7.8.

O&M for Phases 1 and 2 could result in modest, positive impacts to recreational fisheries. As described in Section 6.6, the addition of foundations and scour protection, as well as cable protection in some areas, may act as an artificial reef and provide rocky habitat previously absent from the area. Increases in biodiversity and abundance of fish have been observed around WTG foundations due to attraction of fish species to new structured habitat (Riefolo et al. 2016; Raoux et al. 2017).

By providing additional structure for species that prefer hard, complex bottoms, the WTG and ESP foundations may function as fish aggregating devices (BOEM 2012). Increases in commercially important species, such as Atlantic cod and whiting (Merlangius merlangus), were observed near deep-water offshore wind farms (Løkkeborg et al. 2002; Hille Ris Lambers and ter Hofstede 2009). There is also evidence that WTG reef habitats and the resources they provide increase the growth and condition of juvenile Atlantic cod and whiting-pout (Trisopterus luscus) (Reubens et al. 2013). In the event WTGs aggregate recreationally targeted species, based on the intensity of recreational fishing within the SWDA and its geographic scale, neither congestion effects nor gear conflicts are expected.

The recreational fishing community in the Northeastern US recognizes these potential benefits of offshore wind. A University of Rhode Island study of recreational and commercial fishermen's perceptions of the impacts of the Block Island Wind Farm (BIWF) on the local marine ecosystem found that, for some recreational fishermen, BIWF functions as a landmark and an artificial reef for spearfishing (ten Brink and Dalton 2018). Of the seven commercial fishermen and 18 recreational fishermen who frequented the area in and around BIWF that were interviewed, 22 of the respondents noted an increase in recreational fishing around the BIWF WTGs post-installation (ten Brink and Dalton 2018). According to 20 of the 25 respondents (17 recreational and three commercial fishermen), the WTGs created a new structure for fish habitat and served as an artificial reef (ten Brink and Dalton 2018). The study concluded that, "Perceptions of greater fish abundance around the turbines will likely have future positive impacts on the recreational, commercial rod and reel, and spearfishing sectors in southern New England" (ten Brink and Dalton 2018). In recognition of these potential positive benefits to reactional fishing, organizations such as Anglers for Offshore Wind Power have formed to support the responsible development of offshore wind.

The USCG similarly states in the Massachusetts and Rhode Island Port Access Route Study that, "Future waterway uses by other classes of vessels, such as general recreational vessels, excursion vessels, and recreational fishing vessels are expected to increase based on post-construction activity. These increases have been observed in European wind farms and the Block Island Wind Farm" (USCG 2020).

Anglers' interest in visiting the SWDA may also lead to an increased number of fishing trips out of nearby ports, which could support an increase in angler expenditures at local bait shops, gas stations, and other shoreside dependents (Kirkpatrick et al. 2017).

7.5.2.2.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The modest visual impacts of New England Wind may, at certain beaches, attract more visitors than those who are dissuaded from visiting, thereby creating a net positive effect for visitation. Visual impacts are further described in Appendix III-H.a of COP Volume III.

Impacts associated with periodic maintenance activities during O&M will be localized and temporary. Temporary onshore construction impacts will be adequately minimized or mitigated through the implementation of best management practices when practicable.

To aid mariners navigating the SWDA, each WTG and ESP will be maintained as a PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The Proponent will implement a uniform system of marine navigation lighting and marking, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. Mariner Radio Activated Sound Signals (MRASS) and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety. The number, location, and type of MRASS and AIS transponders will be determined in consultation with USCG. Current plans for the uniform system of lighting and marking are discussed further in Section 7.8.2.2.5 and Appendix III-I.

7.5.2.3 Decommissioning

As described in Sections 3.3.3 and 4.3.3 of COP Volume I, the extent of the decommissioning of New England Wind's onshore facilities will be subject to discussions with the Town of Barnstable regarding the decommissioning approach that best meets the Town's needs and has the fewest environmental impacts. The onshore cables, the duct bank, and onshore substations will likely remain as valuable infrastructure that would be available for future offshore wind or other projects. It is expected that the O&M facilities could be repurposed for continued use by the Proponent or another site operator.

Decommissioning of the offshore components includes removal of the WTGs and ESPs and their foundations, scour protection, and any cable protection within the SWDA and OECC (including the Western Muskeget Variant). The offshore export cables, inter-array cables, and inter-link cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies and stakeholders on the preferred approach to minimize environmental impacts. Removal of the scour protection and any cable protection from the SWDA may result in a shift in the local finfish and invertebrate species assemblages to pre-construction, non-structure communities.

Impacts from these activities will be similar to those associated with construction. During decommissioning, vessel operations will increase in the SWDA and along the OECC (including the Western Muskeget Variant). Avoidance, minimization, and mitigation measures employed during decommissioning will be similar to those described for New England Wind's construction and installation activities in Section 7.5.2.1.3.

7.6 Commercial Fisheries and For-Hire Recreational Fishing

This section describes commercial and for-hire recreational fishing activities within the following areas:

- The Southern Wind Development Area (SWDA) where New England Wind will be developed, which is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 and the Offshore Export Cable Corridor (OECC) where five offshore export cables will transmit electricity generated by the wind turbine generators (WTGs) from the electrical service platforms (ESPs) to shore. Together, the SWDA and OECC are referred to as the Offshore Development Area.
  - While the Proponent intends to install all five New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 offshore export cables[108] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[109] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

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108 It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

109 The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

- ♦ The Massachusetts Wind Energy Area (MA WEA), as shown on Figure 2.1-2 in COP Volume I, which includes Lease Area OCS-A 0501, Lease Area OCS-A 0534, and four other lease areas (OCS-A 0500, OCS-A 0520, OCSA-0521, and OCS-A 0522) designated by the Bureau of Ocean Energy Management (BOEM) for offshore wind energy development.
- ♦ The Offshore Development Region, which is the broader offshore geographic region surrounding the SWDA and OECC that could be affected by New England Wind-related activities. With respect to commercial fisheries and for-hire recreational fishing, the Offshore Development Region includes the MA WEA, the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), and surrounding waters that are fished or transited by fishermen from different states including Massachusetts, Rhode Island, Connecticut, the eastern Long Island region of New York, and New Jersey.[110]

This section also provides estimates of potential economic exposure of these fisheries from New England Wind activities during construction and installation, operations and maintenance (O&M), and decommissioning. These estimates of economic exposure are based primarily on: (1) how New England Wind is expected to impact fish resources, as described in Section 6.5 (Benthic Resources) and Section 6.6 (Finfish and Invertebrates), (2) how New England Wind is expected to impact fishing activity and navigation, as described in the Navigation Safety Risk Assessment (see Appendix III-I), and (3) *Economic Exposure of Commercial Fisheries to the New England Wind Offshore Wind Energy Development* (see Appendix III-N [Economic Exposure Report]). Estimates of potential impacts to commercial fisheries are also based on the Proponent's outreach and engagement with the commercial fishing industry and stakeholders who operate in and near the Offshore Development Region, as well as supplemental fishing data and fishing information provided by fishermen and other stakeholders.

This section has four main parts:

- ♦ Section 7.6.1 provides an overview of the affected environment, including the fishing fleets, fishing ports, fishing activity, and the value of fish harvested in the Offshore Development Region, and outlines how state and federal regulations may affect fishing outcomes.

[110] Commercial and for-hire recreational fishing are vital economic activities that take place in both state and federal waters off the south coast of Massachusetts, Cape Cod and the Islands; off the coast of Rhode Island, Connecticut, and the eastern Long Island region of New York; and off the coast of New Jersey. For purposes of describing commercial and for-hire regional fisheries and assessing potential fishery-related economic impacts of New England Wind, this area is referred to as the "Offshore Development Region."

- Section 7.6.2 presents baseline "without development" estimates of the economic value of commercial fishing activity in the Offshore Development Region and within the Lease Area based on historical landings data.[111] These values represent the potential economic exposure to commercial fishing from development in these areas. However, economic exposure does not equate to expected economic impacts because, as shown in Appendix III-N, an economic impact analysis considers many additional factors.

- This section also describes sources of data that were used to develop baseline estimates of the economic value of commercial fishing and characterize the relative intensity of those commercial fishing activities. These data sources include maps of fishing activity based on vessel monitoring system (VMS) data and vessel trip reports (VTRs) developed by the Northeast Regional Ocean Council (NROC) and the Mid-Atlantic Council on the Ocean (MARCO); estimates of the economic value of commercial fisheries in the Lease Area developed by NOAA Fisheries (NOAA 2022). Section 7.6.2.4 also summarizes the findings of the detailed analysis of the economic exposure of commercial fishing in the Lease Area by King and Associates, LLC included as Appendix III-N.

- Section 7.6.3 describes potential impact producing factors (IPFs) to commercial fisheries resulting from New England Wind activities. The approach used was a conventional application of fishery economic methods which aims to trace two separate pathways by which changes in fishing conditions affect fishing trip performance and generate economic exposure. The first pathway involves changes in fish resources which, for purposes of fishery economic analysis, are best characterized in terms of changes in the abundance, availability, and catchability of various fish species. Section 6.5 (Benthic Resources) and Section 6.6 (Finfish and Invertebrates) provided the basis for this analysis, which is summarized below in Sections 7.6.3.1.1 and 7.6.3.2.2. The second pathway involves New England Wind activities within the SWDA that may alter the level or allocation of fishing effort; in particular, changes that increase steaming, searching, or idle time or otherwise reduce fishing time, or require more time fishing in alternative waters. Appendix III-I and Appendix III-N provide the basis for assessing this pathway of potential economic exposure, which is summarized in Sections 7.6.3.1.2, 7.6.3.2.1, and 7.6.3.2.3.

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[111] For the purposes of estimating economic exposure of commercial fisheries, the Lease Area was chosen to define the impact area for this analysis because a portion of the SWDA is included in Lease Area OCS-A 0501 and economic exposure and economic impacts of commercial fisheries in that part of the SWDA were previously analyzed and mitigated for Vineyard Wind 1 (see Section 6.3 in the Vineyard Wind 1 Terms and Conditions of COP Approval Letter; BOEM 2021).

- Section 7.6.4 discusses for-hire recreational fishing within the Offshore Development Region.

7.6.1 Description of the Affected Environment

This section provides an overview of fishing fleets, fishing ports, fishing activity, and the value of commercial landings in each state within the Offshore Development Region.

The commercial fishing ports described below are some of the more prominent within the Offshore Development Region and within their respective state, primarily because of their historical volume and/or value of landings and importance to coastal communities. Based on currently available information, it is understood that vessels operating from these ports may have some presence within the MA WEA. While there are other ports and fishing fleets within the Offshore Development Region, some of these are not expected to have meaningful economic exposure within the MA WEA. The Proponent anticipates working with federal and state agencies as well as environmental, fisheries, and local community stakeholders to further develop estimates of economic exposure of commercial fisheries within the Offshore Development Region.

Kirkpatrick et al. (2017) established thresholds, or minimum levels, for their exposure assessment that identify subgroups (e.g. individual ports) that are more likely to be impacted by offshore wind development within the MA WEA. Subgroups at or above either of these thresholds were included in the exposure analysis:

- An annual average revenue of more than $1 million sourced from any of BOEM's Wind Energy Areas extending from North Carolina to Massachusetts.

- More than 2% of the average annual revenue sourced from any of BOEM's Wind Energy Areas extending from North Carolina to Massachusetts *and* total exposed revenue greater than $1,000.

Certain ports described below may not meet these thresholds and are therefore not described in the Kirkpatrick et al. (2017) analysis of the MA WEA. Similarly, Kirkpatrick et al. (2017) only provides estimates of exposure for the 10 most exposed ports in the MA WEA. Estimates of port exposure from Kirkpatrick et al. (2017) are provided when available. Non-confidential VTR data for individual ports are also provided below, when available. Whether or not non-confidential VTR data are available and whether or not exposure estimates for individual ports are included in Kirkpatrick et al. (2017), the ports described below are important components of the commercial fisheries within the Offshore Development Region.

7.6.1.1 Massachusetts Commercial Fishing Ports

Several important commercial fishing ports are located within Massachusetts, including the Port of New Bedford, which is consistently, year after year, the highest revenue producing United States (US) port from commercial fishing. The highest revenue producing fishery in the Offshore

Development Region is the sea scallop fishery, which is largely landed at the Port of New Bedford. Massachusetts, however, has diverse commercial fisheries with many species that are important to its fishing fleets, including: monkfish (*Lophius americanus*), American lobster ([lobster] *Homarus americanus*), bay scallops (*Argopecten irradians)* and Atlantic sea scallops ([sea scallop] *Placopecten magellanicus*), Atlantic spiny dogfish (*Squalus acanthias*), skates, Atlantic mackerel (*Scomber scombrus*), butterfish (*Peprilus triacanthus*), flounders, scup (*Stenotomus chrysops*), black sea bass (*Centropristis striata*), silver hake (*Merluccius bilinearis)*, bluefish (*Pomatomus saltatrix*), Atlantic herring ([herring] *Clupea harengus*), haddock (*Melanogrammus aeglefinus*), Jonah crab (*Cancer borealis*), squids, and ocean quahog (*Arctica islandica*). The lobster, surf clam, monkfish, and haddock fisheries each consistently exceed $10 million in landed value each year. Massachusetts' Jonah crab fishery also exceeded $10 million in landed value for the first time in 2017. Massachusetts has an important and growing aquaculture industry, which is focused primarily on shellfish grown in near-coastal waters. Table 7.6-1 lists the weight and value of landings of selected Massachusetts ports.

Table 7.6-1 Volume and Value of Landings at Selected Massachusetts Ports[1]

	2016		2017		2018		2019		2020		2021	
Port	**Pounds (mil.)**	**Value (mil.)**	**Pounds (mil.)**	**Value (mil.)**	**Pounds (mil.)**	**Value (mil.)**	**Pounds (mil.)**	**Value (mil.)**	**Pounds (mil.)**	**Value (mil.)**	**Pounds (mil.)**	**Value (mil.)**
New Bedford & Fairhaven	110.5	$348.3	114	$399.8	116.7	$439.5	120.7	$399.8	118.5	$381.6	107.2	$578
Provincetown & Chatham	26.5	$32.8	22.3	$33.8	22.5	$34.8	18.8	$33.8	21	$25.1	13.2	$35.5

Notes:
1. NOAA (2023a).

According to NOAA Fisheries, the two most valuable Massachusetts fisheries are the sea scallop and lobster fisheries. Since 2010, the sea scallop fishery has landed an average of 31.1 million lbs. per year, worth approximately $320.2 million. Over the same period, the lobster fishery landed an average of 15.6 million lbs. per year, worth approximately $70.8 million.

Commercial fishing vessels active in the Offshore Development Region may be operating from Massachusetts harbors described below.

Port of New Bedford and Fairhaven

The Port of New Bedford is home to a commercial fishing fleet with approximately 228 federally permitted vessels in 2019. New Bedford has a well-established shoreside economy serving the commercial fishing industry, including seafood wholesale and processing companies and other related shoreside industries. Much of this infrastructure is shared among vessels homeported in neighboring Fairhaven. Maritime International, which operates in New Bedford, has one of the largest US Department of Agriculture-approved cold treatment centers on the East Coast. American Seafoods, one of the largest seafood companies in the US, has a large processing facility in New Bedford where they process primarily scallops. Northern Pelagic Group, LLC ("Norpel"), also in New Bedford, is one of the largest pelagic processing companies in the US, catching and processing both mackerel and herring with a dedicated fleet of mid-water trawlers. Eastern Fisheries, Inc. is the New Bedford-based owner and operator of the largest sea scallop fleet in the industry. Sea Watch International, an important harvester and processor of clams, operates a processing facility in New Bedford. New Bedford's auction house, Whaling City Seafood Display Auction, opened in 1994 allowing fishermen to get fair prices for their catch and providing buyers with a more predictable supply of seafood (Colburn et al. 2010).

In addition to sea scallop, other species landed and processed in New Bedford include: Jonah crab, surf clam, herring and mackerel, lobster, haddock, squids, hakes, flounders, skates, Atlantic cod ([cod] *Gadus morhua*), and Atlantic pollock ([pollock] *Pollachius virens*) as well as several other species (New Bedford Port Authority 2019). In total, New Bedford and Fairhaven commercial fishing vessels landed over 107 million lbs. of fish in 2021, worth an estimated $578 million. The Kirkpatrick et al. (2017) analysis of the MA WEA estimated that 0.5% of New Bedford's and 0.6% of Fair Haven's commercial fishing revenue was sourced from within the MA WEA.

Provincetown and Chatham

In 2021, commercial fishermen in the communities of Provincetown and Chatham landed over 13 million lbs. of fish combined, worth an estimated $35.5 million. Species landed in Provincetown and Chatham include lobster, scallops, skates, monkfish, dogfish, summer flounder (*Paralichthys dentatus*), scup, black sea bass, Atlantic surf clam ([surf clam] *Spisula solidissima*), and ocean quahog (Cape Cod Commercial Fishermen's Alliance 2020; NEFSC 2014). The Kirkpatrick et al. (2017) analysis of the MA WEA estimated that 0.9% of Chatham's commercial fishing revenue was sourced from within the MA WEA.

Martha's Vineyard and Nantucket

Martha's Vineyard and, to a lesser extent, Nantucket have commercial fishing fleets active in the Offshore Development Region. Traps, pot, and gillnet fishermen from the Martha's Vineyard Fishermen's Preservation Trust, and other active fishermen on Martha's Vineyard, have identified a number of active fishing locations in the Offshore Development Region.

7.6.1.1.1 Nearshore Commercial Shellfish Resources

Massachusetts cities and towns manage the shellfisheries in all waters within their boundaries that are not closed by the Massachusetts Department of Marine Fisheries (MA DMF) for public health or other reasons, with the exception of the commercial harvest of surf clams and ocean quahogs that remain under state control. The OECC includes potential landfall sites in the Town of Barnstable that may affect nearshore commercial shellfishing activities in that area.

The Town of Barnstable has an active shellfish propagation program for northern quahogs (*Mercenaria mercenaria*), eastern oysters (*Crassostrea virginica*), soft shell clams (*Mya arenaria*), and bay scallops. The Town's propagation programs, including the in-town and out-of-town shellfish relay programs, Quahog upwelling facility, and the Oyster propagation program, are credited with helping to replenish Barnstable's shellfish resources, which includes the Centerville River estuarine systems and adjacent nearshore coastal waters. The in-town relays take contaminated Quahogs from the Centerville River and East Bay and relay them to West Bay and, most recently, to Bay Street, Osterville. For the out-of-town relay, mildly contaminated Quahog stock from off Cape Cod locations is purchased by the Town and transplanted into the designated shellfish relay areas.

Figure 7.6-1 identifies the status of nearshore shellfish areas within the OECC and Phase 1 and Phase 2 landfall sites.

7.6.1.2 Rhode Island Commercial Fishing Ports

Commercial fishermen operating in the Offshore Development Region may also be homeported in Rhode Island. Rhode Island's highest revenue producing fishery is the squid fishery, which is largely landed in Point Judith. However, other species are important to the Rhode Island's commercial fishing fleets, including sea scallop, lobster, oyster, summer flounder, and Jonah crab.

Table 7.6-2 lists the volume and value of landings of selected Rhode Island ports.

Table 7.6-2 Volume and Value of Landings at Selected Rhode Island Ports[1]

	2016		2017		2018		2019		2020		2021	
Port	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)
Newport	6.6	$8	7.3	$8.5	5.5	$7.9	4.9	$7.8	5.2	$7	6.3	$6.4
North Kingstown	17.6	$13.7	27	$17.7	22.8	$16	19.2	$14.1	19.6	$14.4	17.9	$15.3
Point Judith	53.4	$55.7	44.3	$57.4	47.5	$63.7	48.1	$65.9	42.6	$46.7	44.1	$72.1

Notes:
1. NOAA (2023a).

According to Kirkpatrick et al. (2017), the MA WEA is relied on primarily by pot, gillnet, bottom trawl, and midwater trawl fishermen operating from Rhode Island ports. Landings from these vessels consist mainly of small mesh species (whiting, squids, mackerel, and butterfish), ocean quahogs, skates, monkfish, and Jonah crab (Kirkpatrick et al. 2017). During the years studied by Kirkpatrick et al. (2017), the percentage of total port revenue from the MA WEA for Rhode Island ports ranged from 0.9% to 7.7% for the most exposed ports.

Commercial fishing vessels active in the Offshore Development Region may be operating from the Rhode Island ports described below, and potentially from other Rhode Island ports as well.

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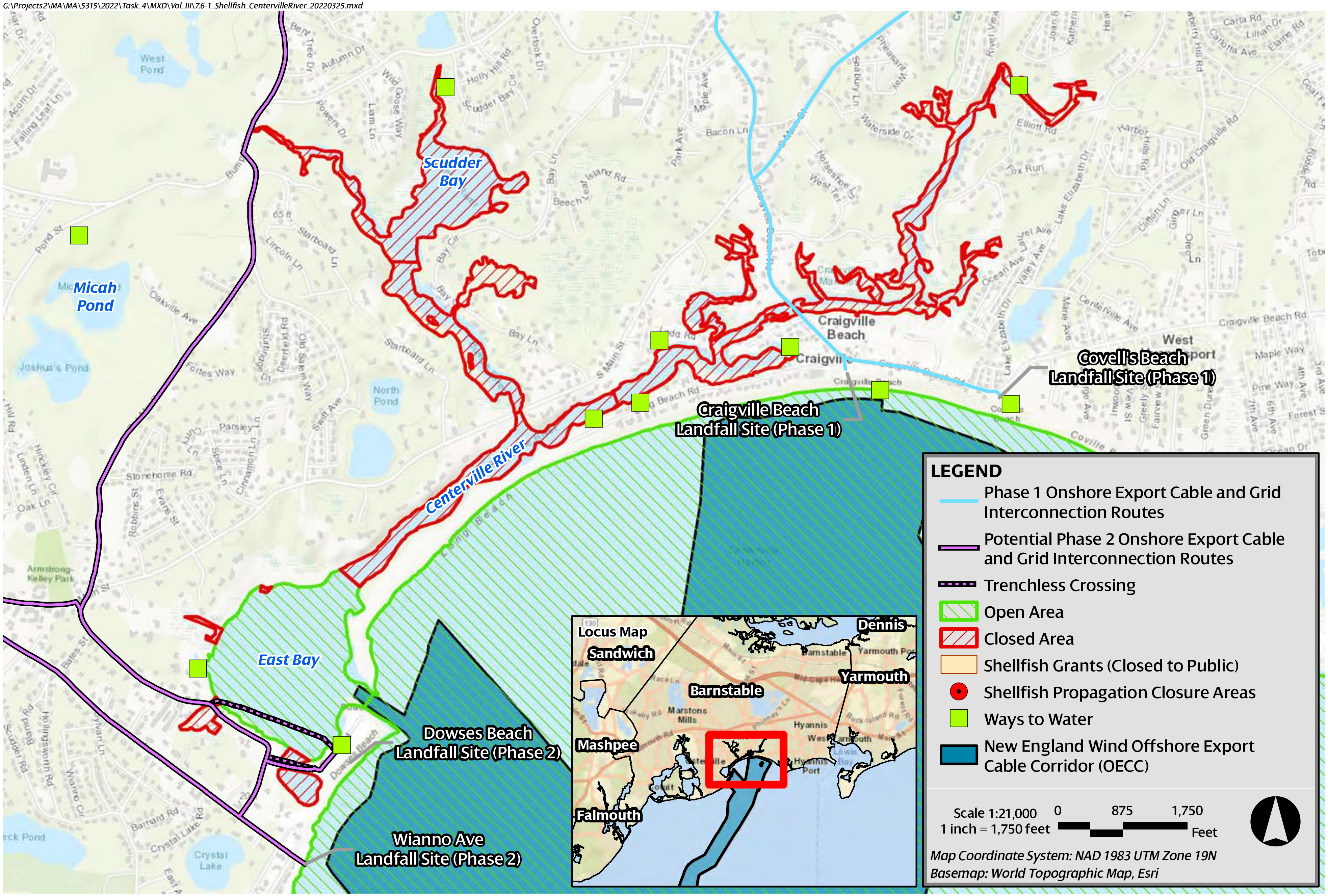

New England Wind
AVANGRID RENEWABLES

Figure 7.6-1

Shellfish Resource Areas—Centerville River (Effective December 9, 2019)

Newport

Most of Newport's fishing revenue comes from the sale of lobster (NEFSC 2014). In 2019, there were 25 federally permitted vessels homeported in Newport. The Kirkpatrick et al. (2017) analysis of the MA WEA estimated that 0.9% of Newport's commercial fishing revenue was sourced from within the MA WEA.

Point Judith

The Port of Galilee in Point Judith is the most active fishing port in Rhode Island, and is supported by bait shops, commercial marine suppliers, and vessel repair shops. According to federal permit data, in 2019, there were 114 federally permitted vessels homeported in Point Judith, 92 of which possess a federal permit in the Squid, Mackerel, and Butterfish FMP. The Port has a number of fish processing companies that do business locally, nationally, and internationally. Point Judith's largest fish processors are the Town Dock Company, Handrigan's Seafood, and Seafreeze Shoreside.

Most of Point Judith's fishing revenue comes from the sale of squid, mackerel, and butterfish; summer flounder, scup, and black sea bass; lobster, and sea scallop (NEFSC 2014). The Kirkpatrick et al. (2017) analysis of the MA WEA estimated that 2.1% of Point Judith's (Narragansett) commercial fishing revenue was sourced from within the MA WEA.

North Kingstown

The North Kingstown fishing fleet lands a wide variety of species groupings and the port there has a number of commercial operations and associations involved in the commercial fishing industry. These include American Mussel Harvesters, one of the Rhode Island's largest purchasers and suppliers of clams and mussels, and SeaFreeze, Ltd., which is the largest producer of sea-frozen fish on the East Coast and berths the two largest fishing vessels in the state, *F/V Relentless* and *F/V Persistence*. Squid, mackerel, butterfish, and groundfish species are landed in North Kingstown (NEFSC 2014).

Most of North Kingstown's fishing revenue comes from the sale of squid, mackerel, and butterfish (NEFSC 2014). Kirkpatrick et al. (2017) does not provide an estimate of the port's commercial fishing revenue sourced from within the MA WEA but does note that mid-water trawl vessels from North Kingstown operate in the MA WEA.

7.6.1.3 Connecticut Commercial Fishing Ports

Commercial fishermen operating in the Offshore Development Region may also be homeported in Connecticut. Connecticut's highest revenue producing fishery is the sea scallop fishery, however, other species are important to Connecticut's commercial fishing fleets, including squid, lobster, and whiting.

Table 7.6-3 lists the volume and value of landings of selected Connecticut ports.

Table 7.6-3 Volume and Value of Landing at Selected Connecticut Ports[1]

	2016		2017		2018		2019		2020		2021	
Port	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)
New London	9	$5.1	5.6	$2.7	7.2	$4.2	4	$3.6	-	-	1.9	$2.9
Stonington	2.1	$5.9	1.8	$6.2	-	-	2.8	$4.4	-	-	3	$7.2

Notes:

1. NOAA (2023a).

Commercial fishing vessels active in the Offshore Development Region may be operating from the Connecticut ports described below, and potentially from other Connecticut ports as well.

New London

New London is the largest fishing port in Connecticut measured by pounds landed. Thirteen federally permitted vessels were homeported in New London in 2019. New London's most valuable landings in 2014 were scallops and whiting (NEFSC 2014).

Stonington

The Stonington commercial fishing fleet is the second most productive in Connecticut. Twelve federally permitted vessels were homeported in Stonington in 2019. Stonington's most valuable landings in 2014 were summer flounder, scup, black sea bass, butterfish, mackerel, and squid (NEFSC 2014).

Kirkpatrick et al. (2017) does not provide an estimate of the port's commercial fishing revenue sourced from within the MA WEA but does note that dredge-gear vessels from Stonington operate in the area

7.6.1.4 New York Commercial Fishing Ports

Commercial fishermen operating in the Offshore Development Region may be homeported in New York. New York's highest revenue producing fishery is the quahog fishery, however, other species are important to New York's commercial fishing industry, including squid, oyster, and golden tilefish (*Lopholatilus chamaeleonticeps*).

Table 7.6-4 lists the volume and value of landings of selected New York ports.

Table 7.6-4 Volume and Value of Landing at Selected New York Ports[1]

Port	2016		2017		2018		2019		2020		2021	
	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)
Hampton Bays - Shinnecock	5.2	$8	3.8	$6.1	3.6	$5.7	4	$5.7	3.6	$4.3	3.1	$4.8
Montauk	11.8	$16.3	10.1	$14.8	11.3	$17.3	11.5	$17.8	10	$14.7	9.7	$16.7

Notes:
1. NOAA (2023a).

Certain ports described below may not meet The Kirkpatrick et al. (2017) thresholds and exposure estimates for those ports are not described in that analysis of the MA WEA. Whether or not they are included in Kirkpatrick et al. (2017), the ports described below are important components of New York's commercial fishing industry. Commercial fishing vessels active in the Offshore Development Region may be operating from the New York ports described below, and potentially from other New York ports as well.

Hampton Bays and Shinnecock

Hampton Bays and Shinnecock, here considered to be the same community, is New York's second largest fishing port. Shinnecock is the fishing port located in Hampton Bays, and fishermen use either port name when reporting their catch (NOAA 2005). Fourteen federally permitted commercial vessels were homeported in Hampton Bays in 2019. Kirkpatrick et al. (2017) does not provide an estimate of Hampton Bays' commercial fishing revenue sourced from within the MA WEA but notes that long-line vessels from Hampton Bays operate in the area.

Montauk

The village of Montauk is the largest fishing port in New York both by pounds and value landed. In 2019, 122 federally permitted vessels were homeported in Montauk.

Most of Montauk's fishing revenue comes from the sale of summer flounder, scup, black sea bass, squid, mackerel, butterfish, and golden tilefish (NEFSC 2014). The Kirkpatrick et al. (2017) analysis of the MA WEA estimated that 1.3% of Montauk's commercial fishing revenue was sourced from within the MA WEA and notes that handgear and bottom trawl vessels from Montauk operate in the MA WEA.

7.6.1.5 New Jersey Commercial Fishing Ports

Commercial fishermen operating in the Offshore Development Region may be homeported in New Jersey. New Jersey's highest revenue producing fishery is the sea scallop fishery, however, other species are important to the New Jersey's commercial fishing fleets, including menhaden and surf clams.

Table 7.6-5 lists the volume and value of landings of selected New Jersey ports.

Table 7.6-5 Volume and Value of Landing at Selected New Jersey Ports[1]

	2016		2017		2018		2019		2020		2021	
Port	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)	Pounds (mil.)	Dollars (mil.)
Atlantic City	24.3	$19.7	24.7	$18.6	24.8	$18.2	23.5	$17.2	17.5	$12.4	17.5	$12.4
Cape May – Wildwood	46.6	$84.7	101.6	$81	101.2	$66.3	94.5	$90	103.7	$92.8	113.5	$147.7
Long Beach-Barnegat	7.2	$26.9	7.6	$24.7	6.3	$24.3	7	$24.9	5.6	$21.7	4.4	$26.9
Point Pleasant	26.3	$32.1	37.5	$35.3	43.3	$32.4	37.3	$35.4	35.3	$35.7	12.5	$33.7

Notes:
1. NOAA (2023a).

Commercial fishing vessels active in the Offshore Development Region may be operating from the New Jersey ports described below, and potentially from other New Jersey ports as well.

According to Kirkpatrick et al. (2017), vessels operating from New Jersey ports with longline and dredge permits have reported landings in the MA WEA.

Atlantic City

The Atlantic City commercial fishery consists of a sizable fleet of vessels targeting surf clams and ocean quahogs alongside a smaller number of inshore crab, hard clam, net, and pot vessels. The clam fleet has reportedly declined in recent years due to changes in federal law allowing the consolidation and transfer of individual quotas (New Jersey Department of Agriculture n.d.).

Most of Atlantic City's revenue comes from surf clam, ocean quahog, and scallops (NEFSC 2014). Thirty federally permitted vessels were homeported in Atlantic City in 2019, 27 of which hold permits for ocean quahogs and surf clam. Kirkpatrick et al. (2017) does not provide an estimate of Atlantic City's commercial fishing revenue sourced from within the MA WEA.

Cape May/Wildwood

The Port of Cape May/Wildwood is the largest commercial fishing port in New Jersey. The Port serves as the center of fish processing and freezing in New Jersey and has numerous shore side support and supply services. Cape May is home to Garden State Seafood Association whose membership includes 92 commercial fishing vessels. Cape May has an active trawler fleet in addition to scallop and surf clam dredge vessels, pot boats, handgear, and purse seiners (New Jersey Department of Agriculture n.d.). In 2019, 133 federally permitted vessels were homeported in Cape May/Wildwood.

Cape May's fishing industry currently generates most of its revenue from the sale of sea scallops (NEFSC 2014).

Long Beach/Barnegat

Barnegat Light is the primary commercial seaport on Long Beach Island with approximately 36 commercial boats working year-round as well as recreational vessels and transient vessels. Barnegat Light's two commercial docks are home to several scallop vessels, longliners, and a fleet of smaller, inshore gillnetters (New Jersey Department of Agriculture n.d.)

The Long Beach/Barnegat fishing industry currently generates most of its revenue from the sale of sea scallops (NEFSC 2014).

Point Pleasant

The Point Pleasant commercial fishing fleet includes dredge vessels, day boat trawlers, and gill net boats. The Fishermen's Dock Cooperative at Point Pleasant operates two docks, an ice-making machine, cold storage facility, retail store, and a truck-loading station. It is one of two active fishing cooperatives in New Jersey.

The Point Pleasant fishing industry currently generates most of its revenue from the sale of sea scallops, surf clam, and ocean quahog (NEFSC 2014).

7.6.1.6 Fisheries Management

Under the Magnuson-Stevens Fishery Conservation and Management Act, which is the primary mechanism governing fishing in US federal waters, including the SWDA, certain fish species are managed through species-specific management plans developed by eight Regional Councils. The Regional Council system allows regional, participatory governance of different fisheries by knowledgeable stakeholders. These councils develop fishery management plans (FMPs), which include fishing seasons, catch quotas, and fishery closure areas. The Regional Councils propose rules for fishermen operating in federal waters and address habitat issues across multiple FMPs. The FMPs and other measures are implemented by the NOAA Fisheries. Within the Offshore Development Region, the New England Fisheries Management Council (NEFMC), the Atlantic States Marine Fisheries Commission (ASMFC), the Mid-Atlantic Fisheries Management Council (MAFMC), and NOAA Fisheries' Highly Migratory Species Office manage the various fisheries. Massachusetts state waters of the Offshore Development Region are managed by MA DMF.

The NEFMC is the primary council in the Offshore Development Region and is charged with conserving and managing the fishery resources of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut, including the Gulf of Maine and Georges Bank. The NEFMC overlaps with the Mid-Atlantic Council for some species harvested in the New England Region.

The ASMFC has coordinated interstate management of the lobster fishery from 0 to 4.8 kilometers (km) (0 to 3 nautical miles [NM]) offshore since 1996 while management authority in the Exclusive Economic Zone (EEZ) from 4.0 km to 321.9 km (3 to 200 NM) from shore lies with NOAA Fisheries. Three separate stocks of lobsters are managed: the Gulf of Maine, Georges Bank, and Southern New England, with each stock further divided into seven management areas. The SWDA is within Lobster Management Area 2 (LMA 2) and Lobster Management Area 3 (LMA 3) of the Southern New England Stock. The OECC (including the Western Muskeget Variant) is located entirely within LMA 2.

The MA DMF oversees commercial fishing within their respective state waters. MA DMF maintains the sole authority for the opening and closing of areas for the taking of any and all types of fish in state waters. In Massachusetts, cities and towns manage the shellfisheries in all waters within their boundaries that are not closed by the MA DMF for public health or other reasons, with the exception of the commercial harvest of surf clams and ocean quahogs, which remain under state control.

7.6.2 Baseline "Without Development" Economic Value of Commercial Fishing Activity

The following sections present baseline "without development" estimates of the economic value of fishing activity in the Offshore Development Region, within the MA WEA, and within the Lease Area. These values represent the economic "exposure" in these areas.

The estimated value of fishery exposure, whether in the Lease Area or OECC, does not represent an absolute value of income from fishing because the estimated exposure does not account for fishing costs. By some estimates, including that of NOAA Fisheries' Fisherman's Contingency Fund Program, fishing costs may be approximately 50% of landed value.

7.6.2.1 Commercial Fishing Data Sources

Several data sources and reports provide information on commercial fishing activities within the Offshore Development Region, the MA WEA, and the SWDA. The following section describes the different data sources and the geographic area for which the data are available.

Vessel Monitoring System Data

VMS data are collected through a satellite monitoring system that primarily is used for monitoring the location of certain commercial fishing vessels working in US federal waters. According to NOAA Fisheries (NOAA 2020b), the system uses satellite-based communications from onboard transceiver units, which certain vessels are required to carry, including certain vessels harvesting scallop, squid, and mackerel. The transceiver units typically send position reports once per hour, which include vessel identification, time, date, and location, that are mapped and displayed on the end user's computer screen. These data make it possible to calculate the approximate speed a vessel is travelling. The data can then be filtered by estimated vessel-speed, depending on the gear and fishery, to indicate areas where a vessel is likely fishing rather than transiting. However, such filtering is not an absolute indication of fishing activity as vessels may operate in harbors and other confined waters at speeds consistent with fishing activity.

As noted in the *Supplement to the Draft Environmental Impact Statement for Vineyard Wind 1*, VMS is a good data source for understanding the spatial distribution of fishing vessels in the Offshore Development Region. In 2018, 912 VMS equipped vessels operating across all fisheries in the Northeast United States represented 71 to 87 percent of summer flounder, scup, black sea bass, and skate landings, and greater than 90 percent of landings for scallops, squid, monkfish, herring, mackerel, large mesh multispecies, whiting, surfclams, and ocean quahogs (BOEM 2020b).

The NROC and MARCO each maintain a suite of databases and maps of the ocean ecosystem and ocean-related human activities, including commercial fishing activities that make use of VMS data. The NROC and MARCO commercial fishing datasets and associated mapping of those datasets characterize the density of commercial fishing vessel activity for seven fisheries[112] in the northeast and mid-Atlantic regions of the US based on VMS data for the years 2006 to 2016.

VMS data provided to NROC and MARCO by NOAA Fisheries contains the day, month, and year; geographic coordinates of the vessel at the time of transmission; speed over ground; and the vessel's declaration code, which may signify fishery plan, program within that plan, and associated area identifier or gear-type information. VMS data are subject to strict confidentiality restrictions. Therefore, the maps produced by NROC[113] and MARCO depict the density of vessel locations following the removal of individually identifiable vessel positions. The process of removing confidential vessel locations follows the "rule of three" mandated by NOAA Fisheries Office of Law Enforcement by using a screening grid to identify which grid cells contained three or more VMS records. Per the rule of three, any record within a cell that contains fewer than three VMS records was eliminated from the analysis.

In order to increase the likelihood of identifying active fishing rather than fishing vessels transiting the SWDA, certain figures below characterize VMS data from vessels operating at or below a vessel speed consistent with gear deployment for that fishery. According to NROC, the speed thresholds were vetted through engagement with fishermen in each fishery. The speed threshold, however, does not perfectly isolate fishing activity because transiting vessels may operate below the speed threshold. Nonetheless, the resulting density grids represent a "heat map" of the vessel activity, which indicate a relative level of vessel presence and spatially represent specific fisheries over specific timespans.

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112 The fisheries include multispecies, monkfish, herring, scallop, surf clam/ocean quahog, herring, squid, and mackerel.

113 Analysis of the VMS data was performed by Applied Science Associates, Inc. on behalf of NROC.

Landings or revenue data are not associated with the VMS point locations. Rather, the VMS maps provide a qualitative assessment of the intensity of fishing activity in the Offshore Development Region and should be evaluated alongside other data sources. Characterizing fishing effort with VMS data is also complicated by the fact that VMS is used differently in separate fisheries. For example, the monkfish fishery only requires VMS for vessels reporting days-at-sea under limited access permits for the offshore monkfish fishery but, otherwise, vessels may elect to report days-at-sea under different monkfish permit categories.

Vessel Trip Report Data

With the exception of vessels with only lobster permits, NOAA Fisheries requires every federally permitted fishing vessel to submit VTRs for every fishing trip. VTRs provide information on when and where the majority of fishing effort occurred and each report includes the trip date, number of crew on board the vessel, species and quantities caught, and the trip location. Vessel permit data additionally include a vessel's "principal port" as well as other variables describing the vessel itself (e.g. length, horsepower, and age). The NOAA Fisheries VTR dataset provides a comprehensive overview of fishing activity for many of the commercial fisheries active in the Offshore Development Region.

VTRs, however, only require that a single geographic position (point location) is reported for each fishing trip, unless a vessel switches to a new gear type or moves into a new statistical reporting area and therefore may not be representative of where the fishing actually occurred. As a result, mapping of fixed gear fishing activity may be more accurate than mapping of mobile fishing gear, and mapping of single day trips may be more accurate than mapping of multi-day trips. VTR reporting requires that fishermen record the position where the majority of fishing occurred but because a new VTR is necessary only when gear type changes or fishing occurs in a new statistical area, multiple tows within the same statistical area using the same gear will likely be assigned only a single point location, which may not necessarily represent the actual location of fishing activity.

NROC and MARCO[114] also provide a commercial fishing data visualization product using VTRs. The VTR-based maps characterize both fixed and mobile gear fisheries within the Offshore Development Region using trip location point data as inputs to create density polygons representing vessel visitation frequency. The VTR-based maps depict total labor including crew time and time spent transiting to and from fishing locations. According to MARCO, VTR data were aggregated to the "community" level and none of the resultant maps represent a fishing area of any individual fisherman or fishing vessel.

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[114] MARCO obtained VTR data from the Northeast Fisheries Science Center (NEFSC), with methodology, data processing, and cartography provided by staff at the Center for Remote Sensing and Spatial Analysis at Rutgers University.

When accessed through the NROC or MARCO data portals, querying any single location on the VTR maps will display, for example, the various port communities that have recorded a significant level of fishing activity at that location. Similarly, the data can be queried by port, which will then identify the geographic area in which 90% of that port's fishing effort is located. According to MARCO, drafts of the maps were reviewed with a diverse range of fishermen and fishing industry managers throughout the Mid-Atlantic and New England states, including at MAFMC and NEFMC meetings. MARCO also notes that overlay comparison of their VTR-based maps with VMS-based maps reveals substantial agreement between the two, with the VMS maps providing additional useful precision for fisheries where both VTR and VMS data are available.

Landings Data

Vessels with Massachusetts commercial fishing permits are required to submit monthly "Trip-level" reports for commercial landings. Permits with federal reporting requirements are exempt from reporting to MA DMF. Certain non-confidential landings data reported to MA DMF for landings within state designated Statistical Reporting Areas (SRAs) from 2010 to 2019 were provided. Landings data, reported below, are for those SRAs where New England Wind activities may occur and are the cumulative total of federal and state landing reports. Only the OECC (including the Western Muskeget Variant) is within the SRAs; the SWDA and associated offshore facilities for New England Wind, are not located within SRAs or Massachusetts waters.

Automatic Identification System

The Automated Identification System (AIS) is, in part, a shipborne mobile equipment system that typically consists of integrated Very High Frequency radio and Global Positioning Systems which broadcast a vessel's name, dimensions, course, speed, and position, as well as destination and estimated time of arrival, amongst other vessel characteristics. The primary use of AIS is to allow vessels to monitor marine traffic in their area and to broadcast their location to other vessels with AIS equipment onboard. Broad categories of vessel type, including fishing vessels, can also be identified using the information contained in a vessel's AIS transmissions. As of 2017, Federal regulations require self-propelled commercial fishing vessels greater than 20 meters (m) (65 feet [ft]) in length to operate an AIS Class B device to broadcast vessel information (33 CFR § 164.46). Because of the autonomous and continuous nature of AIS data, it can also be compiled to establish a record of a vessel's operating history. The Proponent obtained AIS data for portions of the Offshore Development Region that include the SWDA and OECC. The AIS datasets were used to evaluate vessel traffic in the vicinity of New England Wind, including AIS-equipped commercial fishing vessel traffic counts within the Lease Area, the SWDA, and along the OECC (including the Western Muskeget Variant).

7.6.2.2 Baseline Fishing Activity in the Offshore Development Region

As described in Section 7.6.2.1, VMS data from commercial vessels was used to characterize commercial fishing effort in the Offshore Development Region, including within the MA WEA and the SWDA. The VMS datasets and associated mapping made available by NROC and MARCO qualitatively characterize the density of commercial fishing vessel activity for seven fisheries[115] in the northeast and mid-Atlantic regions (Fontenault 2018).

Maps of commercial fishing effort using VTR data were also made available by NROC and MARCO. Using VTR data to create density polygons that represent the visitation frequency of fishing vessels, these maps can be interpreted as an indicator of "community presence," in this case, the type of gear deployed in the SWDA and the ports from which these vessels are operating.

Each of the aforementioned datasets produced qualitative representations of vessel activity within the Multispecies,[116] monkfish, herring, sea scallop, surf clam/ocean quahog, mackerel, and squid fisheries, and within the bottom trawl, dredge, gillnet, longline, and pots and traps fisheries.

Figures 7.6-2 through 7.6-7 depict a standardized density of commercial fishing vessel activity within the Multispecies, monkfish, herring, scallop, surf clam/ocean quahog, and squid fisheries in the northeast and mid-Atlantic regions of the US based on VMS data for the years 2015 to 2016.

The VMS-based analysis indicates the density of Northeast Multispecies vessel activity can be characterized largely as “Medium-Low” in portions of the SWDA with some areas characterized as “Medium-High” (see Figure 7.6-2). However, much of the SWDA has little to no multispecies vessel activity during the years analyzed. The terms “Medium-Low” or “Medium-High” are not specifically defined, rather they indicate the relative density of vessel traffic as classified by the underlying model (Fontenault 2018). The highest relative vessel density is located to the north and outside of the SWDA, with concentrated areas of vessel density immediately south of Martha’s Vineyard and Nantucket, to the east and west of Muskeget Channel.

Vessels targeting monkfish (see Figure 7.6-3) appear to be deploying gear in limited areas of the SWDA during the years analyzed. Vessel density increases to the north of the SWDA, in the areas on either side of Muskeget Channel.

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[115] The fisheries include multispecies, monkfish, herring, scallop, surf clam/ocean quahog, herring, squid, mackerel.

[116] The multispecies data includes the following species: cod, haddock, yellowtail flounder, pollock (*Pollachius pollachius*), plaice, witch flounder (*Glyptocephalus cynoglossus*), white hake (*Urophycis tenuis*), windowpane flounder (*Scopthalmus aquosus*), Atlantic halibut (*Hippoglossus hippoglossus*), winter flounder (*Pseudopleuronectes americanus*), redfish (*Sciaenops ocellatus*), Atlantic wolffish (*Anarhichas lupus*), and ocean pout (*Macrozoarces americanus*).

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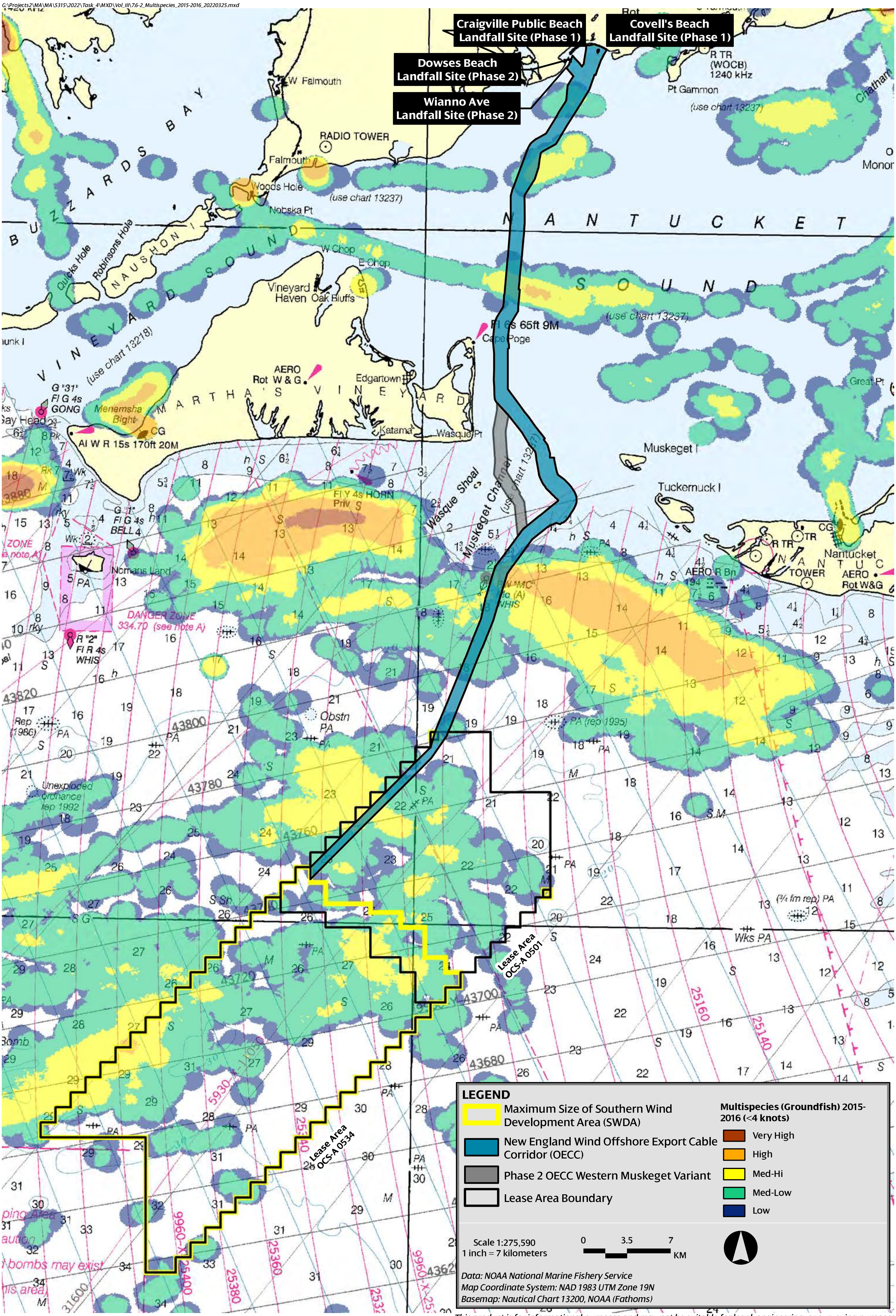

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-2

(VMS) Northeast Multispecies 2015-2016 (<4 knots) Commercial Fishing Density

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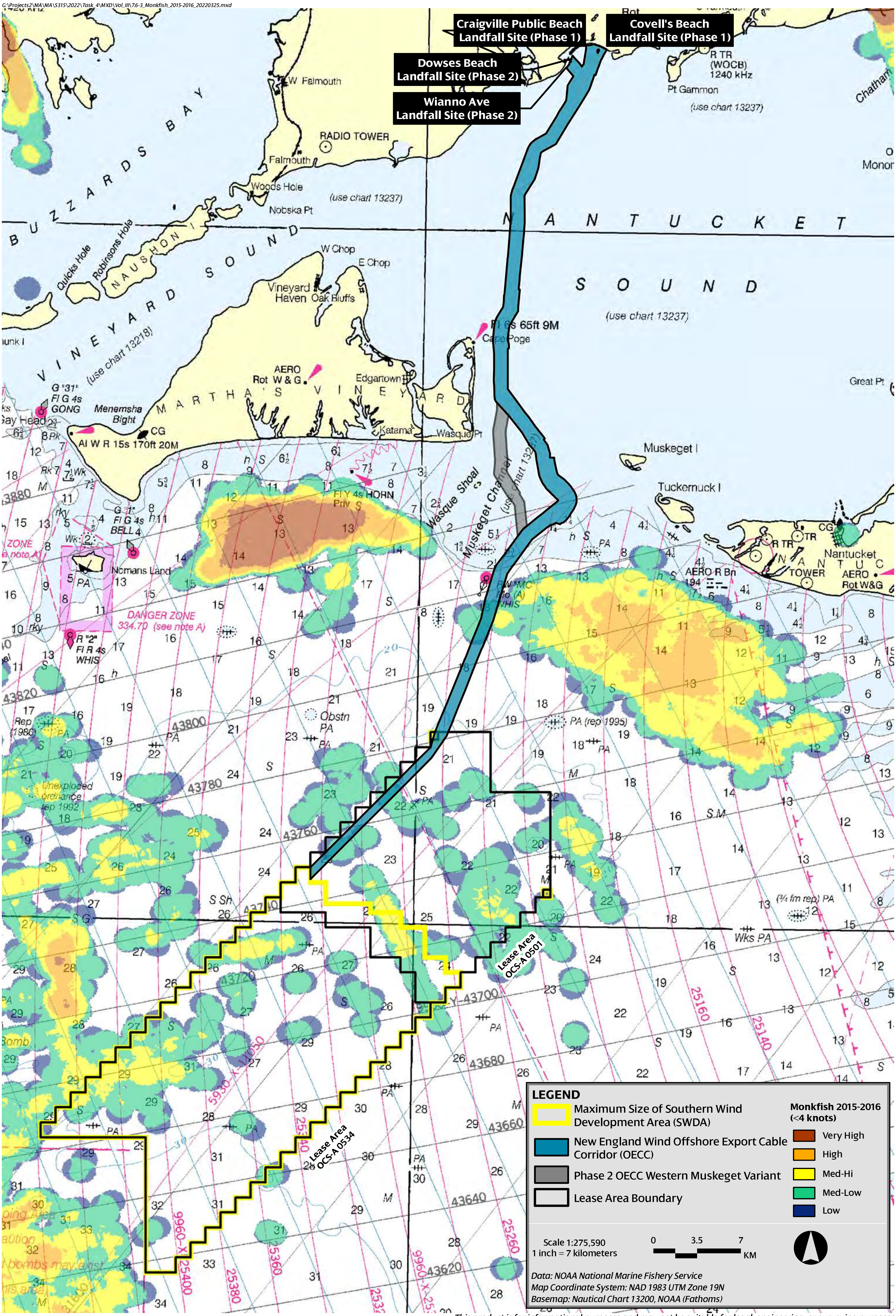

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-3

(VMS) Monkfish 2015-2016 (<4 knots) Commercial Fishing Density

Scallop vessel density during the years analyzed is Medium-Low, with a small section characterized as Medium-High within limited areas of the SWDA and along a section of the OECC near Muskeget Channel (see Figure 7.6-4). Much of the SWDA shows no presence of scallop vessel activity during the years analyzed.

Vessels targeting surf clam/ocean quahogs appear to have almost no presence in the SWDA during the years analyzed. Areas of Medium-High to High density occur to the north of the SWDA (see Figure 7.6-5).

Squid vessels appear active in the SWDA and along portions of the OECC through Nantucket Sound (see Figure 7.6-6) during the years analyzed. However, the highest concentration of squid activity occurs outside and to the north of the SWDA. Fishermen have communicated that squid activity primarily occurs inside and near the SWDA, in federal waters, from approximately May/June to August, and areas within Nantucket Sound and Massachusetts coastal waters from April to June. This is consistent with the AIS data presented in Figure 7.6-6.

During the years analyzed, vessels targeting herring do not appear to deploy gear in the SWDA (see Figure 7.6-7).

Fishermen have also indicated that vessels targeting whiting (silver hake) and scup, may be active in the SWDA throughout the year and vessels targeting yellowtail and winter flounder are active in proximity to the northwest corner of "The Dump," a popular fishing location approximately 45 km (24.3 NM) south of Martha's Vineyard and marked as an area of unexploded ordnance on NOAA charts. The whiting fishery is not represented in VMS heat map data since regulations allow vessels to "Declare Out of Fishery"[117] when targeting whiting. As described in Section 7.6.2.5, VTR data provided by NOAA Fisheries for the SWDA reflect landings of hakes. The Proponent will continue to work with whiting fishermen to better understand that fishery's operations in the Offshore Development Area.

Figures 7.6-8 through 7.6-19 are VTR-based maps depicting the bottom trawl, dredge, gillnet, longline, and pots and traps fisheries (excluding lobster). It is important to note that the VMS figures (Figures 7.6-2 through 7.6-7) depict relative vessel density between 2015 and 2016, while VTR figures, as referenced herein, have been aggregated, separately, for 2006 to 2010 and 2011 to 2015.

VTR-based analysis of the bottom trawl fishery is further divided into two categories: vessels less than 20 m (65 ft) in length (see Figures 7.6-8 and 7.6-9) and vessels greater than 20 m (65 ft) in length (see Figures 7.6-10 and 7.6-11). During the years analyzed, smaller bottom trawl vessels

[117] A vessel with a limited access Northeast multispecies permit may fish for whiting while the vessel is not fishing under a day-at-sea and while declared "out of the fishery," if the vessel is otherwise required to operate a VMS.

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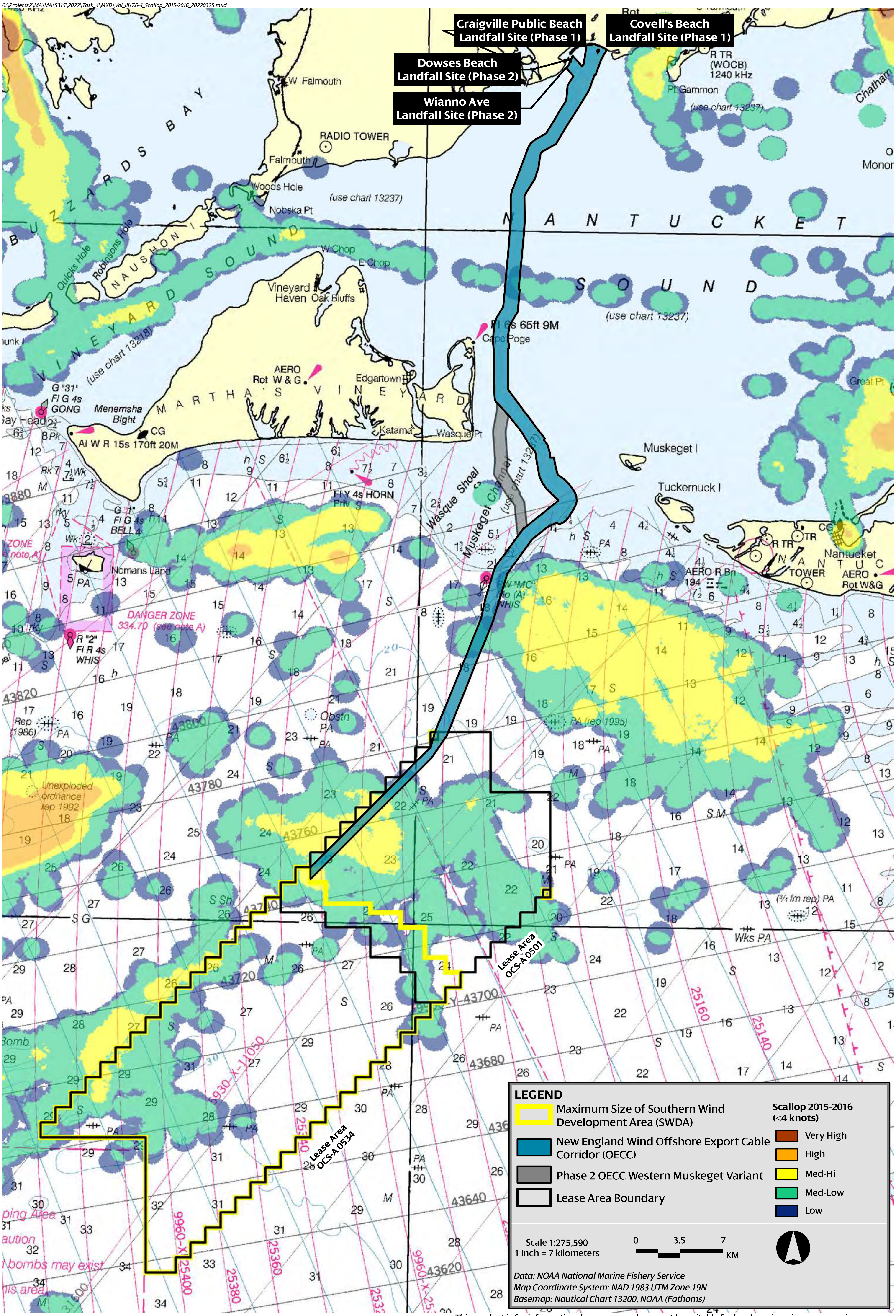

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-4

(VMS) Scallop 2015-2016 (<5 knots) Commercial Fishing Density

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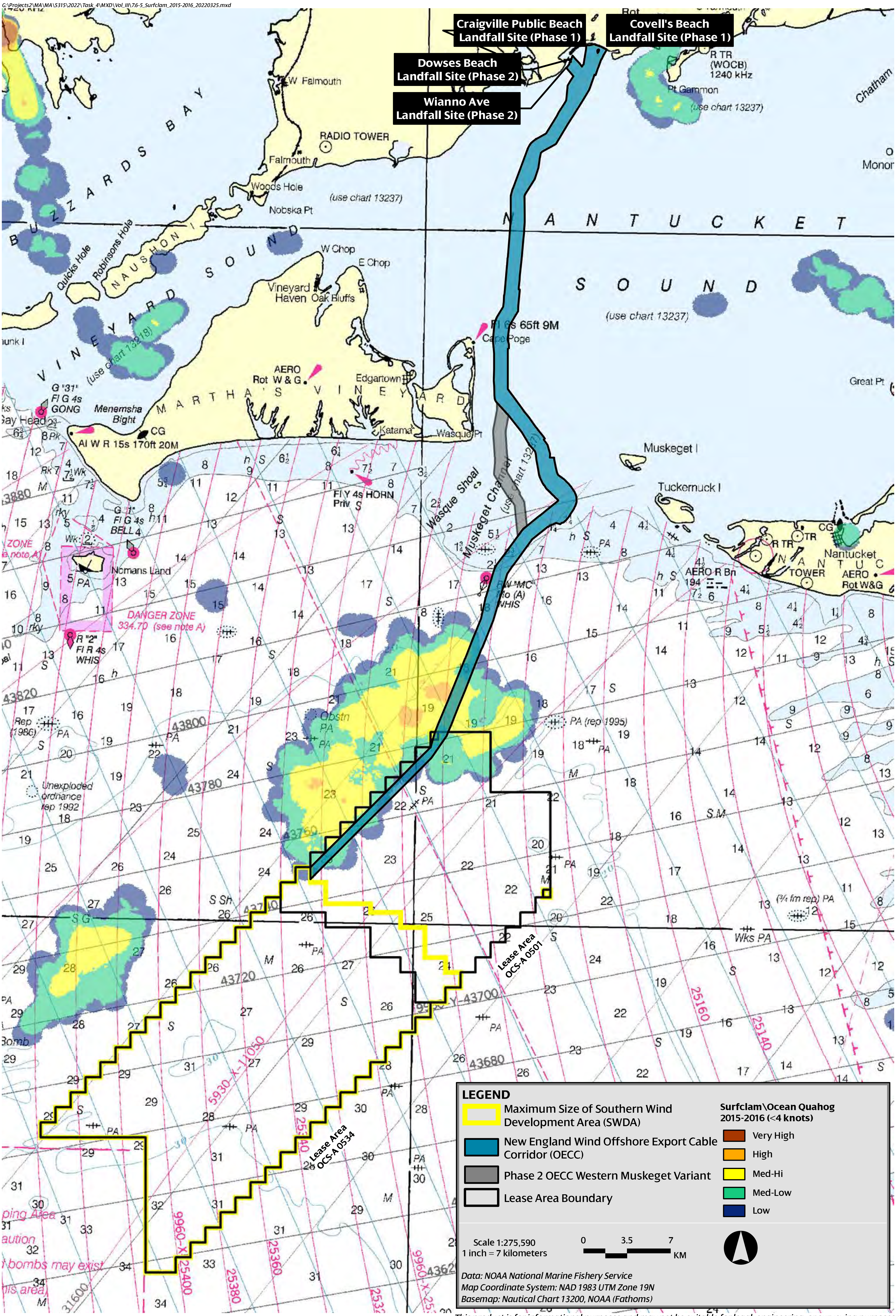

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-5

(VMS) Surfclam/Ocean Quahog 2015-2016 (<4 knots) Commercial Fishing Density

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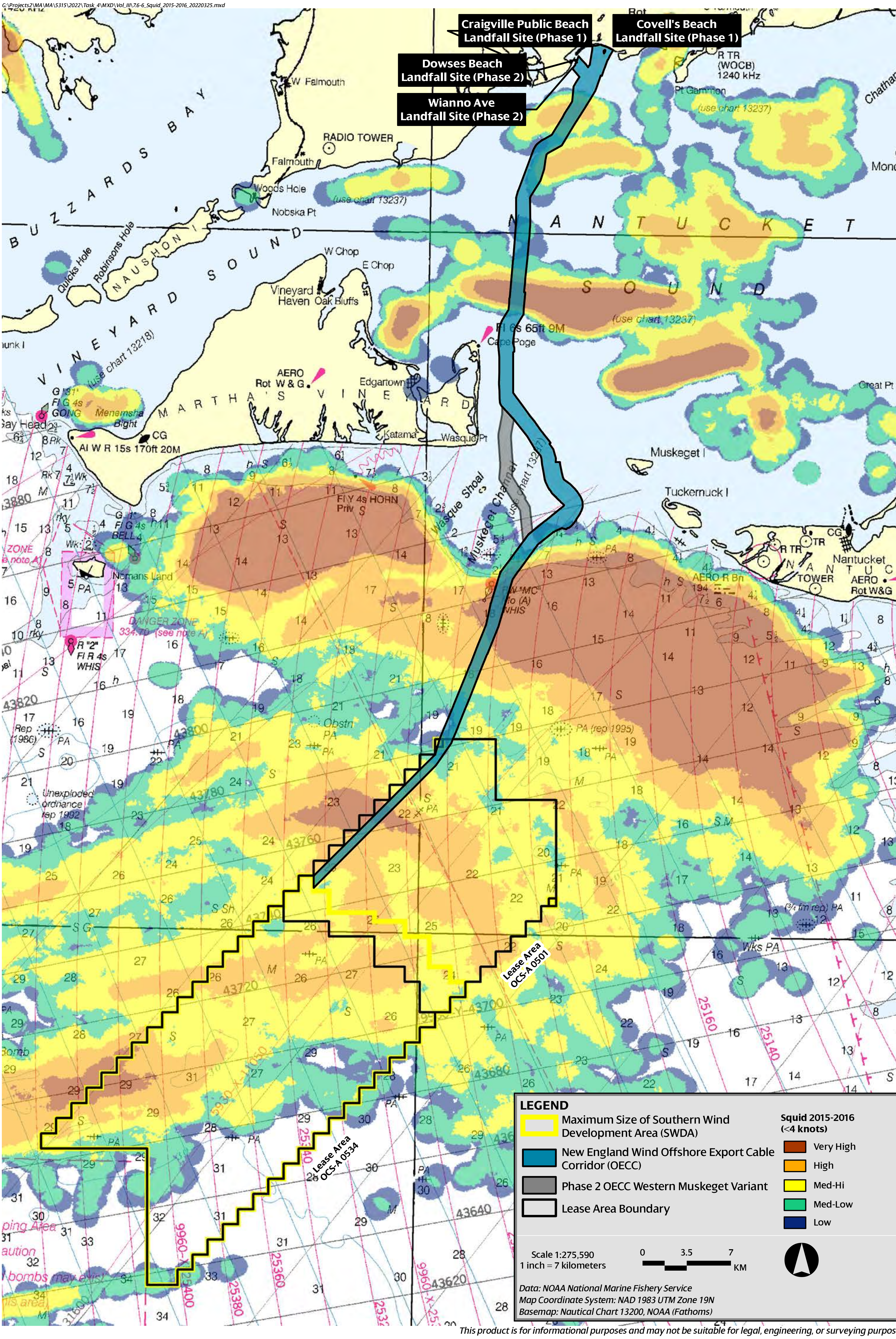

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Figure 7.6-6

(VMS) Squid 2015-2016 (<4 knots) Commercial Fishing Density

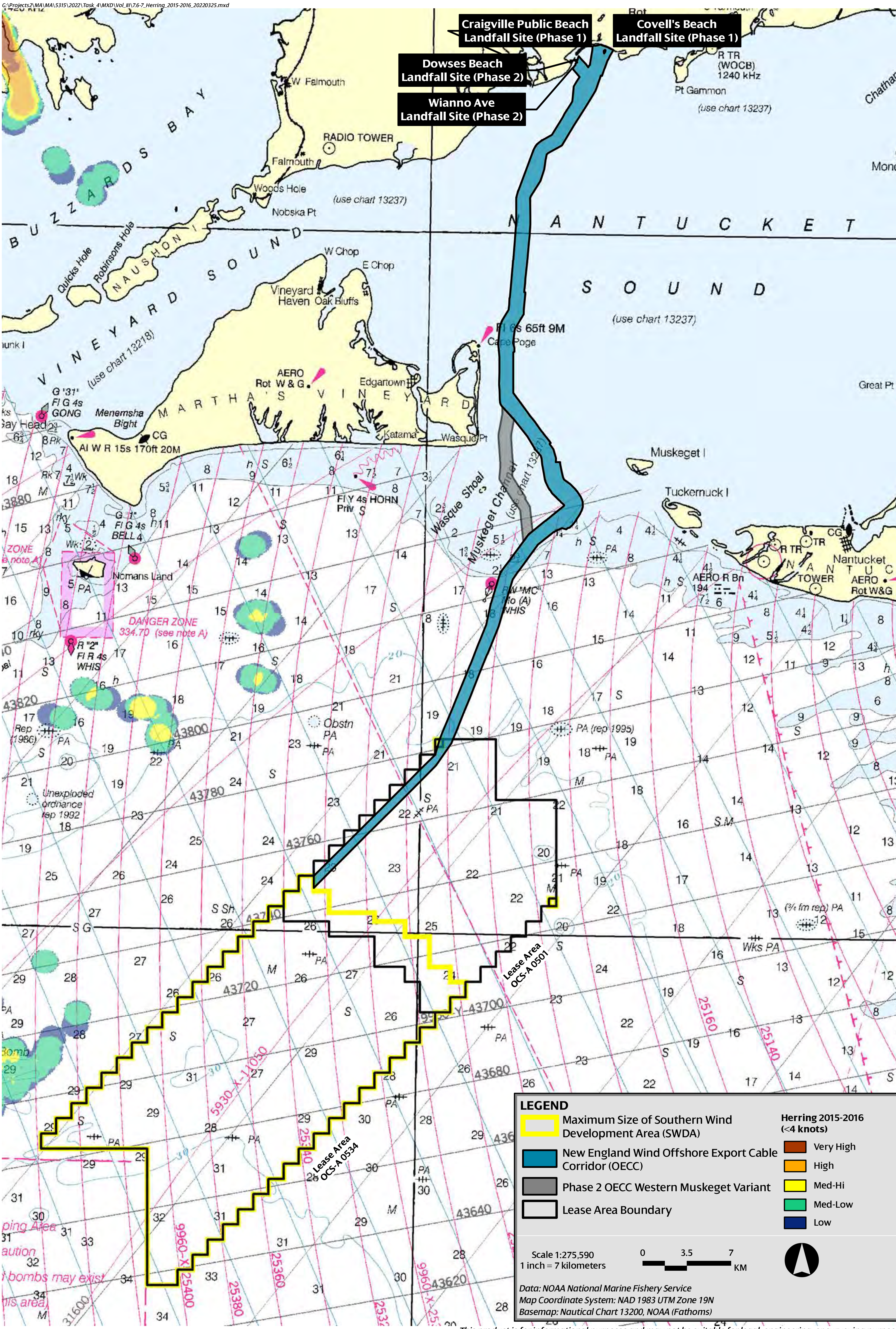

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Figure 7.6-7

(VMS) Herring 2015-2016 (<4 knots) Commercial Fishing Density

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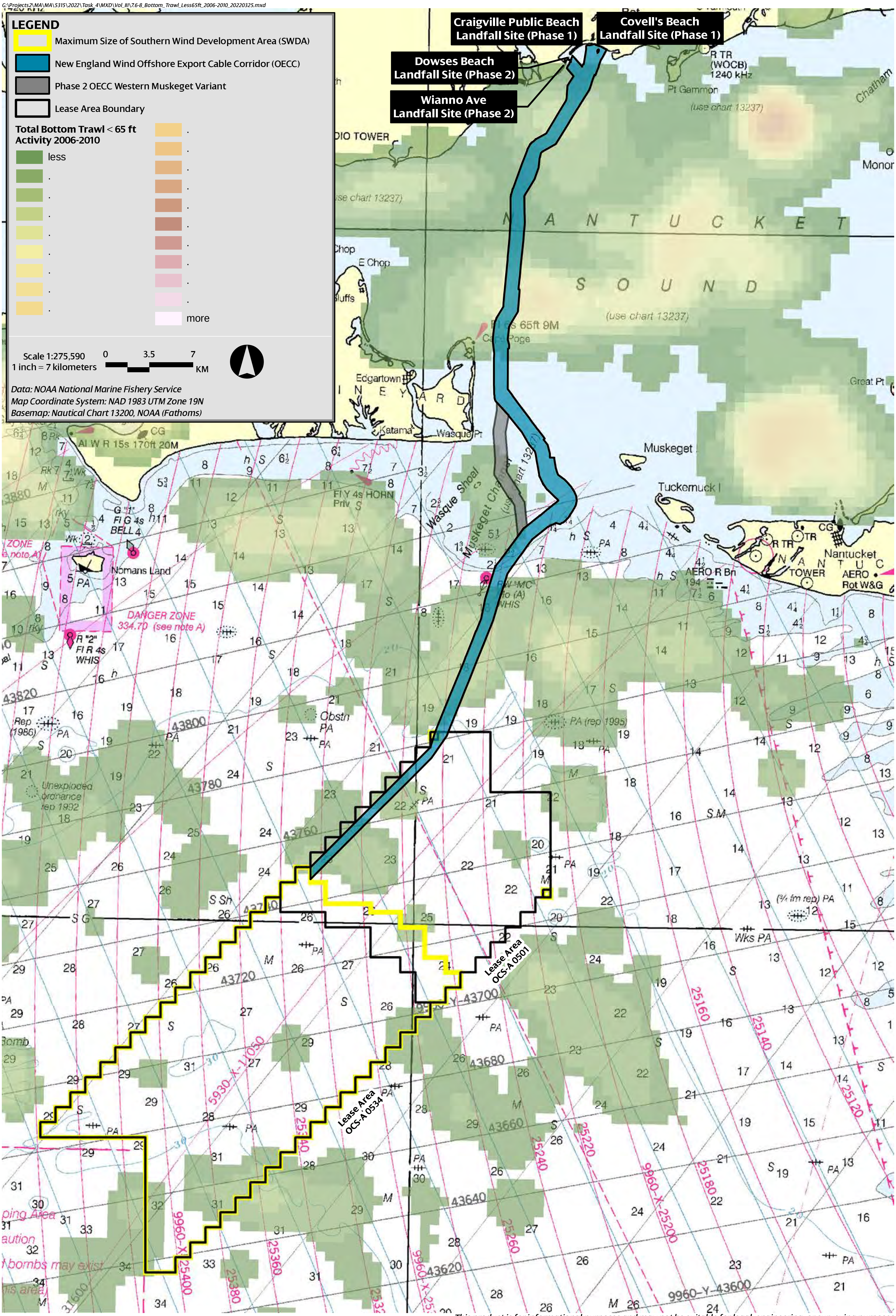

This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes

New England Wind
AVANGRID RENEWABLES

Figure 7.6-8

(VTR) Bottom Trawl (Vessels <65 ft.) 2006 - 2010

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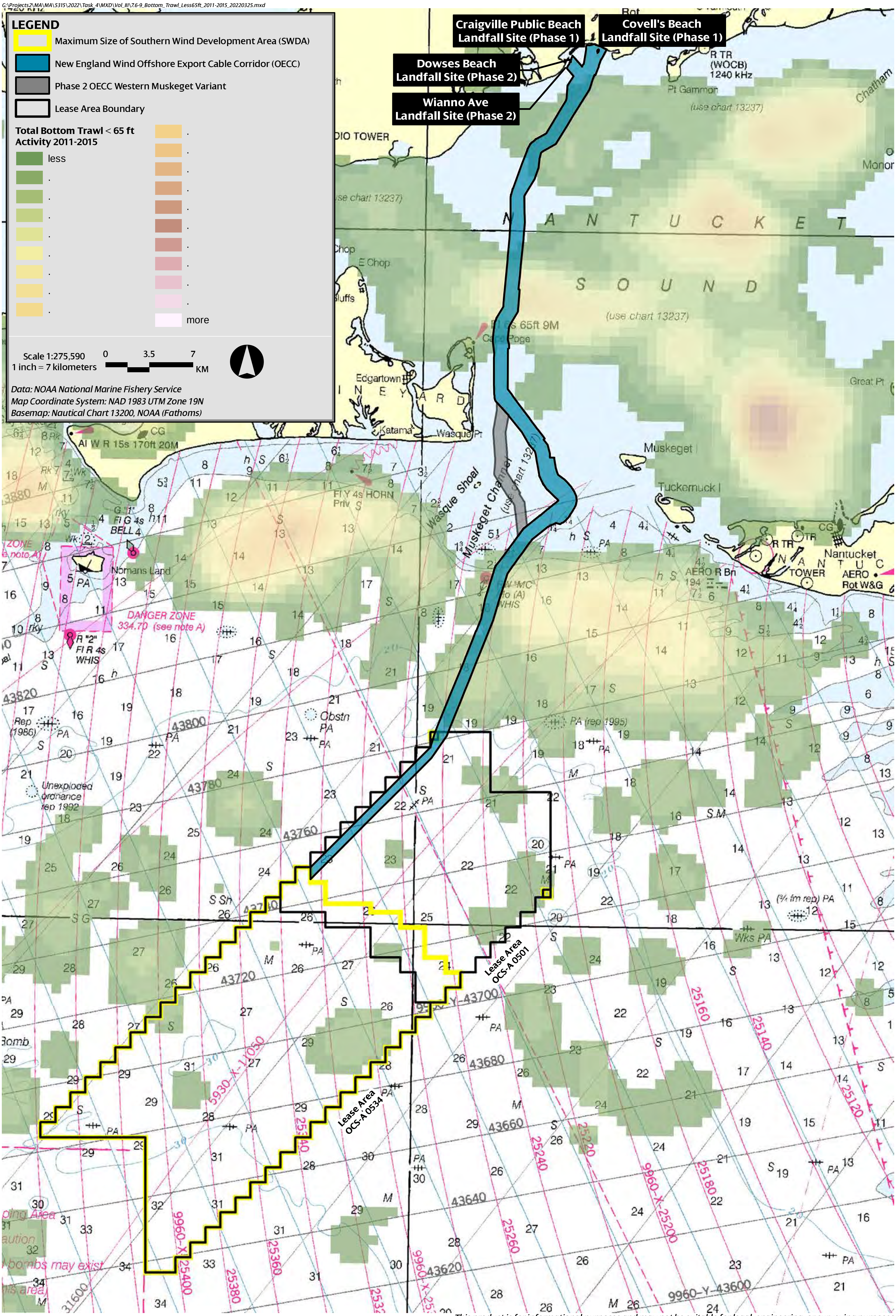

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-9

(VTR) Bottom Trawl (Vessels <65 ft.) 2011 - 2015

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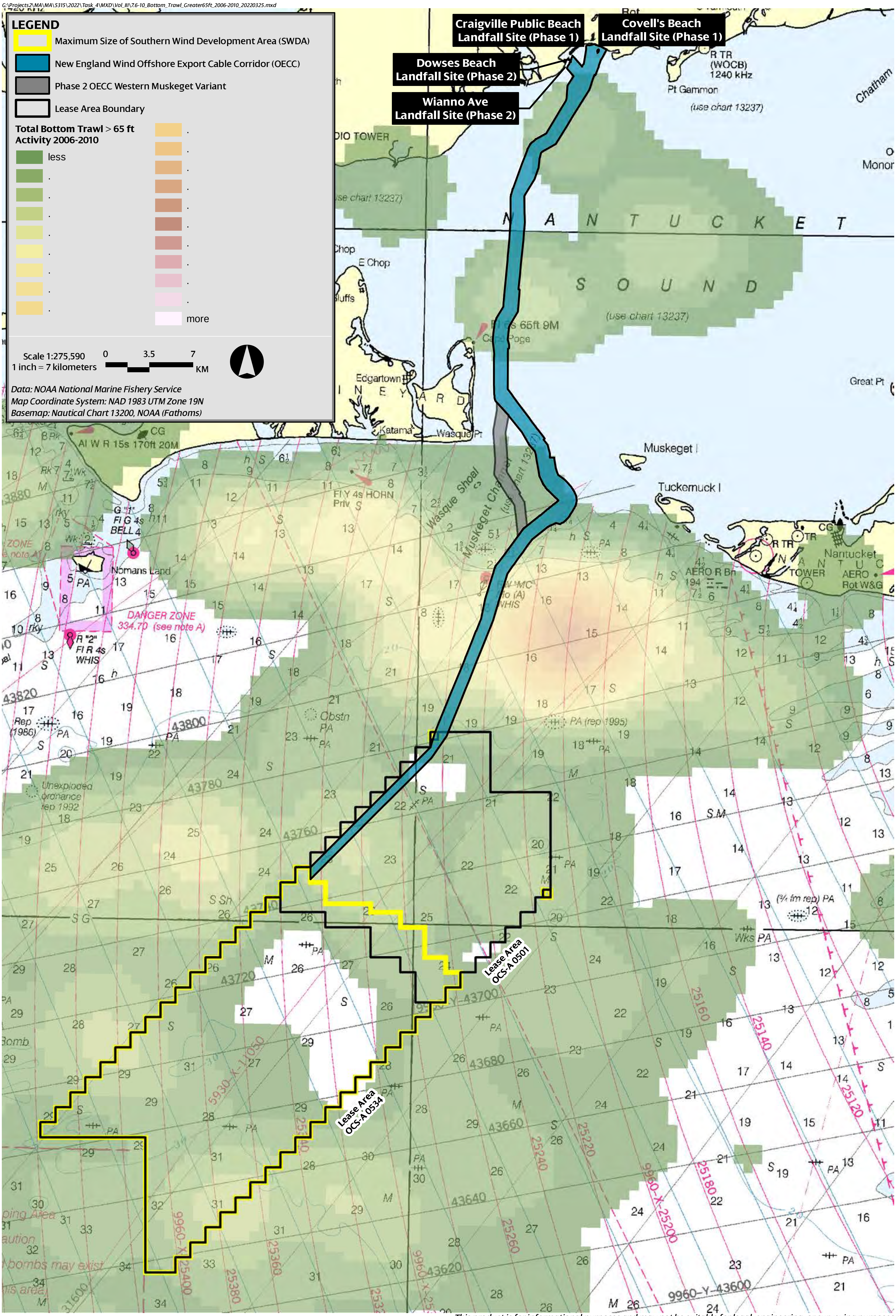

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-10

(VTR) Bottom Trawl (Vessel >65 ft.) 2006 - 2010

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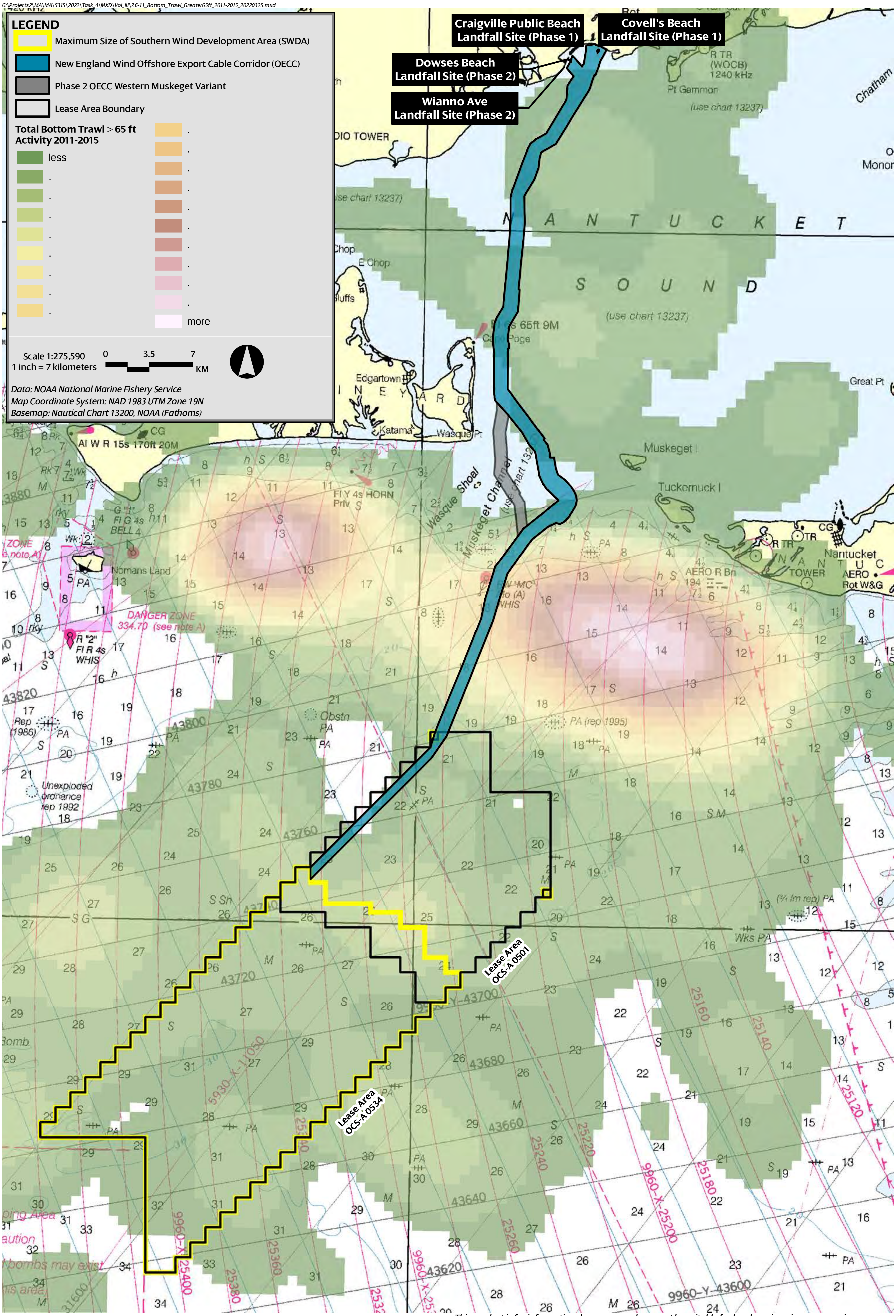

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-11

(VTR) Bottom Trawl (Vessel >65 ft.) 2011 - 2015

appear to operate largely within Nantucket Sound and in areas outside the SWDA, south of Nantucket and Martha's Vineyard. Figures 7.6-8 and 7.6-9 depict areas of low to moderate fishing effort by these vessels. During the years analyzed, low fishing effort by vessels greater than 20 m (65 ft) in length appears distributed throughout the SWDA and along the portions of the OECC (including the Western Muskeget Variant), as shown on Figures 7.6-10 and 7.6-11. Elevated fishing effort, likely reflecting vessels targeting squid, occurs outside and to the north of the SWDA and south of Martha's Vineyard and Nantucket.

During the years analyzed, there were limited areas of low fishing effort by vessels deploying dredge gear occur along the OECC (including the Western Muskeget Variant) for 2006 through 2010, and less fishing effort by dredge vessels between 2011 and 2015 (see Figures 7.6-12 and 7.6-13). Fishing effort by dredge vessels is limited to one small area within the SWDA during 2006 through 2010.

During the years analyzed, only limited areas of low fishing effort by gillnet vessels is reflected in the SWDA and along the OECC (see Figures 7.6-14 and 7.6-15).

During the years analyzed, limited fishing effort by longline vessels occur within the SWDA or along the OECC (see Figures 7.6-16 and 7.6-17).

During the years analyzed, deployment of pots and traps occurs predominantly within Nantucket Sound and very limited pot and trap fishing effort is reflected within the SWDA and limited along the OECC south of Muskeget Channel (see Figures 7.6-18 and 7.6-19).

BOEM developed a revenue-intensity raster dataset using fishery dependent landings data to support the Kirkpatrick et al. (2017) analysis of socioeconomic exposure of commercial fisheries to wind energy development in the US Atlantic (BOEM 2020a). According to Kirkpatrick et al. (2017), revenue-intensity rasters were built as part of an effort to improve upon the spatial precision of self-reported VTR fishing locations. VTR data merged with at-sea fisheries observer data allowed for the development of statistical models to generate predictions for the spatial footprint of fishing reported on a VTR (Kirkpatrick et al. 2017). To further quantify commercial fishing activities in the SWDA, revenue intensity rasters were evaluated for the waters of the Offshore Development Area evaluated from 2013 to 2018. Similar to the other data sources used to evaluate commercial fishing intensity in the Offshore Development Region, the revenue intensity rasters provide a geographic representation of commercial fishing intensity and revenue. Figure 7.6-20 through Figure 7.6-25 depict the annual revenue intensity for all FMPs. As shown by these figures, in general, the areas of greatest revenue intensity are located outside the SWDA.

The lobster fishery is also active in the Offshore Development Region. As noted above, the SWDA and OECC are located in LMA 2 and LMA 3 of the Southern New England Stock. The lobster resource and fishery are cooperatively managed by the states and NOAA Fisheries under the ASMFC framework.

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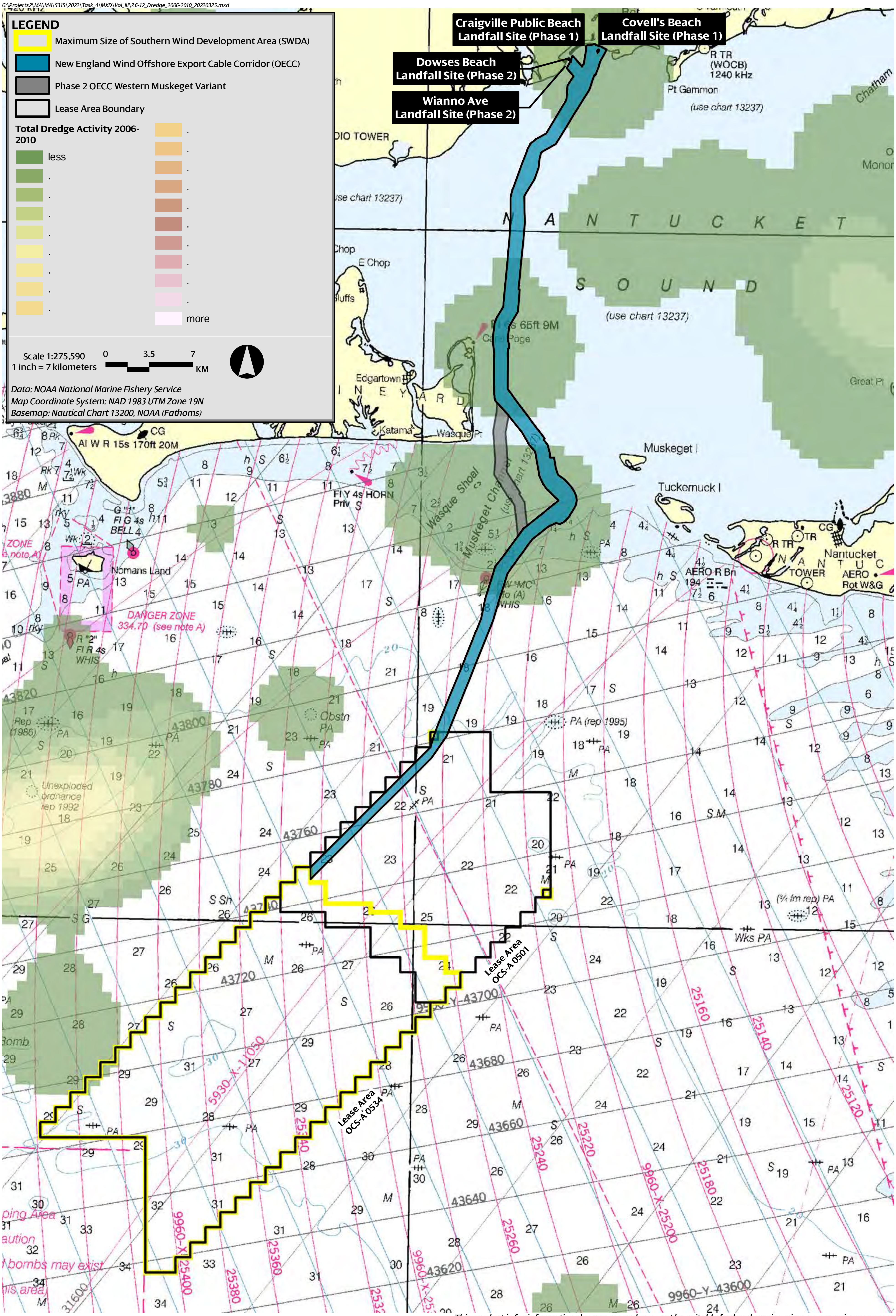

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-12
(VTR) Dredge 2006 - 2010

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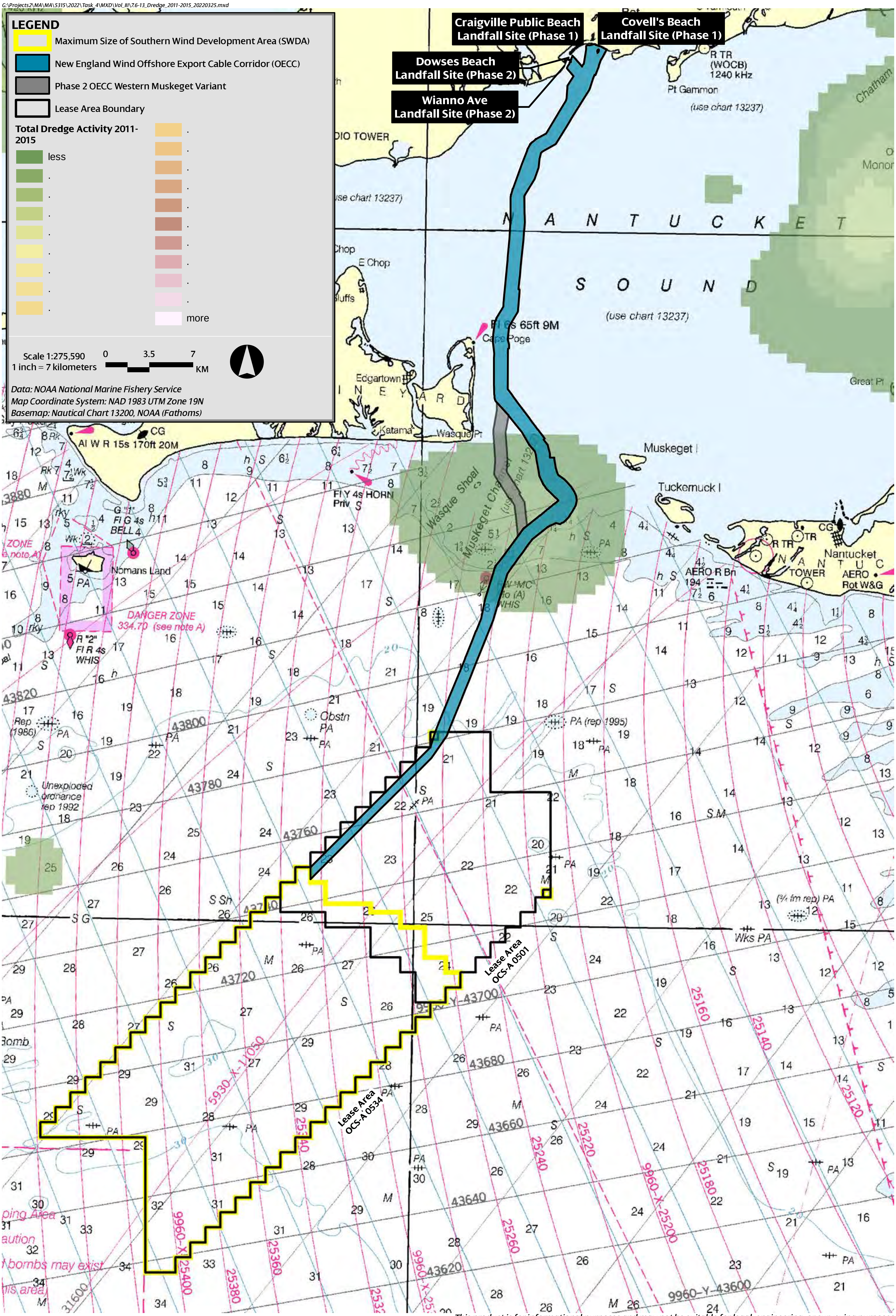

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Figure 7.6-13

(VTR) Dredge 2011 – 2015

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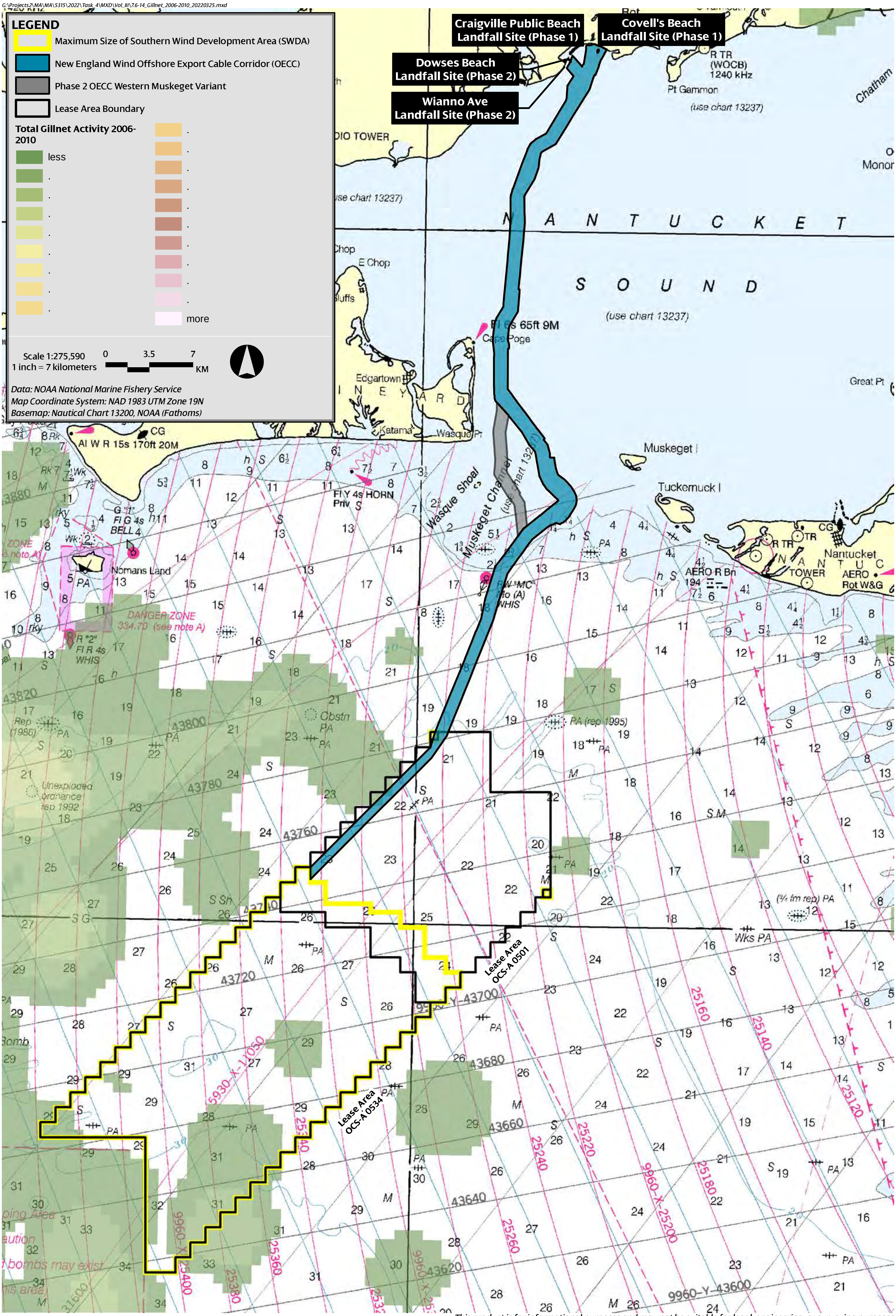

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-14

(VTR) Gillnet 2006 – 2010

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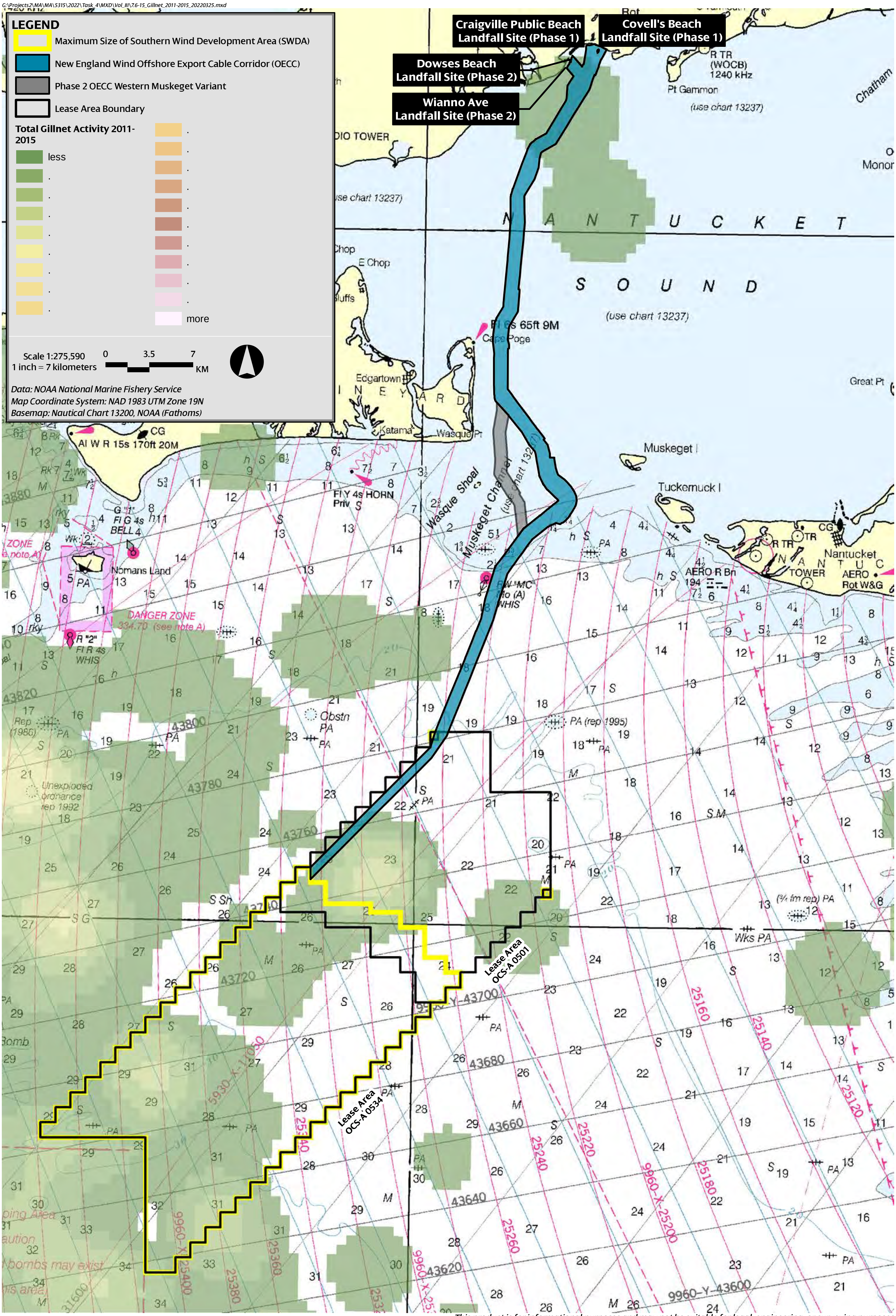

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-15
(VTR) Gillnet 2011 – 2015

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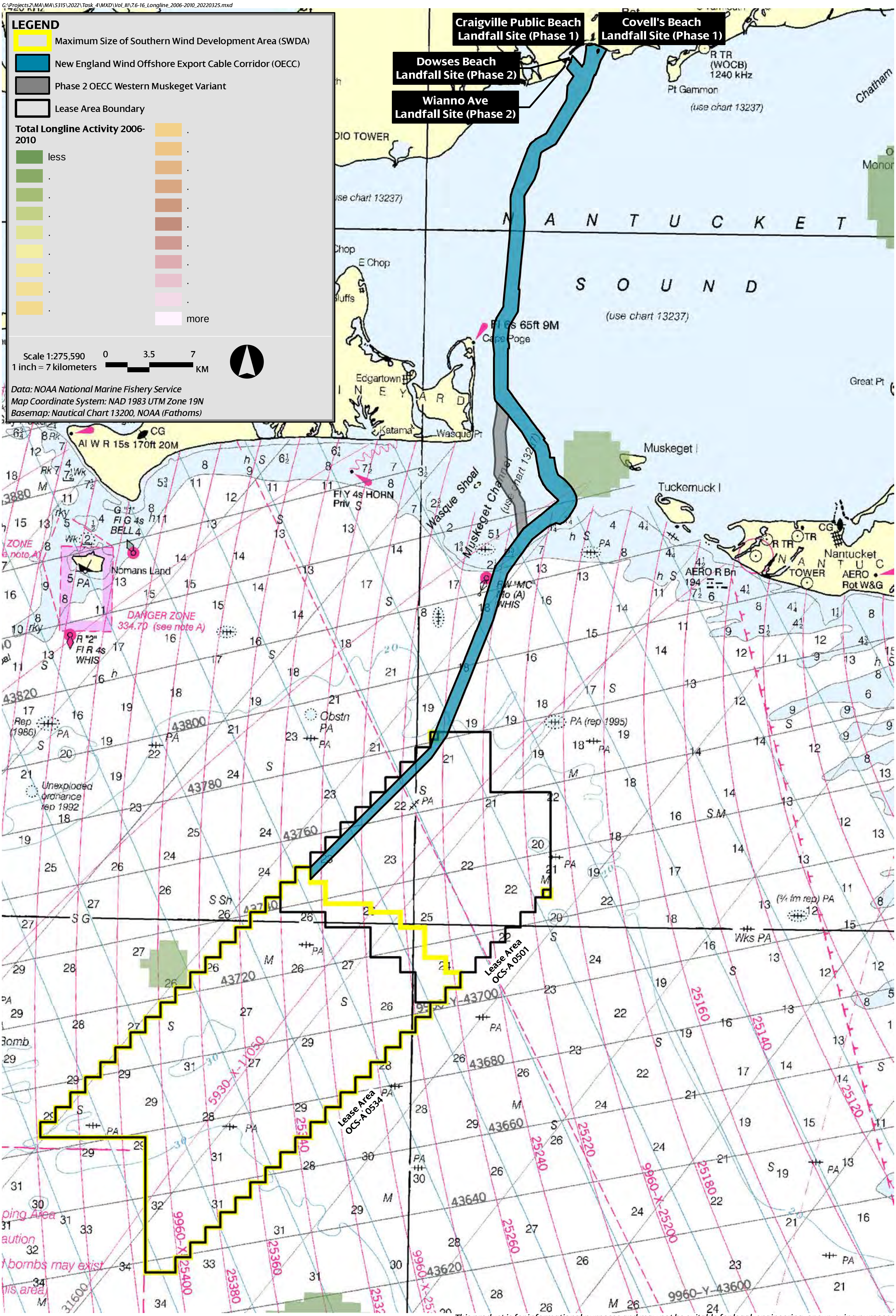

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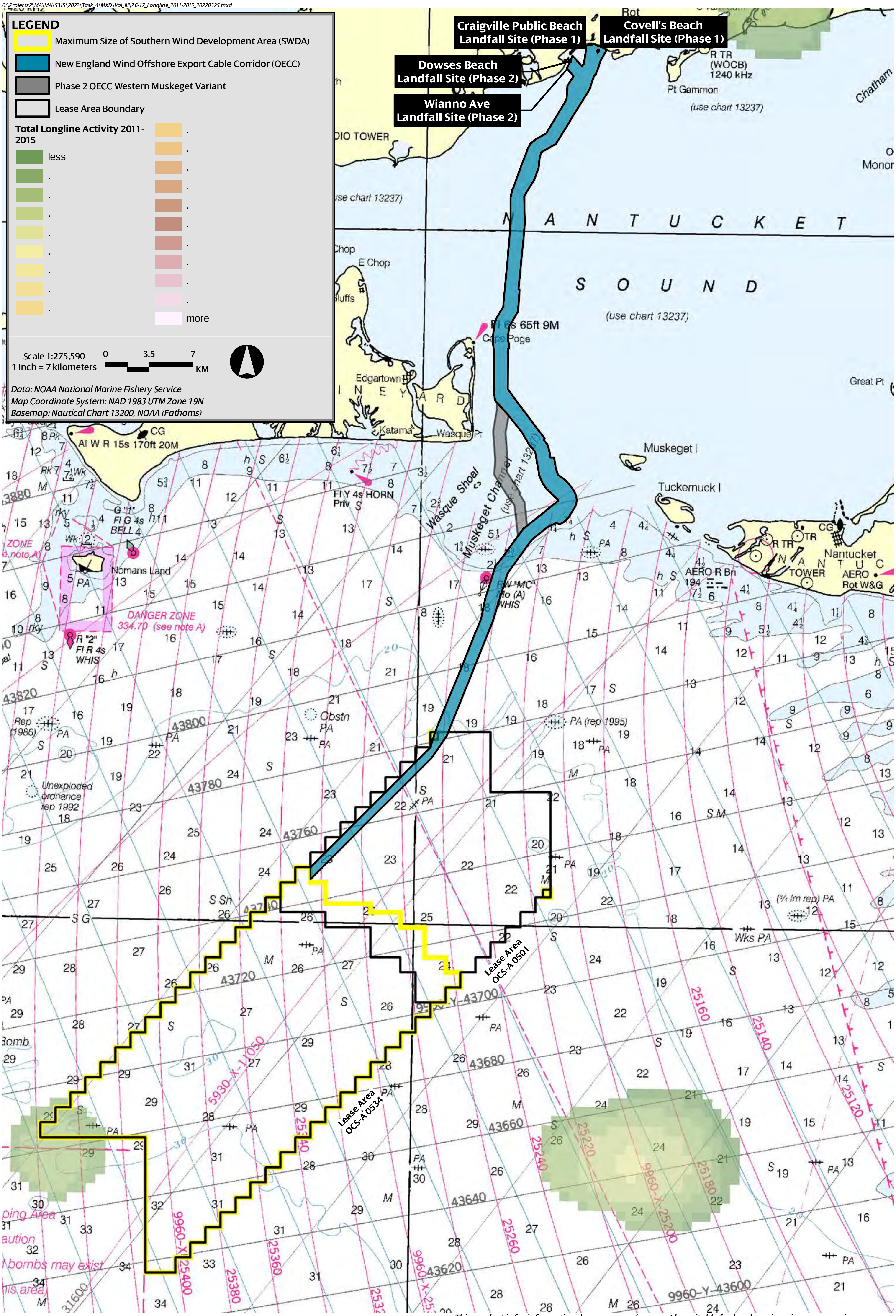
New England Wind
AVANGRID RENEWABLES

Figure 7.6-16
(VTR) Longline 2006 – 2010



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New England Wind
AVANGRID RENEWABLES

Figure 7.6-17
(VTR) Longline 2011 – 2015

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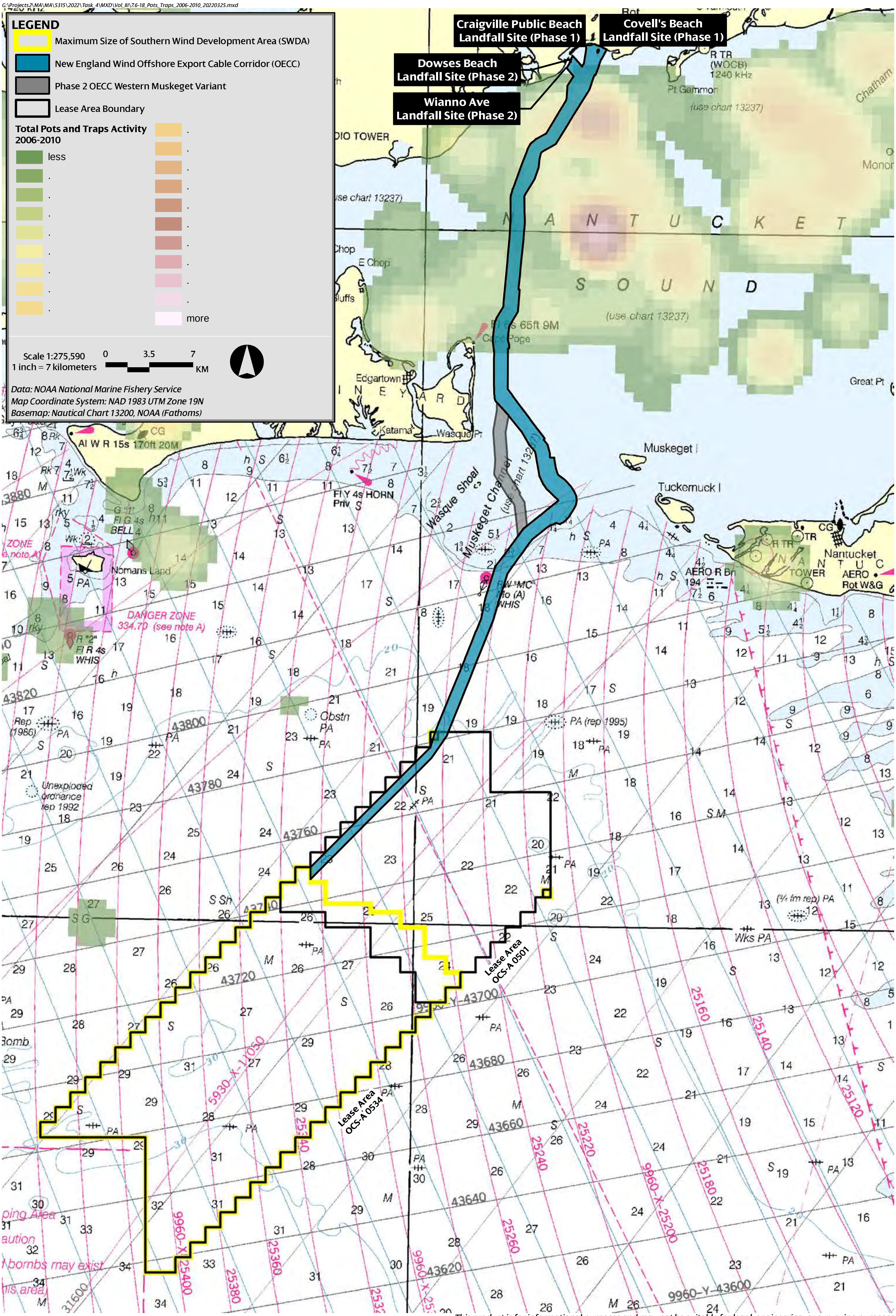

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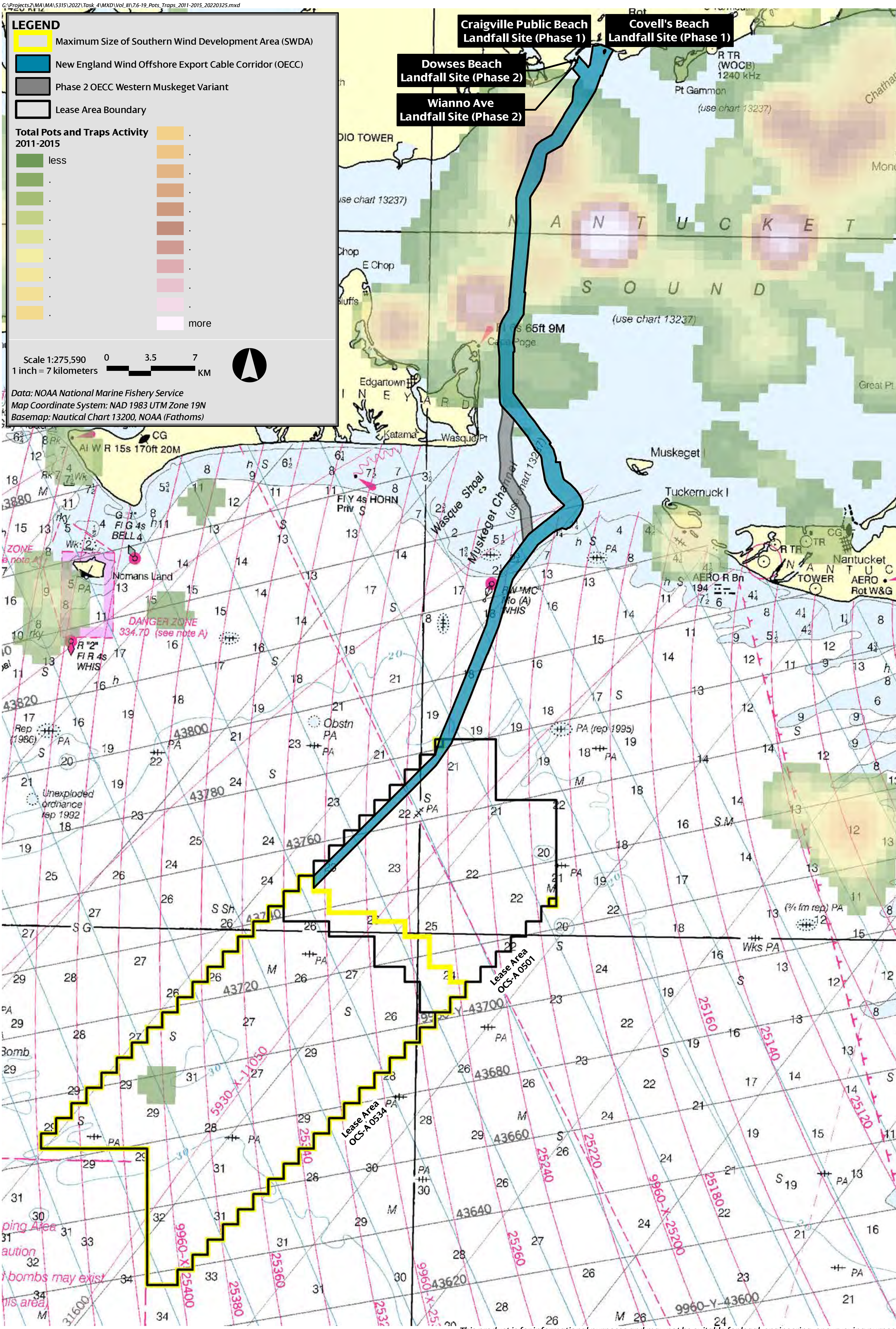
Figure 7.6-18

(VTR) Pots and Traps 2006 – 2010



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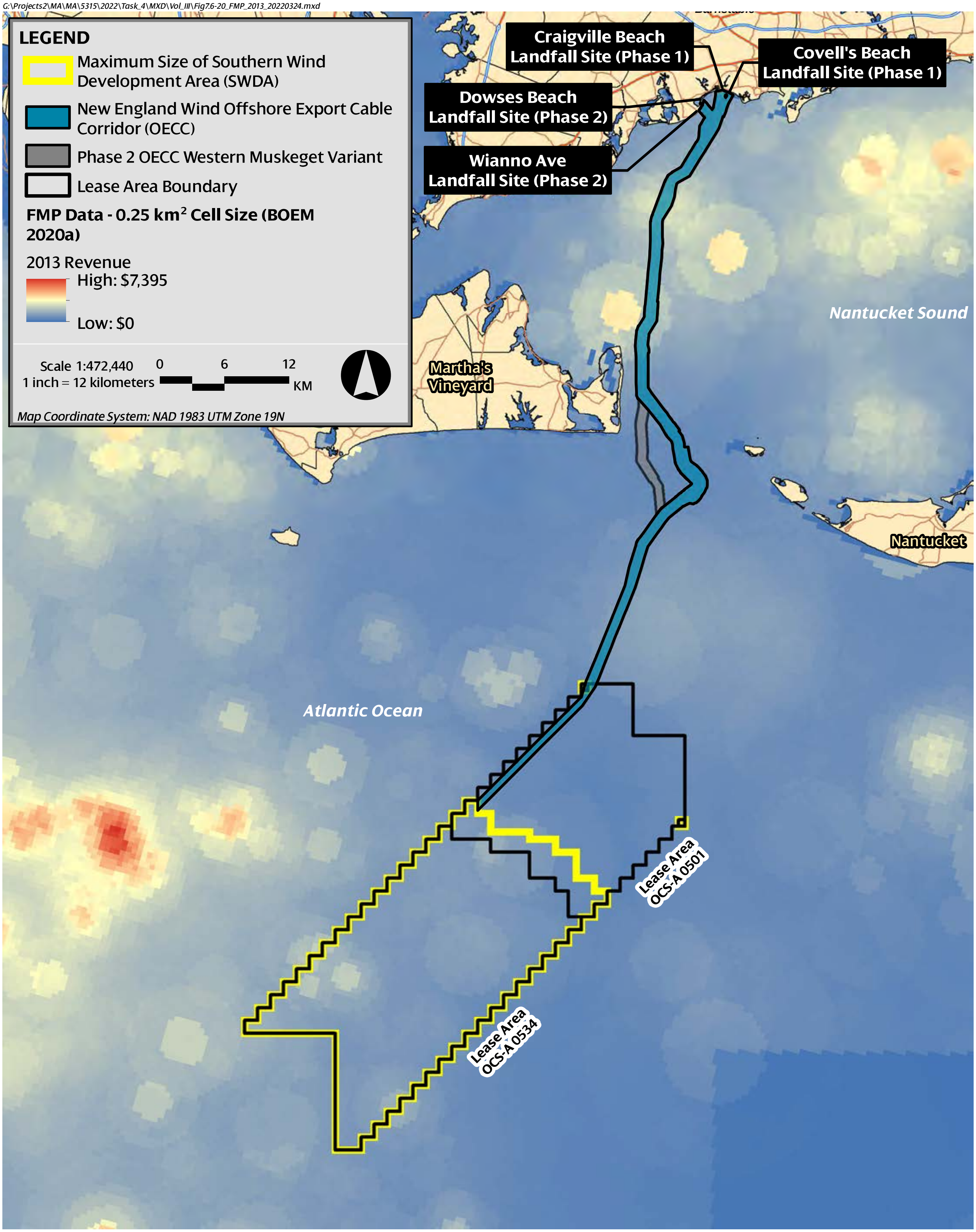
New England Wind
AVANGRID RENEWABLES

Figure 7.6-19
(VTR) Pots and Traps 2011 – 2015



New England Wind
AVANGRID RENEWABLES

Figure 7.6-20
Revenue Intensity, All FMPs, 2013

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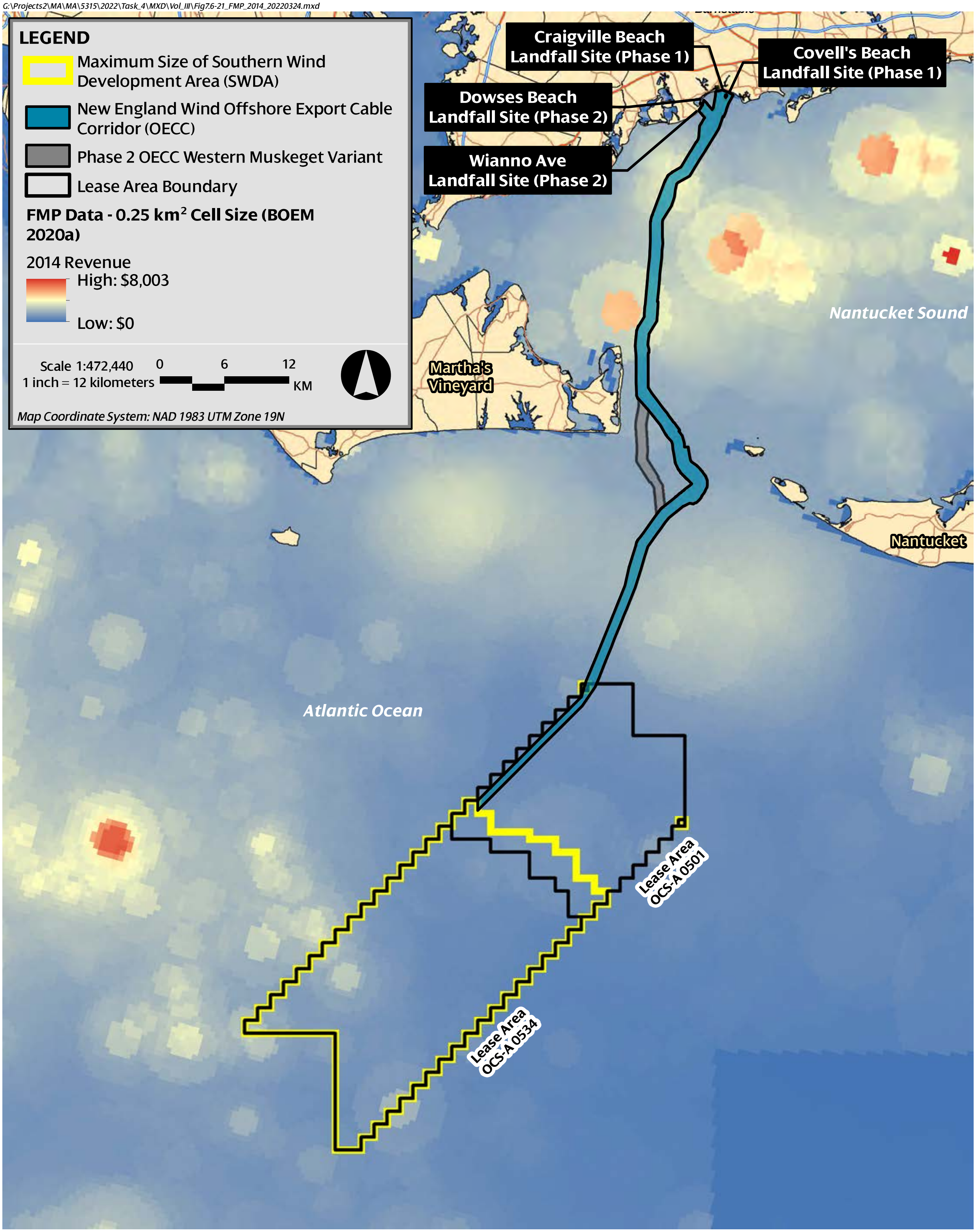

New England Wind
AVANGRID RENEWABLES

Figure 7.6-21

Revenue Intensity, All FMPs, 2014

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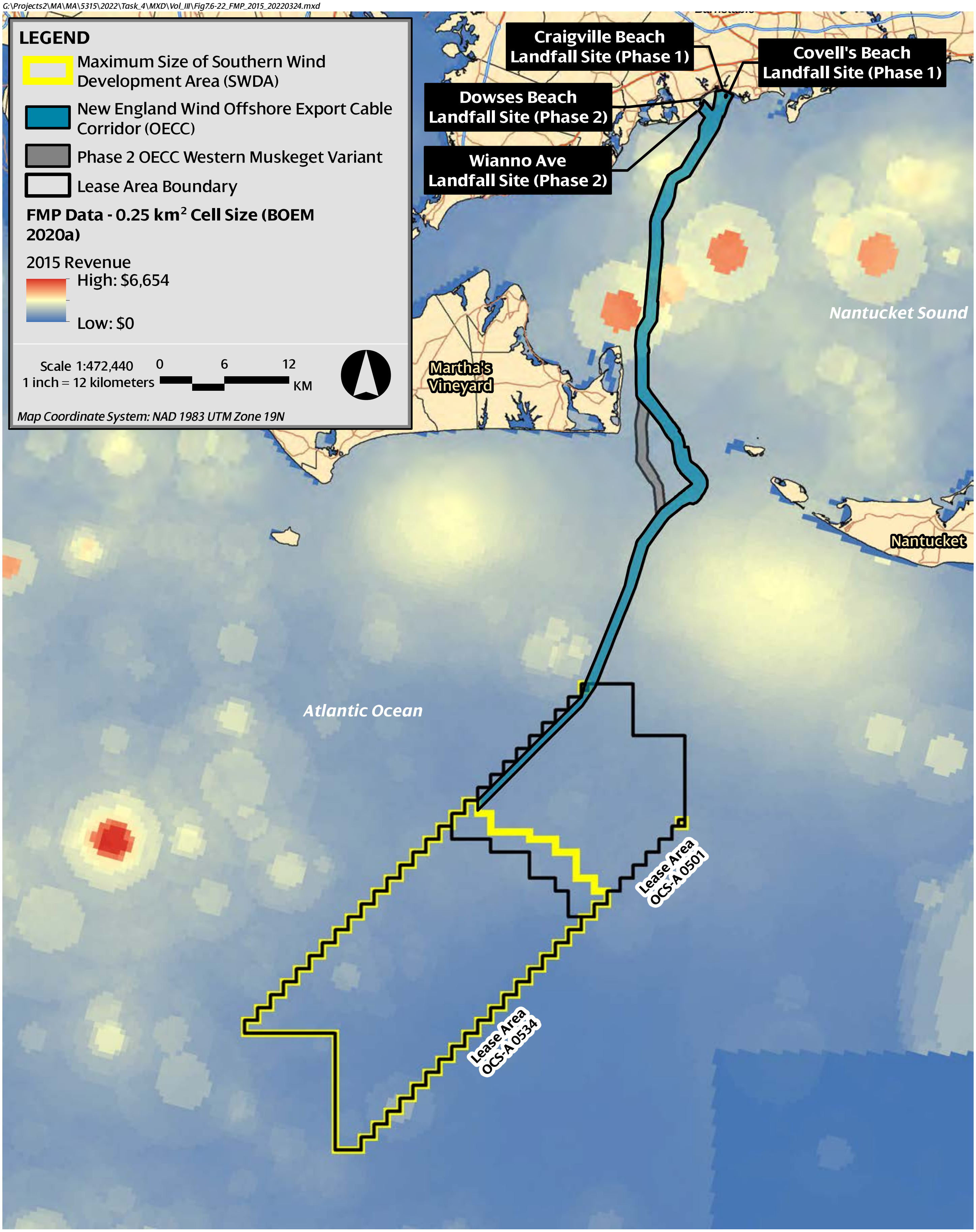

New England Wind
AVANGRID RENEWABLES

Figure 7.6-22

Revenue Intensity, All FMPs, 2015

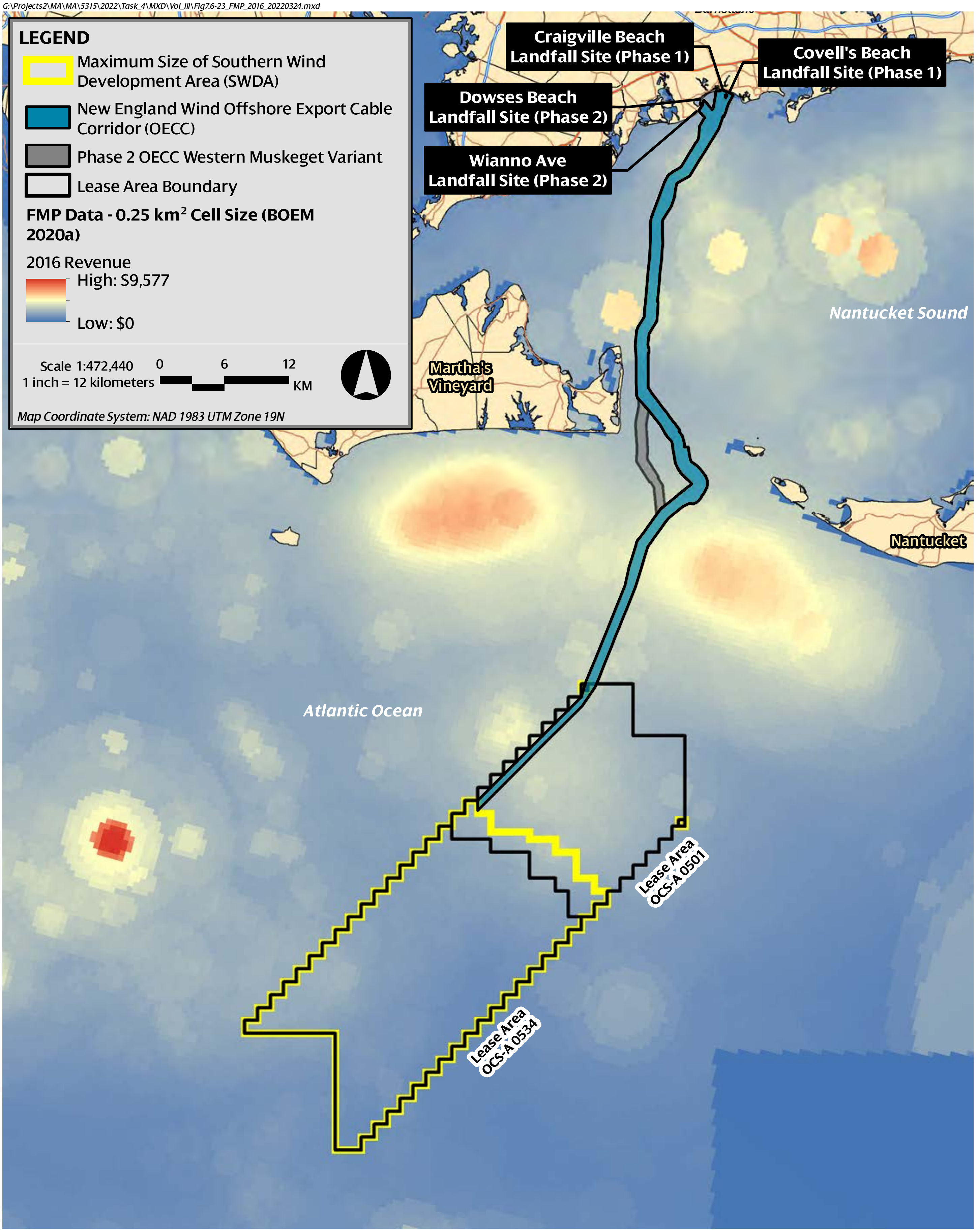

Figure 7.6-23

Revenue Intensity, All FMPs, 2016

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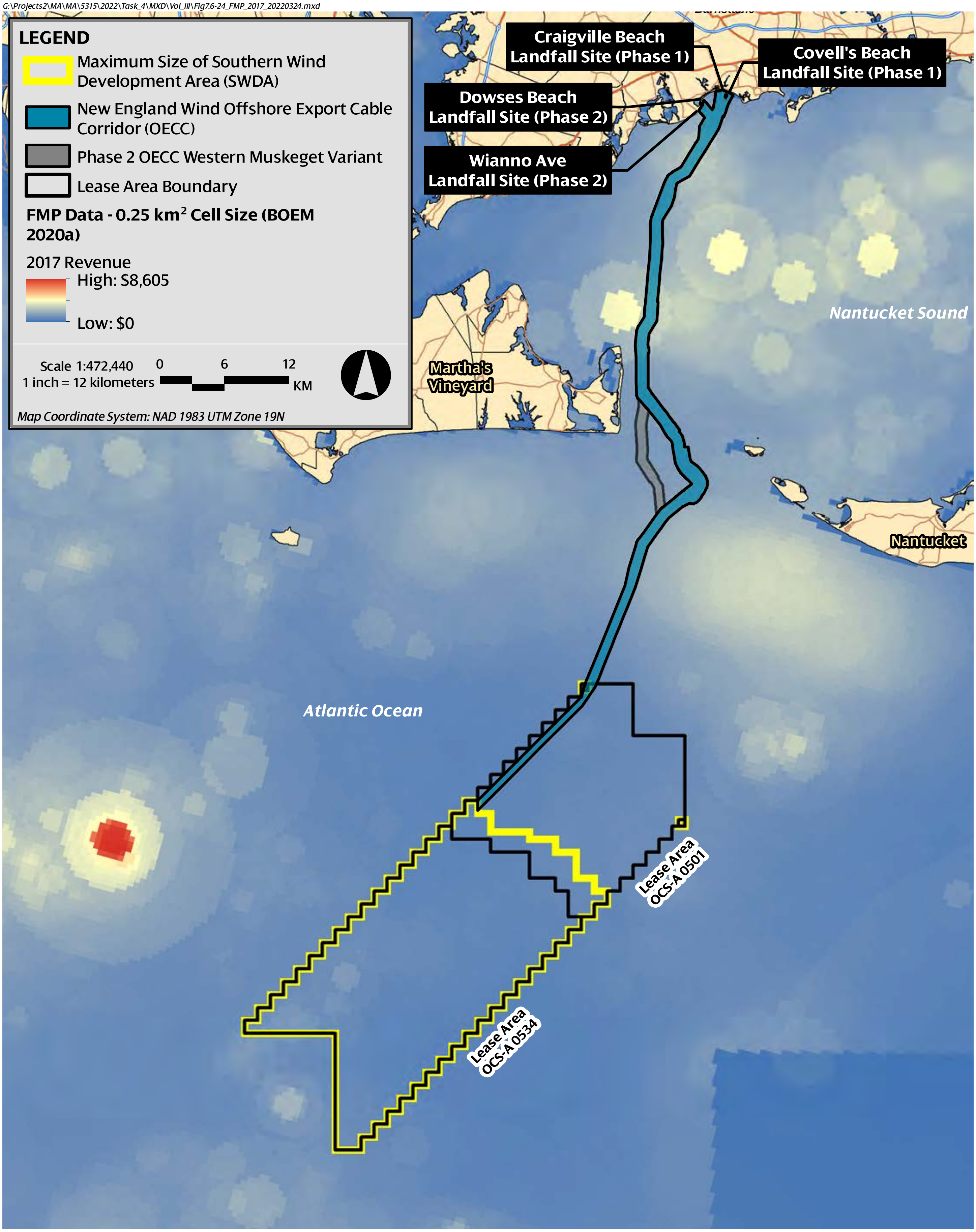

New England Wind
AVANGRID RENEWABLES

Figure 7.6-24

Revenue Intensity, All FMPs, 2017

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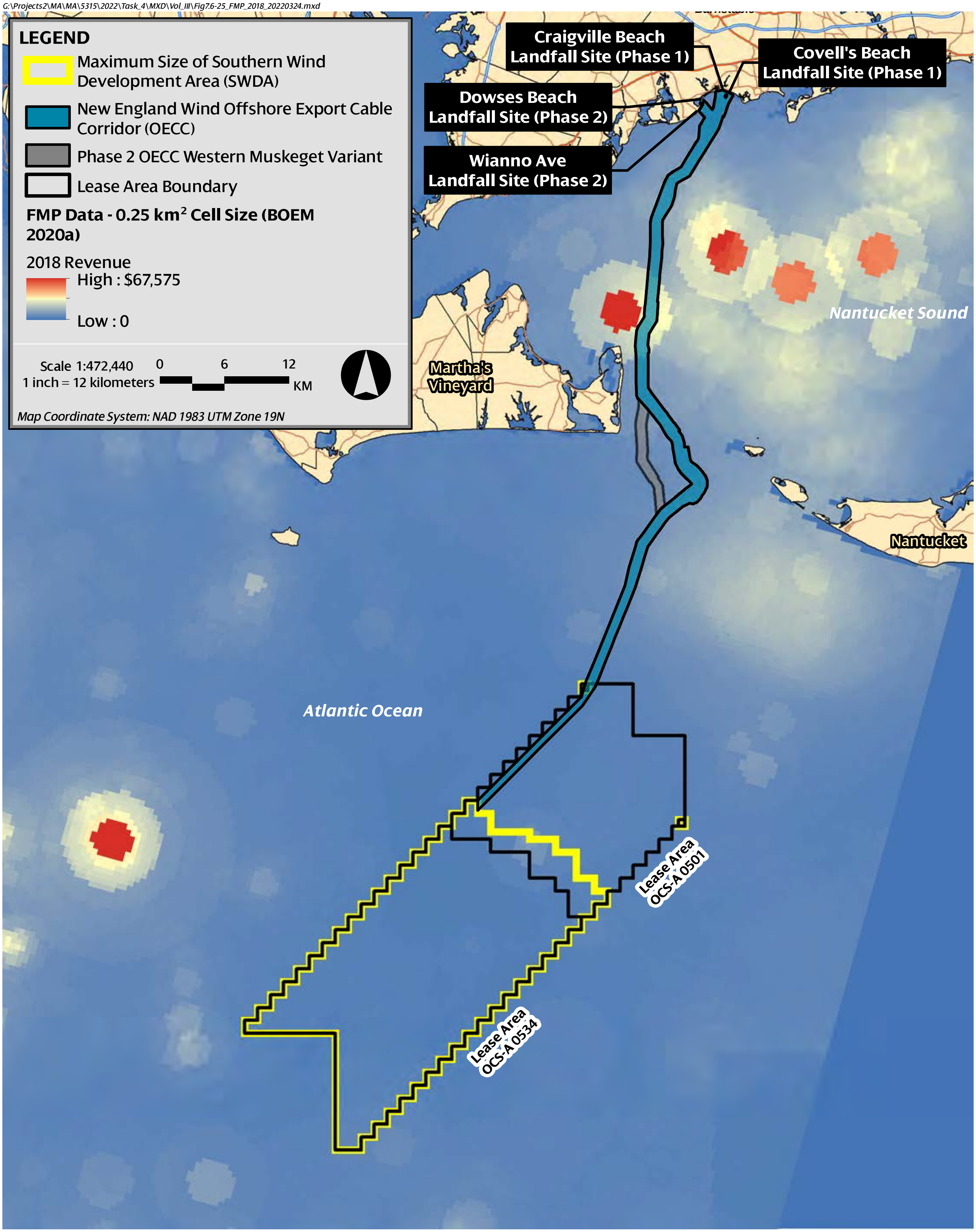

Figure 7.6-25
Revenue Intensity, All FMPs, 2018

NOAA Fisheries regulations do not require lobster fishing vessels to have installed operational VMS units on their vessels and, although the Greater Atlantic Regional Fisheries Office requires permitted vessels to submit a VTR for every fishing trip regardless of where the fishing occurs or what species are targeted, vessels that possess only a lobster permit are exempt from these reporting requirements. Estimates of economic exposure of the lobster fishery to activities in the Lease Area are provided in Section 7.6.4 and Appendix III-N.

Based on outreach to fishermen that hold LMA 2 lobster permits who are currently actively fishing, there may be only five to six lobstermen who actively fish in the Lease Area. Lobstermen have also indicated that the scour protection that may be placed at the base of the WTGs might attract lobster and other fish species and could improve lobster fishing within the SWDA.

As described above, portions of the OECC (including the Western Muskeget Variant) are within the state waters of Massachusetts. Lobster harvesting in Massachusetts requires a commercial lobster permit issued by the MA DMF, and landings can only be sold to licensed Massachusetts dealers. Cable installation within the OECC and related vessel traffic will occur within a limited geographic area of two MA DMF Statistical Reporting Areas: SRA 10 and SRA 12, as shown on Figure 7.6-26. These Statistical Reporting Areas are within Massachusetts waters and the federal waters of Nantucket Sound; a very short segment of the OECC (including the Western Muskeget Variant), in the vicinity of Muskeget Channel, traverses SRA 12. The SWDA is not within either Statistical Reporting Area.

The 2015 Massachusetts Ocean Management Plan identifies areas of “high commercial fishing effort and value” within state waters (EEA 2015), including portions of the Offshore Development Region within Nantucket and Vineyard Sounds, as shown on Figure 7.6-27.

As described in Section 7.6.2, certain non-confidential landings data reported to MA DMF for those SRA 10 and SRA 12 were made available. Landings reported to MA DMF within SRA 10 are shown in Table 7.6-6 and landings reported to MA DMF within SRA 12 are shown in Table 7.6-7.

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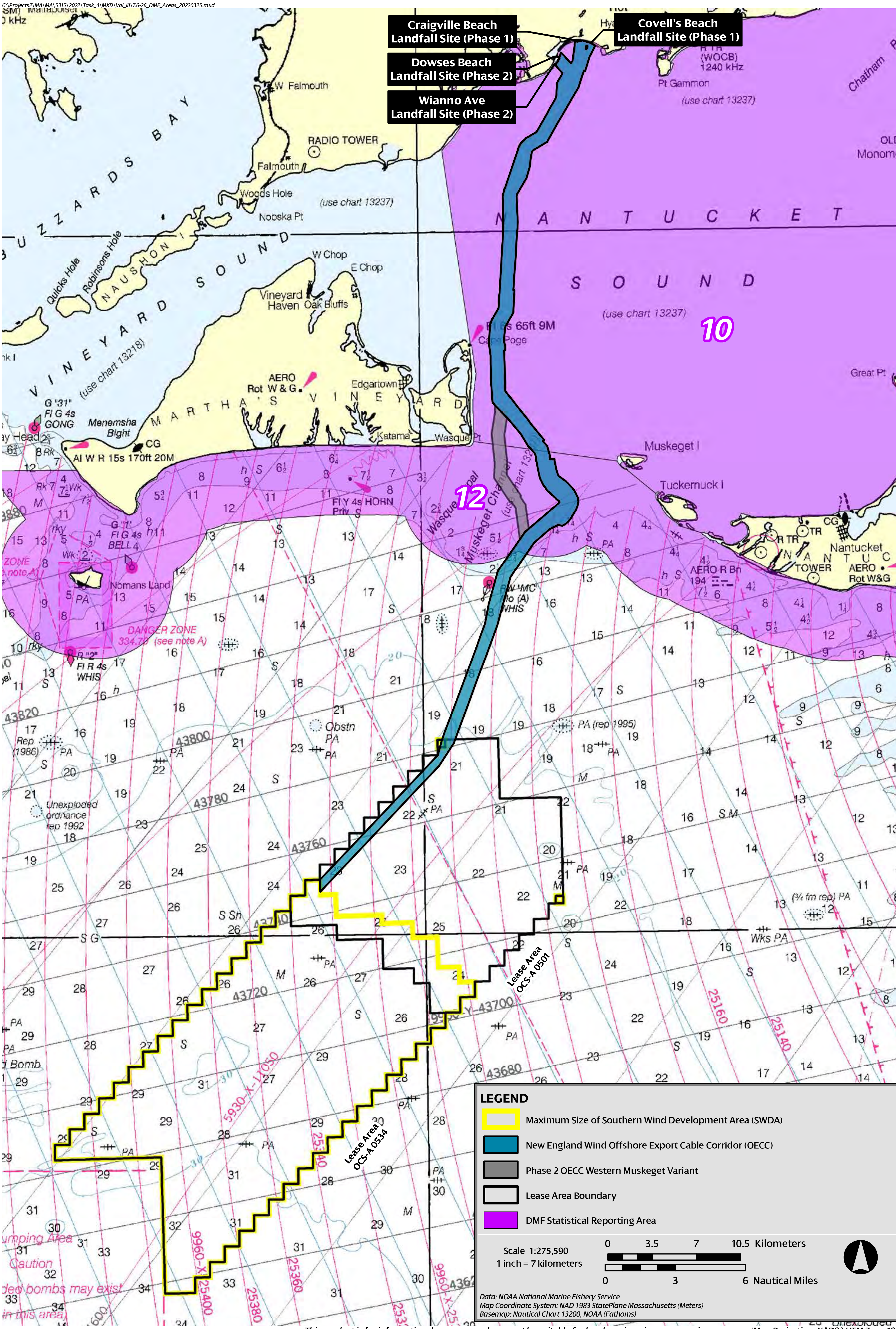

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New England Wind
AVANGRID RENEWABLES

Figure 7.6-26

Massachusetts Division of Marine Fisheries (DMF) Statistical Reporting Areas

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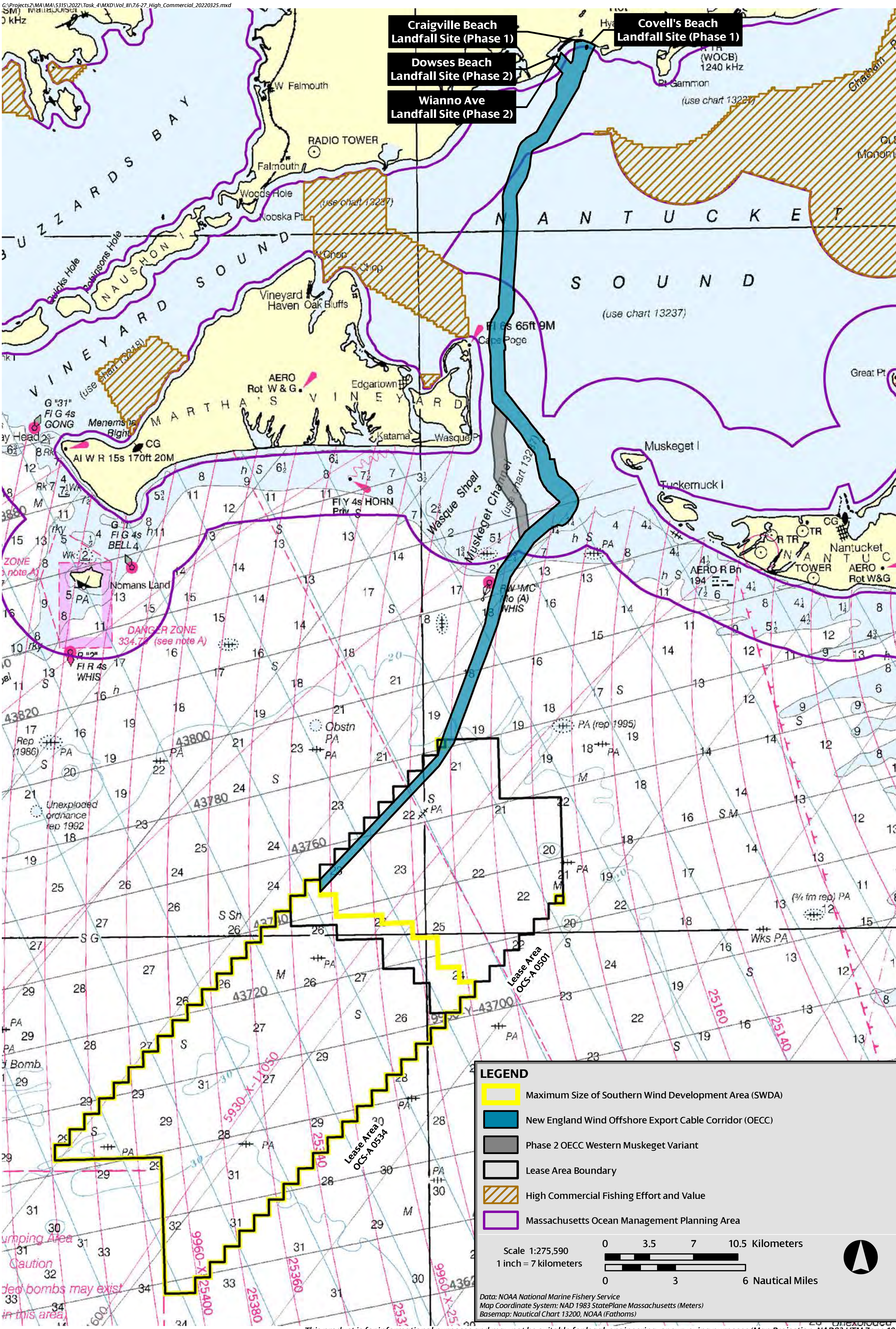

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New England Wind
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Figure 7.6-27

Massachusetts Ocean Management Plan, High Commercial Fishing Effort and Value

Table 7.6-6 Massachusetts State Reported Annual Landings (Live Pounds) by Species in Statistical Reporting Area 10[1]

SPECIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
BASS, BLACK SEA	64,228	75,508	57,794	68,193	78,510	71,812	67,023	133,661	75,035	84,536
BASS, STRIPED	58,127	57,179	81,256	92,695	178,726	36,169	47,307	35,927	49,698	35,406
BLUEFISH	83,680	180,070	157,323	217,153	174,975	231,247	79,515	107,091	85,573	50,971
BUTTERFISH	3,959	2,249	*	*	6,351	26,279	10,029	6,894	6,787	7,018
CLAM, QUAHOG, NORTHERN	2,360,252	1,625,631	1,216,958	1,243,674	1,095,157	1,367,394	1,505,757	1,249,168	1,298,353	1,128,585
CLAM, RAZOR, ATLANTIC	*	*	23,866	234,018	20,556	794	4,307	6,089	5,107	12,510
CLAM, SOFT	244,115	472,429	1,565,831	505,959	183,072	445,280	451,584	288,404	282,214	558,456
CRAB, HORSESHOE	230,889	234,815	282,631	360,559	288,020	313,873	352,523	326,328	360,792	519,789
FINFISH-OTHER	25,039	3,002	5,803	10,220	31,755	3,917	535,953	368,203	345,182	283,131
FLOUNDER, SUMMER	66,506	86,216	101,496	88,892	110,082	145,068	89,017	51,236	88,014	123,265
FLOUNDER, WINTER	720	*	*	1,276	1,264	*	241	*	661	43
GOOSEFISH	*	0	*	*	*	*	*	*	*	*
GROUNDFISH-OTHER	*	*	0	*	*	0	0	*	*	0
INVERTABRATES-OTHER	*	*	4,117	*	5,133	13,474	82,104	21,994	45,782	64,173
LOBSTER, AMERICAN	13,752	7,509	18,859	20,515	11,599	4,574	5,415	*	16,007	*
MACKEREL, ATLANTIC	*	*	*	402	42,793	6,568	4,072	5,134	1,618	2,822
MUSSEL, BLUE	52,529	63,214	492,391	1,761,181	*	*	1,046,261	2,825,915	743,337	71,363
OCEAN QUAHOG / SURF CLAM	4,525,270	1,170,716	119,822	502,687	68,387	308,273	212,812	2,850	325,846	229,981
OYSTER, EASTERN	4,280	547,877	860,852	704,984	969,123	1,381,339	889,459	3,060,795	1,463,474	1,993,869
SCALLOP, BAY	241,355	487,734	584,752	455,937	466,191	269,178	296,637	409,464	298,006	104,222
SCALLOP, SEA	0	*	0	23,270	*	*	0	*	0	*
SCUP	57,256	55,024	86,308	68,234	86,762	76,135	275,798	248,244	234,301	86,094
SHARK, DOGFISH, SPINY	*	*	165,808	*	*	*	0	*	*	0
SHELLFISH-INSHORE	*	*	0	*	1,882	4,128	7,535	2,842	1,306	*
SKATES	*	*	*	*	*	0	*	*	*	*
SQUID, LONGFIN LOLIGO	67,256	75,550	445,906	13,453	390,098	130,677	338,196	158,947	135,109	266,257
TAUTOG	*	4,869	2,614	7,528	7,530	616	2,453	1,464	611	2,315
WHELK, CHANNELED	1,404,484	1,873,770	1,617,983	1,314,856	800,867	714,283	654,767	389,898	427,191	283,939
WHELK, KNOBBED	45,604	112,198	89,389	225,783	237,996	227,504	150,759	117,927	197,194	140,449

Notes: MATL Reports and NOAA Fisheries VTRs. Source: MA DMF * = Confidential data.

Table 7.6-7 Massachusetts State Reported Annual Landings (Live Pounds) by Species in Statistical Reporting Area 12[1]

SPECIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
BASS, BLACK SEA	3,642	9,325	3,360	24,091	25,960	47,269	43,795	76,296	86,835	82,775
BASS, STRIPED	45,177	24,413	20,161	20,469	32,036	12,069	10,721	11,754	13,469	9,480
BLUEFISH	3,366	6,383	8,675	25,350	9,122	7,236	5,111	11,820	5,819	3,419
BUTTERFISH	0	0	*	0	*	0	0	*	0	0
CLAM, QUAHOG, NORTHERN	0	*	*	0	*	*	*	*	*	*
CLAM, RAZOR, ATLANTIC	0	0	*	0	*	0	0	0	*	0
CLAM, SOFT	7,960	*	14,902	21,570	20,683	30,342	23,024	19,916	5,010	9,402
CRAB, HORSESHOE	0	*	*	0	*	0	*	0	*	*
FINFISH-OTHER	230	542	652	2,423	14,106	2,200	681	3,618	252	161
FLOUNDER, SUMMER	27,467	44,563	76,412	38,537	42,146	37,616	19,501	36,625	21,478	20,536
FLOUNDER, WINTER	505	2,024	2,306	2,267	1,956	476	*	*	*	*
GOOSEFISH	16,758	42,742	44,330	22,679	*	0	*	*	*	*
GROUNDFISH-OTHER	*	*	*	*	*	*	*	*	*	*
INVERTABRATES-OTHER	1,960	0	*	4,013	*	*	*	*	*	*
LOBSTER, AMERICAN	55,039	41,217	73,736	80,307	51,015	63,142	96,499	53,299	49,311	44,580
MACKEREL, ATLANTIC	0	0	*	*	*	*	0	0	*	0
OCEAN QUAHOG / SURF CLAM	*	0	0	0	0	0	0	0	*	0
OYSTER, EASTERN	2,495	6,529	11,167	35,491	50,185	250,850	40,254	12,663	22,698	7,216
SCALLOP, BAY	396	15,221	25,119	56,740	26,715	*	*	8,794	*	0
SCALLOP, SEA	0	0	0	*	0	0	0	*	0	0
SCUP	92,316	123,317	241,201	254,101	140,514	132,036	124,648	128,166	76,465	70,470
SHARK, DOGFISH, SPINY	*	43553	*	*	0	0	0	0	*	0
SKATES	*	*	*	*	*	*	*	*	*	*
SQUID, LONGFIN LOLIGO	0	0	*	0	*	*	*	*	*	0
TAUTOG	*	1,229	1,561	4,285	2,901	4,907	3,245	2,197	3,195	2,300
WHELK, CHANNELED	14,042	51,660	42,969	35,840	67,513	*	*	52,512	2,949	5,051
WHELK, KNOBBED	0	*	0	1,218	1,080	*	*	*	574	*

Notes:

1. MATL Reports and NOAA Fisheries VTRs. Source: MA DMF
2. * = Confidential data.

It has been reported that species of large gastropod whelks—knobbed whelk (*Busycon carica*) and channeled whelk (*Busycotypus canaliculatum*)—are present within SRA 10 and SRA 12, which is confirmed by the landings of those species shown in Tables 7.6-6 and 7.6-7. Similarly, the 2015 Massachusetts Ocean Management Plan identifies areas of commercially and recreationally important species with high abundance for knobbed whelk and channeled whelk in the vicinity of OECC (EEA 2015), based on MA DMF trawl survey data. MA DMF reports that in 2018 the Massachusetts channeled whelk fishery landed, in total, approximately 1.3 million lbs. valued in excess of $4.3 million. Based on MA DMF's 2018 landings data, approximately 57% of channeled whelk harvested in Massachusetts was sourced from SRA 10 and SRA 12, though largely from SRA 10. No portion of the SWDA is located within either SRA 10 or SRA 12 and the OECC represents 2.8% of the combined areas of SRA 10 and SRA 12.

MA DMF also reports that recent stock assessments indicate that the whelk stock in Nantucket Sound is overfished and overfishing is still occurring. The biomass index based on the MA DMF trawl survey has declined by over 70% since the early 1980s. Indeed, MA DMF biologists conducting sampling trips aboard commercial vessels fishing targeting channeled whelk in Nantucket Sound and Buzzards Bay since 2003 have identified a 0.95-centimeter (0.375-inch) decrease in the average size of channeled whelk observed. And, despite minimum legal-size increases that occurred in 2014, 2015, and 2017, the average size has decreased and there are fewer whelk above the size at which females reach maturity than in previous years (MA DMF 2017).

7.6.2.3 Baseline Economic Exposure of Fishing Activity within the Lease Area and Offshore Export Cable Corridor

The Proponent's evaluation of existing research on fisheries exposure and extensive outreach and conversations with fisheries stakeholders has aided in identifying and quantifying commercial fishing effort and exposure in the Offshore Development Area and, more specifically, within the SWDA. Based on feedback from the fishing community during that outreach, the following fisheries likely operate within the SWDA and along the OECC (including the Western Muskeget Variant) and therefore, are potentially impacted by New England Wind:[118]

- Static gear (e.g. gill nets, traps/pots)
- Groundfish/bottom trawl mobile gear (e.g. squids/summer flounder/mackerel, whiting, and butterfish)
- Atlantic surf clam/ocean quahog dredge fishery

[118] The Proponent's ongoing assessment of fishing effort in the Offshore Development Region will continue to be a collaborative effort among fishermen, the Proponent, regulatory authorities, and other stakeholders, and will inform New England Wind's best management practices during all phases of New England Wind.

The following section describes the Proponent's review of the commercial fishing data sources to estimate fishing effort and exposure within the SWDA and along the OECC (including the Western Muskeget Variant). Economic exposure estimates presented below and in Appendix III-N are based on NOAA Fisheries reports summarizing historic fishing values and effort in the Lease Area (NOAA 2022).[119]

To quantify fishing effort, AIS data were queried to establish estimates of commercial fishing vessel traffic within the SWDA. These vessel counts are believed to capture larger commercial fishing vessels that are required to operate an AIS Class B device, such as the bottom trawl vessels over 20 m (65 ft) in length characterized by the mapping of VTR data described in Section 7.6.2.1. The bottom trawl vessels that appear active in proximity to the SWDA are likely small mesh trawl vessels targeting squid in the Offshore Development Region. Thus, the AIS data provides additional clarity on the types and numbers of vessels that may operate near the SWDA and OECC.

As described in the Navigation Safety Risk Assessment (NSRA) included in Appendix III-I, the AIS data show that historical vessel traffic levels within the SWDA are relatively low. The vessel traffic is seasonal in nature, with a daily average of approximately 0.5 vessels in the SWDA during the winter months (December through February) and a peak of 6.4 vessels per day, on average, in the month of August. An evaluation of vessel proximity indicated that two or more vessels are present within the SWDA simultaneously for only 124 hours per year on average (1.4% of the year). There was one short period (a few hours) in September 2016 in which up to 14 vessels were in the SWDA at one time, with most of these vessels sailing at speeds less than 4 knots while trawling.

Of the relatively low volume of vessel transits within the SWDA, the NSRA in Appendix III-I established that the most common type of vessels in the SWDA are AIS-equipped commercial fishing vessels. Table 7.6-8 identifies the number of commercial fishing vessels operating within the SWDA from 2016 to 2019 based on AIS data and broken down by vessel speed. Vessel counts were tabulated individually; therefore, vessels may be counted more than once if present in the SWDA across multiple months. Vessel speed reported by AIS data may indicate whether a vessel is fishing (≤four knots) or transiting (>four knots). Commercial fishing vessels are assumed to operate at vessels speeds up to four knots when mobile gear is deployed. When these vessels are transiting an open water area, they are assumed to operate at speeds greater than four knots. Based on these assumptions, the AIS data were queried to identify commercial fishing vessels operating at or below four knots to estimate the number of vessels fishing within the SWDA from 2016 to 2019.

[119] NOAA Fisheries data are available at: https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/ALL_WEA_BY_AREA_DATA.html

Table 7.6-8 Number of AIS-Equipped Fishing Vessels in the Southern Wind Development Area (SWDA) per Month (2016–2019)[1]

Year	Month												
2016	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total (Unique Vessels)**
Fishing Vessels (≤4.0 knots)	0	0	1	1	2	3	6	20	42	6	2	2	56
Vessel Tracks (≤4.0 knots)	0	0	2	1	4	3	20	156	220	12	2	2	421
Fishing Vessels (>4.0 knots)	1	6	12	6	11	17	26	34	52	18	11	9	85
Vessel Tracks (>4.0 knots)	1	10	19	9	26	46	71	118	125	34	18	15	487
2017													
Fishing Vessels (≤4.0 knots)	0	0	0	1	3	3	6	4	18	6	0	0	33
Vessel Tracks (≤4.0 knots)	0	0	0	1	3	3	8	15	34	6	0	0	70
Fishing Vessels (>4.0 knots)	8	13	6	14	19	26	32	35	35	15	3	0	96
Vessel Tracks (>4.0 knots)	29	18	10	24	28	48	73	92	81	20	3	0	417
2018													
Fishing Vessels (≤4.0 knots)	0	0	0	0	5	2	1	3	3	2	0	0	14
Vessel Tracks (≤4.0 knots)	0	0	0	0	7	3	2	3	10	3	0	0	28
Fishing Vessels (>4.0 knots)	2	1	1	12	39	39	38	36	22	7	3	1	98
Vessel Tracks (>4.0 knots)	2	0	1	12	66	85	70	62	34	10	4	1	339

Table 7.6-8 Number of AIS-Equipped Fishing Vessels in the Southern Wind Development Area (SWDA) per Month (2016–2019) (Continued)[1]

Year	Month												
2019	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total (Unique Vessels)**
Fishing Vessels (≤4.0 knots)	0	0	0	1	0	2	5	12	12	1	0	0	29
Vessel Tracks (≤4.0 knots)	0	0	0	1	0	5	6	25	23	4	0	0	63
Fishing Vessels (>4.0 knots)	1	1	6	19	34	38	46	51	33	10	6	2	124
Vessel Tracks (>4.0 knots)	1	2	8	25	50	72	111	125	42	15	6	2	446

Notes:

1. For more detail on the AIS data, see Appendix III-I.

NOAA Fisheries published a website in March 2021 that focused on the socioeconomic impacts of Atlantic offshore wind development by summarizing fishing activity, revenue exposure, and landings between 2008 and 2021 within each offshore wind lease area. This website provides annualized landings and revenue by species, gear type, and fishery management plan as well as revenue by port and vessel dependence upon operations within the study areas. This website was used to identify major harvested species, fishery operations, and ports potentially affected by development in the Lease Area.

The data summarized in Tables 7.6-9 through 7.6-14 are based on NOAA Fisheries' analysis of combined data from VTRs and dealer reports submitted by those issued a permit for managed species in federal waters (i.e. outside of 3 NM from shore). Annual values reported in these tables have been deflated to 2021 dollars.

Table 7.6-9 extrapolates the total annual revenue and total landed pounds of all species by all gear types within the Lease Area. As shown in Table 7.6-9, between 2008 and 2021, an annual average of approximately $534,602 worth of landings were harvested from the Lease Area.

Table 7.6-9 Annual Landings from the Lease Area, 2008-2021

Year	Landings (lbs)	Value (2021 dollars)
2008	565,180	$519,479
2009	581,476	$437,906
2010	698,373	$575,805
2011	387,260	$403,508
2012	512,867	$559,010
2013	838,105	$741,944
2014	623,448	$685,778
2015	459,595	$564,633
2016	920,341	$958,501
2017	415,918	$425,740
2018	313,375	$331,341
2019	401,696	$423,934
2020	281,835	$294,468
2021	426,745	$562,379
Annual Average	530,444	$534,602

Notes:

1. NOAA (2022)
2. Values have been deflated to 2021 dollars.

Table 7.6-10 extrapolates the value of landings by fishery management plan within the Lease Area between 2008 and 2021. According to NOAA Fisheries (NOAA 2022), between 2008 and 2021, the three highest value FMPs within the Lease Area were Mackerel, Squid, and Butterfish; the Atlantic States Marine Fisheries Commission (ASMFC) FMP;[120] and Summer Flounder, Scup, and Black Sea Bass.

[120] The ASMFC FMP includes the following species: American lobster, cobia, Atlantic croaker, black drum, red drum, menhaden, NK sea bass, NK seatrout, spot, striped bass, tautog, Jonah crab, and pandalid shrimp.

Table 7.6-10 Landings from the Lease Area by Fishery Management Plan, 2008-2021

Fishery Management Plan	Annual average Landings (lbs)	Annual average Value (2021 dollars)	Percentage of Annual Average Lease Area Value
Mackerel, Squid, and Butterfish	104,400	$134,318	25%
ASMFC FMP	51,596	$74,963	14%
Summer Flounder, Scup, Black Sea Bass	53,395	$68,732	13%
Small-Mesh Multispecies	80,756	$55,812	10%
Monkfish	29,682	$50,020	9%
Skates	83,443	$38,972	7%
Sea Scallop	2,425	$26,726	5%
Northeast Multispecies	7,254	$14,819	3%
Tilefish	1,480	$6,170	1%
Atlantic Herring	41,532	$5,637	1%
All Others	74,482	$58,432	11%
Total	530,444	$534,602	-

Notes:

1. NOAA Fisheries (2022)
2. Values have been deflated to 2021 dollars.

Due to their economic importance in the area, NOAA Fisheries analyzed the most exposed species by isolating landings of those species from the combined landings reported under the FMPs (NOAA 2022). According to NOAA Fisheries' analysis, the five most exposed species in the Lease Area are longfin squid, silver hake, monkfish, Jonah crab, and skates. Annual average landings of the 15 most exposed species account for approximately 88% of annual average landings from the Lease Area. The 14-year total and annual average value of those species are shown in Table 7.6-11.

Table 7.6-11 Landings from the Lease Area by Species, 2008-2021

Species	Annual average Landings (lbs)	Annual average Value (2021 dollars)	Percentage of Annual average Lease Area Value
Longfin Squid	92,658	$127,631	24%
Silver Hake	71,705	$52,515	10%
Monkfish	29,682	$50,020	9%
Jonah Crab	45,100	$41,535	8%
Skates	83,443	$38,972	7%
Summer Flounder	10,413	$33,613	6%
American Lobster	6,455	$33,333	6%

Table 7.6-11 Landings from the Lease Area by Species, 2008-2021 (Continued)

Species	Annual average Landings (lbs)	Annual average Value (2021 dollars)	Percentage of Annual average Lease Area Value
Scup	42,218	$32,175	6%
Sea Scallop	2,425	$26,726	5%
Yellowtail Flounder	4,613	$8,473	2%
Golden Tilefish	1,478	$6,165	1%
Atlantic Herring	41,532	$5,637	1%
Butterfish	7,567	$5,079	1%
Winter Flounder	1,742	$4,930	1%
Black Sea Bass	763	$2,943	1%
All Others	88,650	$64,853	12%
Total	530,444	$534,602	-

Notes:

1. NOAA (2022)
2. Values have been deflated to 2021 dollars.

To better understand the type of fishing occurring in the Lease Area, NOAA Fisheries also analyzed the revenue from select gear types (NOAA 2022). The 14-year total and annual average value of revenue from specific gear types are shown in Table 7.6-12. As shown in Table 7.6-12, the highest values in the Lease Area are landed using bottom trawl (mobile gear), gillnet (fixed gear), and lobster pots (fixed gear). The prevalence of bottom trawl gear in the Lease Area is consistent with the mapping of VTR data described in Section 7.6.2.1 and the AIS data presented herein.

To preserve data confidentiality, a separate grouping of landings classified as "All Others," refers to landings of by fewer than three permit holders or identified on fewer than three dealer reports.

Table 7.6-12 Landings from the Lease Area by Gear Type, 2008-2021

Gear Type	Annual average Landings (lbs)	Annual averagle Value (2021 dollars)	Percentage of Annual average Lease Area Value
Bottom Trawl	287,050	$286,491	54%
Gillnet (sink)	82,245	$79,275	15%
Lobster Pot	54,560	$76,685	14%
Clam Dredge	41,837	$33,661	6%
Scallop Dredge	1,726	$18,822	4%
All Others	63,049	$39,684	3.5%
Total	530,466	$534,618	-

Notes:
1. NOAA (2022)
2. Values have been deflated to 2021 dollars.

NOAA Fisheries also analyzed the value of landings from the Lease Area at the ports most exposed by revenue to better understand the dependence of certain ports on fishing within the Lease Area (NOAA 2022). The 14-year total and annual average value of landings from the most exposed ports are shown in Table 7.6-13. According to NOAA Fisheries' analysis, these ports are Point Judith, RI, New Bedford, MA, Montauk, NY, Chatham, MA, and Fairhaven, MA. Annual average landings of these five ports account for approximately 78% of average annual landings from the Lease Area.

Table 7.6-13 Landings from the Lease Area by Port, 2008-2021

Port	Annual average Landings (lbs)	Annual average Value (2021 dollars)	Percentage of Annual average Lease Area Value
Point Judith, RI	175,301	$184,904	35%
New Bedford, MA	161,651	$159,551	30%
Montauk, NY	24,873	$33,096	6%
Chatham, MA	20,251	$20,936	4%
Fairhaven, MA	20,306	$20,164	4%
All Others	127,409	$115,027	22%
Total	529,790	$533,678	-

Notes:
1. NOAA (2022)
2. Values have been deflated to 2021 dollars.

NOAA Fisheries also analyzed the value of landings from the Lease Area from the states most exposed by revenue to better understand the dependence of certain states on fishing within the Lease Area (NOAA 2022). The 14-year total and annual average value of landings from the most exposed states are shown in Table 7.6-14. According to NOAA Fisheries' analysis, these states are Massachusetts, Rhode Island, New York, Connecticut, and Virginia. Annual average landings from these five states account for approximately 97% of average annual landings from the Lease Area.

Table 7.6-14 Landings from the Lease Area by State, 2008-2021

State	Annual average Landings (lbs)	Annual average Value (2021 dollars)	Percentage of Annual average Lease Area Value
Massachusetts	247,383	$235,245	44%
Rhode Island	231,487	$224,923	42%
New York	25,408	$34,087	6%
Connecticut	16,238	$17,086	3%
Virginia	3,962	$8,868	2%
All Others	5,313	$13,470	3%
Total	529,791	$533,679	-

Notes:

1. NOAA (2022)
2. Values have been deflated to 2021 dollars.

7.6.2.4 Summary of Economic Exposure

The following section summarizes results of the economic exposure analysis presented in Appendix III-N and the underlying data which is described in Section 7.6.2.

The Lease Area economic exposure estimates presented in Appendix III-N were developed in three stages. In the first stage, estimates of fishing values (referred to as "unadjusted" values) in the Lease Area for all landed species other than lobster and Jonah crab not reported on VTRs were established using estimates of revenue exposure developed by NOAA Fisheries (NOAA 2022). Based on NOAA Fisheries' analysis of the Lease Area, the average fishery revenue density in the Lease Area is estimated at $1,301 per km^2 ($3,362 per mi^2) and the average annual unadjusted value of landings from the Lease Area is $534,602. Table 7.6-15 summarizes estimate of unadjusted values in the Lease Area extrapolated from NOAA Fisheries analysis (NOAA 2022).

Table 7.6-15 Unadjusted Estimate of Commercial Fishing Economic Exposure in the Lease Area

Total Fishing Revenues (2008–2021)	Annual average Revenues	Annual average Fishing Revenues per km^2
$7,484,427	$534,602	$1,301

The second stage of estimating economic exposure involves estimating values for lobster and Jonah crab harvested from the Lease Area. Prior to 2020, vessels that fished exclusively for lobster and Jonah crab were not required to file VTRs, which makes determining the landed value harvested from a particular geographic area challenging. VTR data showing the location and value of lobster and Jonah crab harvests are only available for vessels that fish those two species in addition to other species and are required to include landings of those two species with their reported landings of other species.

As described in Appendix III-N, federal fishing permit data are available showing how many pots that federally permitted vessels are allowed to fish for lobster and Jonah crab in LMA 2, which includes the Lease Area.[121] Because the number of permitted pots is available for vessels that file VTRs and for vessels that do not file VTRs, these data provide a measure of potential fishing effort by both VTR and non-VTR vessels and allow for estimates of value per permitted pot. Federal fishing permit data for 2022 show that a total of 56,039 pots were permitted to harvest lobster in LMA 2. Of these pots, 21,093, or 38% of all LMA 2 pots, were fished from vessels that possess only LMA 2 permits to fish for lobster and Jonah crab species. These are the vessels that are not required to file VTRs. The remaining 34,946 permitted pots, or 62% of all permitted pots in LMA 2, fish for species other than lobster and Jonah crab and therefore file VTRs, which include their landings of lobster and Jonah crab.

NOAA Fisheries' analysis shows that from 2008 to 2021, the average annual value of lobster and Jonah crab harvested from the Lease Area by vessels that filed VTRs was $74,868. As described in Section 7.6.2.1, VTR data do not provide a complete picture of the value or intensity of any one fishery, particularly for lobster and Jonah crab because vessels that fish exclusively for these two species were not required to file VTRs. VTR vessels (which represent 34,946 pots) landed an average of $2.14 per pot within the Lease Area.

Feedback from the MA DMF on an earlier analysis of lobster and Jonah crab exposure in the Lease Area suggested that vessels that do not file VTRs are likely to have: (1) a higher percent of permitted pots actively fished, (2) a higher percent of active pots fishing in the Lease Area, and (3) higher revenues per active pot. To account for these factors, the analysis assumes that non-VTR pots are 25% more active, spend 25% more active time fishing in the Lease Area, and generate 25% more fishing revenues. In effect, these assumptions result in an estimate of per pot revenues generated in the Lease Area by non-VTR vessels of $4.18 (1.25 * 1.25 * 1.25 * $2.14). Therefore, the 21,093 non-VTR pots are estimated to harvest $88,261 of lobster and Jonah crab from the Lease Area per year.

[121] Portions of the Lease Area are within LMA 3. Because of the size of LMA 3 and the large number of pots permitted therein, the analysis does not include LMA 3 permitted vessels. Excluding LMA 3 pots from the analysis provides a more liberal estimate of lobster and Jonah crab exposure within the Lease Area.

The third stage is adding the results of Stage 1 and Stage 2 to arrive at final estimates of annual fishing values to provide an overall measure of annual economic exposure in the Lease Area. The estimated landings of non-VTR lobster and Jonah crab are added to the unadjusted economic exposure estimates shown in Table 7.6-15 to provide a final, "adjusted" estimate of the overall economic exposure in Lease Area shown in Table 7.6-16.[122]

Table 7.6-16 Adjusted Estimate of Annual Commercial Fishing Economic Exposure in the Lease Area

Total Fishing Revenues (2008-2021)	Annual average Fishing Revenue	Annual average Fishing Revenues per km^2
$8,720,081	$622,863	$1,515

Notes:

1. Values include landings of lobster or Jonah crab.

Table 7.6-16 shows that the annual adjusted economic exposure of commercial fisheries in the Lease Area is $622,863 with an average annual revenue of $1,515 per km^2.

Based on NOAA Fisheries data for years 2008-2021 (NOAA 2023b), average annual fishing revenues in the OECC is $209,331, or $2,505 per km^2 (2021 dollars). The economic exposure is estimated to be $5,899 during the approximately nine months (75% of a year) when two cables are being installed during Phase 1 and $8,849 during the 13.5 months (112.5% of a year) when three cables are being installed during Phase 2 resulting in overall economic exposure of approximately $14,748 during both Phase 1 and Phase 2.

The analysis described above was also conducted for the Western Muskeget Variant. Based on fishing revenue data provided by NOAA Fisheries for years 2008-2021 (NOAA 2023b), average annual fishing revenues in the Western Muskeget Variant is $2,524 per km^2 (2021 dollars), which is just $19 higher than the OECC value of $2,505 per km^2. In the unlikely event the Western Muskeget Variant is used to install one cable for Phase 2, economic exposure is estimated to be $8,871 during the 13.5 months when one cable is being installed in the Western Muskeget Variant and two cables are being installed in the OECC. This would result in overall economic exposure of approximately $14,771, just $22 higher than the OECC. See Appendix III-N for additional details on the economic exposure analysis.

Many factors, both environmental and regulatory, contribute to productive commercial fishing areas and, as a result, the locations of commercial fishing efforts are variable. Restrictions limiting fishing activity for certain species can give an incomplete picture of the potential value of fishery resources available in the Lease Area and surrounding waters. Fisheries management impacts commercial fisheries through the management of sustainable fish stocks and measures to reduce impacts on important habitat and protected species. Measures to manage the duration of fishing

[122] Note this adjustment method is conservative and likely results in a high estimate of the annual lobster and Jonah crab revenues from the Lease Area that are not included in fishing revenues reported in NOAA Fisheries (2022).

seasons, quotas, and closed areas, can also reduce or increase the size of available landings to commercial fisheries. Therefore, estimates of fisheries exposure do not necessarily capture the full potential economic value of resources in the Lease Area. Nonetheless, the Proponent will continue to meet with fishermen to solicit additional information on fishing efforts in the Lease Area, and to ensure that the most accurate and relevant information regarding each of the fisheries in the Offshore Development Region is incorporated into New England Wind O&M plans.

7.6.3 Potential Impacts of New England Wind

Potential impacts to commercial fisheries are most closely related to New England Wind offshore development as a whole within the SWDA and along the OECC; therefore, this assessment considers the total buildout of Phases 1 and 2 of New England Wind. Further, long-term impacts to commercial fisheries are primarily related to the O&M of New England Wind. Temporary impacts may also occur during construction and installation within the SWDA and along the OECC. The impact producing factors for commercial fishing are provided in Table 7.6-17.

Table 7.6-17 Impact Producing Factors for Commercial Fishing

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Habitat alteration	•	•		•	•	•
Cable installation/ maintenance	•	•		•	•	
Navigation hazard	•			•	•	•
Vessel traffic	•	•		•	•	•
Fish aggregation	•				•	

7.6.3.1 Construction and Installation

7.6.3.1.1 Temporary Impacts to Commercially Important Species (Phases 1 and 2)

As described in further detail in Section 6.6.2.1, impacts to finfish and invertebrates within the SWDA and along the OECC (including the Western Muskeget Variant) from construction of each Phase of New England Wind, including those species targeted by commercial fishermen, are expected to be short-term and localized. Pelagic fish and invertebrate species may respond to construction activities with localized and short-term avoidance behavior. Mobile pelagic, demersal, and invertebrate species targeted by commercial fishing vessels known to occur within the SWDA and OECC include herring, mackerel, butterfish, whiting, and squid. These species will be able to avoid construction areas and are not expected to be substantially impacted by construction and installation. The abundance of mobile pelagic, demersal, and invertebrate species, therefore, would not be affected. However, availability of these species in proximity to construction and installation activities may decrease, potentially resulting in increased catch per unit effort outside the SWDA.

As described in Section 6.6.2.1, burial and mortality of some demersal eggs (fish [e.g. herring], squid [e.g. longfin inshore squid (*Doryteuthis pealeii*)]), and whelk species) may occur during installation of offshore components and cable installation activities. Such impacts are confined to small, localized areas in the SWDA and OECC within the footprint of offshore components or where sediment deposition from dredging and cable installation may be greater than one millimeter (0.04 inches).

At the Phase 1 and Phase 2 landfall sites, horizontal directional drilling (HDD) is expected to be used to avoid or minimize impacts in the nearshore region, though open trenching may also be used during Phase 2 if it is not feasible to use the Dowses Beach Landfall Site and open trenching is needed at the Wianno Avenue Landfall Site. Temporary, limited increases in suspended sediments could occur near the landfall sites at the HDD exit point or during open trenching (only if the Wianno Avenue Landfall Site is used for Phase 2), but impacts would be localized and short-term. Export cable installation at and just offshore the Phase 2 landfall site will have no direct impacts on East Bay (i.e. cable installation will either occur outside East Bay or HDD will be used to pass under East Bay) and the localized, short-term increases in suspended sediments and deposition from standard cable installation techniques are expected to stay within 100-200 m (328-656 ft) of the cable alignment.

Construction and installation-related impacts for either Phase 1 or Phase 2 may result in direct mortality events for sea scallop and surf clam in the limited area of the construction footprint. Mobile benthic invertebrates, such as lobsters and crabs, may be temporarily displaced by construction and installation activities.

As described further in Section 6.6, the SWDA has moderate total fish biomass and high species richness, which potentially reduces impacts to individual populations and the high diversity may enhance recovery following any construction and installation related disturbances (MacArthur 1955). The SWDA and much of the OECC are primarily composed of uniform sandy bottom habitat, which will likely begin recovering quickly after construction is completed relative to other habitat types. Previous research indicates that dynamic, sandy physical habitat begins to recover substantially within a few months of disturbance and can fully recover by measure of abundance within two years and recover by measure of biomass and diversity in two to four years (Dernie et al. 2003; Van Dalfsen and Essink 2001). Some alteration from unconsolidated fine habitat to structured habitat in the SWDA may change species assemblages in the SWDA and attract more structure-oriented species.

Consultations have occurred with shellfish constables in Barnstable, MA DMF, and members of the commercial bay scallop and whelk fishing communities. These consultations will continue and will be useful for determining the extent of commercial fishing effort for these species. Any impacts to the whelk fishery within the OECC should be limited both in spatial extent and duration.

7.6.3.1.2 Temporary Impacts to Navigation and Fishing Activities (Phases 1 and 2)

Temporary impacts to navigation may occur from vessel traffic associated with New England Wind. During Phases 1 and 2, the construction and installation vessels operating in the SWDA and along the OECC (including the Western Muskeget Variant) may temporarily preclude commercial fishing activities in the immediate vicinity of construction vessels or cause commercial fishing vessels to slightly alter their navigation routes to avoid the construction area (see Appendix III-N for more information on potential economic exposure in the OECC during cable installation). Temporary safety buffer zones may be established around work areas during construction and installation. Temporary safety buffer zones are expected to improve safety in the vicinity of active work areas and would not affect the entire SWDA or OECC (including the Western Muskeget Variant) at any given time. Vessel traffic associated with the construction of each Phase of New England Wind is not anticipated to represent a significant increase over the current levels of vessel traffic within the Offshore Development Region. Potential impacts to navigation as they relate to commercial fishing are evaluated in the Navigation Safety Risk Assessment (see Appendix III-I).

As described in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I, the Proponent has identified several port facilities and construction staging areas in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for major Phase 1 or Phase 2 construction staging activities. With the exception of New Bedford and New London, the commercial fishing ports described in Section 7.6.1 are not expected to be used for New England Wind activities and should not experience direct impacts such as increased traffic congestion or competition for dockside services.

7.6.3.1.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

For each Phase of New England Wind, construction and installation activities will occur within very limited and well-defined areas of the SWDA and along the OECC (including the Western Muskeget Variant). Vessel restrictions are not generally proposed other than temporary safety buffer zones in the immediate vicinity of the construction and installation vessels. Accordingly, the majority of the SWDA and OECC (including the Western Muskeget Variant) will remain accessible to commercial fishing vessels throughout the construction and installation process.

To minimize hazards to navigation, all New England Wind vessels and equipment will display the required navigation lighting and day shapes. The Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the US Coast Guard (USCG) to provide Notices to Mariners to notify recreational and commercial vessels of their intended operations within the Offshore Development Region.

To further minimize impacts, the Proponent has developed a Fisheries Communication Plan (FCP) (included as Appendix III-E). The purpose of the FCP is to define outreach and engagement to potentially affected fishing interests during design, development, construction, operation, and final decommissioning of the Proponent's offshore wind projects. Fisheries communication is conducted through several roles, including Fisheries Liaisons (FLs) and Fisheries Representatives

(FRs). FLs are employed by the Proponent and are responsible for the implementation of the Fisheries Communication Plan whereas FRs represent the interests of different fisheries and fishing communities to the Proponent. The Proponent has hired FLs and works with a number of FRs who are actively engaged with the fishing industry. The Proponent also employs a Marine Operations Liaison Officer, who is responsible for safe marine operations by the Proponent. In addition, in an effort to provide fishermen with the most accurate and precise information on work within the SWDA and along the OECC, the Proponent is currently providing and will continue to provide portable digital media with electronic charts depicting locations of New England Wind-related activities. Finally, the Proponent is developing and implementing procedures for handling compensation to fishermen for potential gear loss. Additional information is provided in Appendix III-E.

The Proponent also plans to contribute to fisheries research and education, as well as assist Connecticut fishermen. These initiatives are further discussed in Section 7.6.3.2.4.

Finally, the MA WEA was selected by BOEM to exclude most sensitive fishes and invertebrate habitat after a multi-year process. Only a small portion of available habitat in the area will be impacted by construction activities within the SWDA and along the OECC (including the Western Muskeget Variant) and recovery is expected. While there may be temporary impacts to some commercially important species, availability of these species supported by and in nearby waters outside the SWDA, as described in Section 7.6.2, suggest that increased fishing effort outside the SWDA could offset any such impacts inside the SWDA. Specific to commercially important species targeted by the dredge fishery, while construction and installation related impacts may result in limited mortality for sea scallop and surf clam, resulting in their decreased availability within the SWDA, characterization of dredge gear vessels targeting sea scallop and surf clam in Section 7.6.2 suggests that fishing effort for this gear type is quite low within the SWDA.

7.6.3.2 Operations and Maintenance

7.6.3.2.1 Economic Exposure (Phases 1 and 2)

Section 7.6.2.5 presents the baseline exposure estimates for the Lease Area, assuming installation of both Phases 1 and 2. The annual average adjusted economic exposure of commercial fisheries in the Lease Area is $622,863 (see Table 7.6-16). Economic exposure is a measure of fishing that occurs within the Lease Area and, following BOEM guidance, is a measure of maximum potential losses in fishing revenues based on assumptions that New England Wind will result in the total cessation of fishing activity in the Lease Area and OECC with all related fishing revenues and fish landings from those areas being lost, and that lost fishing revenues and fish landings from the Lease Area and OECC will not be recouped as a result of fishing effort shifting from those areas to other fishing areas. Economic exposure is not a measure of actual economic impact which, as further described in Appendix III-N, is less than economic exposure, assuming New England Wind will result in no overall decline in fishing effort, that fishing vessels will continue to operate and generate some fishing revenues in the Lease Area and OECC, and that at least some of the reduced fishing revenues in Lease Area and OECC will be recouped by fishing effort shifting from those areas to nearby fishing areas.

A number of factors suggest that any economic impact from New England Wind will be only a small percentage of the estimated economic exposure. Commercial fishing vessels will continue to have access to the Lease Area and OECC as currently permitted by regulation and the proposed grid layout, set in response to input from commercial fishermen and recommendations from the USCG, which provides 1 NM (1.85 km) wide corridors in the east-west and north-south directions as well as 0.7 NM (1.3 km) wide corridors in the northwest-southeast and northeast-southwest directions. Similarly, alternative fishing grounds with a demonstrated higher fishery revenue density are available nearby and may be fished at little to no additional cost. As described in Section 6.6, abundance of mobile pelagic, demersal, and invertebrate species will not be affected by New England Wind. Appendix III-N provides a detailed description of potential economic exposure and fishing congestion impacts.

7.6.3.2.2 Habitat Alteration of Commercially Important Species (Phases 1 and 2)

During O&M, permanent habitat alteration in the SWDA may occur from the installation of WTG and ESP foundations, associated scour protection, and potential cable protection (if required). Cable protection for the inter-array or inter-link cable may be used where is it difficult to achieve a sufficient burial depth and may consist of rocks, gabion rock bags, prefabricated flexible concrete coverings (referred to as concrete mattresses), or half-shell pipes (or similar products). The placement of foundations, scour protection, and cable protection (if required) may displace sea scallop and surf clam habitat, if it is present where placement occurs; however, such habitat alteration would be very limited. The total amount of habitat alteration in the SWDA from the addition of foundations, scour protection, and cable protection (if required) would be approximately 1.17 km^2 (289 acres), which is 0.26% of the maximum size of the SWDA.

The foundations, scour protection, and potential cable protection (if required) may serve as fish aggregating structures and may also alter local food web dynamics and species distribution. Research on habitat changes associated with wind farms has observed that new communities of rocky-habitat fishes establish near WTG foundations while communities remain unchanged in sandy areas between the WTGs (Stenberg et al. 2015). In addition, increases in commercially important species, such as Atlantic cod and whiting, were observed near deep water wind farms (Hille Ris Lambers and ter Hofstede 2009; Løkkeborg et al. 2002). There is also evidence that WTG reef habitats and the resources they provide increase the growth and condition of juvenile Atlantic cod and whiting-pout (Reubens et al. 2013). Further, cobble and boulder-type habitats are particularly important to lobsters because they serve as both nursery grounds for benthic juveniles and as home substrata for adults (Linnane et al. 1999) and addition of scour protection could attract lobsters to these artificial habitats. Although reef habitat created by WTG and ESP foundations may increase biodiversity and ecosystem production, these introduced habitats could also act as a stepping-stone for the establishment and dispersal of nonindigenous species (Glasby et al. 2007).

Along the OECC (including the Western Muskeget Variant), the installation of cable protection may be required where it is difficult to achieve a sufficient burial depth or where cables must cross existing infrastructure. For both Phases, the Proponent conservatively estimates that up to approximately 0.22 km^2 (54 acres) of cable protection may be used for within the OECC. Should one or two Phase 2 offshore export cables be installed within the Western Muskeget Variant, the maximum amount of cable protection for both Phases combined is 0.23- 0.24 km^2 (57-60 acres) of cable protection for the Western Muskeget Variant. See Appendix III-T for additional details on potential seafloor disturbance. Such limited cable protection may also result in localized attraction of structure-oriented species.

Electromagnetic fields (EMF) will be generated by inter-array cables connecting WTGs in the SWDA and from cables along the OECC (including the Western Muskeget Variant). A white paper review study funded by BOEM determined that there would be negligible, if any, effects on bottom-dwelling commercial and recreational fish species and no negative effects on pelagic commercial and recreational fish species in the southern New England area from EMF produced by power transmission cables (Snyder et al. 2019). As described in Section 6.6.2.2.3, of species potentially present in the SWDA and along the OECC (including the Western Muskeget Variant), electrosensitivity has been documented in elasmobranchs (sharks, skates, and rays) and some teleost fish species (ray-finned fishes). Because EMF produced by cables decreases with distance, and the target burial depth for the cables is 1.5–2.5 m (5–8 ft), the EMF at the seabed would be expected to be weak and likely only detectable by demersal species (Normandeau et al. 2011). Another study funded by BOEM found that although there were changes in the behavior of little skate (*Leucoraja erinacea*), an elasmobranch, and American lobster in the presence of energized cables, EMF from cables did not act as a barrier to movement in any way (Hutchison et al. 2018). In addition, research investigating habitat use around energized cables found no evidence that fishes or invertebrates were attracted to or repelled by EMF emitted by cables (Love et al. 2017). To date, there is no evidence linking anthropogenic EMF from WTG cables to negative responses in fish (Baruah 2016; Normandeau et al. 2011). In addition, subsea power cables are already present in the region (outside of the Offshore Development Area) with four located between Martha's Vineyard and Falmouth and two more between Nantucket and Cape Cod (see Section 7.9).

7.6.3.2.3 Impacts to Navigation and Fishing Activities (Phases 1 and 2)

The SWDA will be open to marine traffic, and no permanent vessel restrictions are proposed within the SWDA or along the OECC (including the Western Muskeget Variant) during O&M for either Phase. If in-water maintenance activities are required, there could be temporary safety buffer zones established around work areas in limited areas of the SWDA or along the OECC (including the Western Muskeget Variant). However, it is expected that most maintenance activities will not require in-water work but will instead be based from the WTGs and ESP structures themselves.

The layout of New England Wind will facilitate ongoing transit and fishing activities by commercial fishermen. Within the SWDA (which includes both Phases of New England Wind), the WTGs and ESPs will be oriented in fixed east-to-west rows and north-to-south columns with one nautical mile spacing between WTG/ESP positions. This grid layout provides 1 NM (1.85 km) wide corridors in the east-west and north-south directions as well as 0.7 NM (1.3 km) wide corridors in the northwest-southeast and northeast-southwest directions.

The proposed layout is consistent with the recommendations from the USCG. The USCG undertook a Massachusetts and Rhode Island Port Access Route Study (MARIPARS) to evaluate the need for vessel routing measures, including regional transit lanes, within the MA WEA and RI/MA WEA[123] (USCG-2019-0131). On May 27, 2020, USCG published the final MARIPARS, which found that:

> "Based on fishing vessel tracks, specifically squid, mackerel, and butterfish vessels, there is significant east to west fishing activity in the WEA, particularly in August and September, following the north to south migration of the fish. Based on comments received on this report, there is a 'gentlemen's agreement' between the fixed gear fishermen and the mobile gear fishermen to prevent gear entanglement. The fixed gear fishermen set their gear along traditional LORAN-C lines that are generally in an east to west direction. The mobile gear fishermen fish in functional lanes between the set fixed gear, in a general east to west direction."

The USCG concluded:

> "The PARS evaluated several concerns that resulted in the following recommendations: That the MA/RI WEA's turbine layout be developed along a standard and uniform grid pattern with at least three lines of orientation and standard spacing to accommodate vessel transits, traditional fishing operations, and search and rescue operations, through the MA/RI WEA. 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" (USCG 2020).

The USCG also recommended that mariners in the WEA should use extra caution, ensure proper watch and assess all risk factors.

Based on these findings and recommendations from the USCG, the proposed layout is expected to accommodate traditional fishing patterns, including the "gentlemen's agreement" regarding the placement of mobile and fixed gear within the WEA.

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[123] The "MA/RI WEA" as used in the USCG's (2020) MARIPARS includes all seven adjacent lease areas on the Outer Continental Shelf (OCS) south of Martha's Vineyard, Massachusetts, and east of Rhode Island, which are referred to in the COP as the "MA WEA and RI/MA WEA."

Separately, vessels towing mobile gear in the SWDA may choose to exit the SWDA before retrieving gear or reversing course for a subsequent tow through the SWDA, thereby extending the amount of time fishing gear is deployed and/or more frequent retrieval and deployment of gear. It is possible that vessels electing to exit the SWDA in these scenarios may incur additional costs or downtime associated with additional gear handling and increased steaming distances. In certain situations, longer periods of gear deployment may result in increased landings. Nonetheless, a trawling vessel turn analysis performed for Vineyard Wind 1 (located in in Lease Area OCS-A 0501), demonstrated that trawling vessels within Lease Area OCS-A 0501 are expected to have sufficient room to maneuver, including executing a 180 degree turn, within the proposed 1 NM (1.85 km) navigation corridors (Vineyard Wind 1 COP, Appendix III-I).

Should vessels elect to fish outside the SWDA, they may spend additional time steaming to alternate fishing grounds. As noted in Appendix III-N, fishing grounds with similar harvest potential in proximity to the SWDA, however, suggests these choices would have only modest impacts on cost and revenue. Some fishing vessels may choose to divert around the entire SWDA rather than transiting through it. Appendix III-I provides an analysis of fishing vessel transits through the SWDA and estimated that the average increase in transit time for vessels diverting around the SWDA ranges from 6 to 46 minutes (which corresponds to a 1 to 7% increase in transit time), and the average increase in transit distance ranges from 0.8 NM (1.5 km) to 5.8 NM (10.7 km). Additional discussion of potential vessel transit impacts is provided in Appendix III-N.

Finally, the installation of submarine cables within the SWDA and along the OECC (including the Western Muskeget Variant) is not anticipated to preclude commercial fishing activities. The target burial depth for all inter-array, inter-link, and offshore export cables is 1.5–2.5 m (5–8 ft) below the seafloor, which the Proponent's engineers have determined is more than twice the burial depth that is required to protect the cables from potential fishing activities and also provides a maximum of 1 in 100,000 year probability of anchor strike, which is considered a negligible risk. Except for limited areas where the sufficient cable burial is not achieved and placement of cable protection on the seafloor is required, the inter-array, export, and offshore cables are not anticipated to interfere with any typical fishing practices. Should cable protection be required, it will be designed to minimize impacts to fishing gear to the extent feasible, and fishermen will be informed of the areas where protection is used. Finally, the use of pots and traps, predominantly deployed along the OECC within Nantucket Sound, is not expected to be impacted by New England Wind.

7.6.3.2.4 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The original siting of the MA WEA by BOEM included a significant public engagement process. Through this process, and in response to stakeholder concerns, the MA WEA was extensively modified. BOEM excluded areas of high fisheries value to reduce potential conflict with commercial and recreational fishing activities. This careful siting of MA WEA, which includes the SWDA, avoids many impacts to commercial fisheries. In addition, the layout of WTGs and ESPs for New England Wind is the result of input from numerous stakeholders, including the USCG and fishermen who use or transit the SWDA, and is expected to accommodate traditional fishing patterns.

As described in Section 7.6.3.1.2, the Proponent has developed an FCP (included as Appendix III-E) to further minimize impacts.

The Proponent has also made substantial commitments to fisheries research. As part of Phase 1, the Proponent has committed to provide up to $2.5 million to support fisheries research and education as part of a new initiative launched by the University of Connecticut to improve the understanding of potential environmental impacts from offshore wind. In partnership with the Connecticut Sea Grant, the University of Connecticut's Department of Marine Sciences will also use funding to support public education efforts focused on ocean literacy, wind energy, and the environmental research that is being undertaken by Connecticut's Initiative on Environmental Research of Offshore Wind.

Additionally, as part of Phase 1, the Proponent will allocate up to $7.5 million in funds to support environmental initiatives, assist Connecticut fishermen, and further bolster local communities in Connecticut where offshore wind development is taking place. The Proponent anticipates working with federal and Connecticut state agencies as well as environmental, fisheries, and local community stakeholders in Connecticut to identify key priorities and programs these funds could support.

Finally, the Proponent is committed to fisheries science and research as it relates to offshore wind energy development. Working with the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST), the Proponent is already collecting pre-construction fisheries data (via trawl and drop camera surveys) within the SWDA. The Proponent plans to develop a framework for during and post-construction fisheries studies within the SWDA. In recognition of the regional nature of fisheries science, the Proponent expects that such during and post-construction studies will involve coordination with other offshore wind energy developers in the RI/MA WEA and MA WEA, especially since there may be some offshore wind energy construction occurring concurrently in multiple lease areas. The Proponent also expects the development of the fisheries studies will be undertaken in coordination with BOEM, federal and state agencies, fisheries stakeholders, academic institutions, and other stakeholders. The Proponent is already engaging in collaboration with other developers, fishing industry representatives, and state and federal agencies through its participation in the Responsible Offshore Science Alliance (ROSA) and the Regional Wildlife Science Entity (RWSE).

The survey and monitoring work the Proponent will conduct will generate a substantial body of environmental, fisheries, and other data, which will be available in the public domain in a manner consistent with other academic research. Much of the data is publicly available through the federal and state permitting process, as well as reports or academic publications that may come out of the survey or monitoring work. The Proponent also plans to make all fisheries monitoring data generated publicly available on its website. For other environmental and fisheries data, the

Proponent will explore cost-effective and appropriate ways to store and make data publicly available and easy to access. Through the ROSA and RWSE, the Proponent will work with fishermen, regulators, stakeholders and neighboring developers to find ways to streamline and standardize available data across all offshore efforts.

To aid mariners navigating the SWDA, each WTG and ESP will be maintained as a Private Aid to Navigation (PATON) in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. The Proponent will implement a uniform system of marine navigation lighting and marking, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. Mariner Radio Activated Sound Signals (MRASS) and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety. The number, location, and type of MRASS and AIS transponders will be determined in consultation with USCG. Current plans for the uniform system of lighting and marking are discussed further in Section 7.8.2.2.5 and Appendix III-I.

Similar to the protocols followed during construction, all New England Wind vessels and equipment involved in O&M will display the required navigation lighting and day shapes. Through various media, the Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the USCG to provide Notices to Mariners to notify recreational and commercial vessels of their intended operations within the Offshore Development Region. Each WTG and ESP will also be clearly identified on NOAA charts.

7.6.3.3 Decommissioning

Decommissioning of the offshore components includes removal of WTG and ESP foundations below the mudline. Scour protection would be removed. The offshore export cables, inter-array cables, and inter-link cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies and fishing industry stakeholders on the preferred approach to minimize environmental impacts. Removal of the scour protection and any cable protection from the SWDA may result in a shift in the local finfish and invertebrate species assemblages to pre-construction, non-structure communities.

Impacts from the decommissioning activities would be similar to those associated with construction (see Sections 3.3.3 and 4.3.3 of COP Volume I). During decommissioning, vessel operations will increase in the SWDA, along the OECC, and along vessel routes to/from the Offshore Development Area and ports used by New England Wind. Avoidance, minimization, and mitigation measures employed during decommissioning will be similar to those described for New England Wind's construction activities. Additionally, once offshore components are removed, there will be no more WTGs, ESPs, foundations, or scour protection within the SWDA and commercial fishing may occur in any orientation, though the WTGs and ESPs will no longer serve as aids to navigation.

7.6.4 For-Hire Recreational Fishing

7.6.4.1 For-Hire Recreational Fishing in the Offshore Development Region

For-hire recreational fishing is an important activity throughout the Offshore Development Region. NOAA Fisheries Marine Recreation Information Program (MRIP) data for 2017 indicate that cod, hake, striped bass (*Morone saxatilis*), and mackerel were the most caught species within the Massachusetts for-hire recreational fishery (NOAA MRIP 2017). Black sea bass, scup, and summer flounder were the most caught species within the Rhode Island for-hire recreational fishery.

An estimated 601 vessels based out of ports in Connecticut, Rhode Island, and Massachusetts provide for-hire recreational fishing opportunities in the Offshore Development Region. Of these vessels, approximately 430 were homeported in Massachusetts (Steinback and Brinson 2013). In 2020, 35,352 angler trips were estimated to occur in state and federal waters off the coast of Massachusetts (NOAA MRIP 2021). The entire near-coastal region and numerous offshore locations within the Offshore Development Region may host species targeted by for-hire recreational fishing operations.[124]

For-hire recreational fishing activities have been reported to occur in portions of the MA WEA and the adjacent RI/MA WEA, which is also designated by BOEM for offshore wind energy generation. Captain Seagull's Nautical Sportfishing Chart, "Offshore: Canyon chart off MA, RI, CT, NY" describes several notable recreational fishing areas, including "The Dump," the approximately 260 km^2 (100 mi^2) dumping area identified on NOAA charts near the southerly end of the MA WEA, abutting the SWDA. Other identified areas include "The Owl," "The Star," and "Gordon's Gully" (see Figure 7.6-28).

As described in Section 7.5, a recent study by Kneebone and Capizzano (2020) estimates the level of recreational fishing effort within the MA WEA and RI/MA WEA. This study provides data for a combination of private recreational fishing (as discussed in Section 7.5) and for-hire recreational fishing activities; however, this study is one of the most recent and comprehensive data sources available on recreational fishing effort and thus represents some of the best available data on for-hire recreational fishing. As described in the study, baseline information on recreational fishing effort was collected by: (1) surveying recreational fishermen from the private (angling category) and charter/headboat sectors on their recreational fishing efforts over the past five years, and (2)

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124 NOAA Fisheries report of socioeconomic impacts of Atlantic offshore wind development describe selected fishery landings and estimates of recreational party and charter vessel revenue from NOAA Fisheries Vineyard Wind Study Areas 1 and 2 (NOAA 2021a). However, in order to protect confidentiality, the data is referred to as "all others" for most impacted species and number of vessel trips and anglers trips by port because it has less than three permits.

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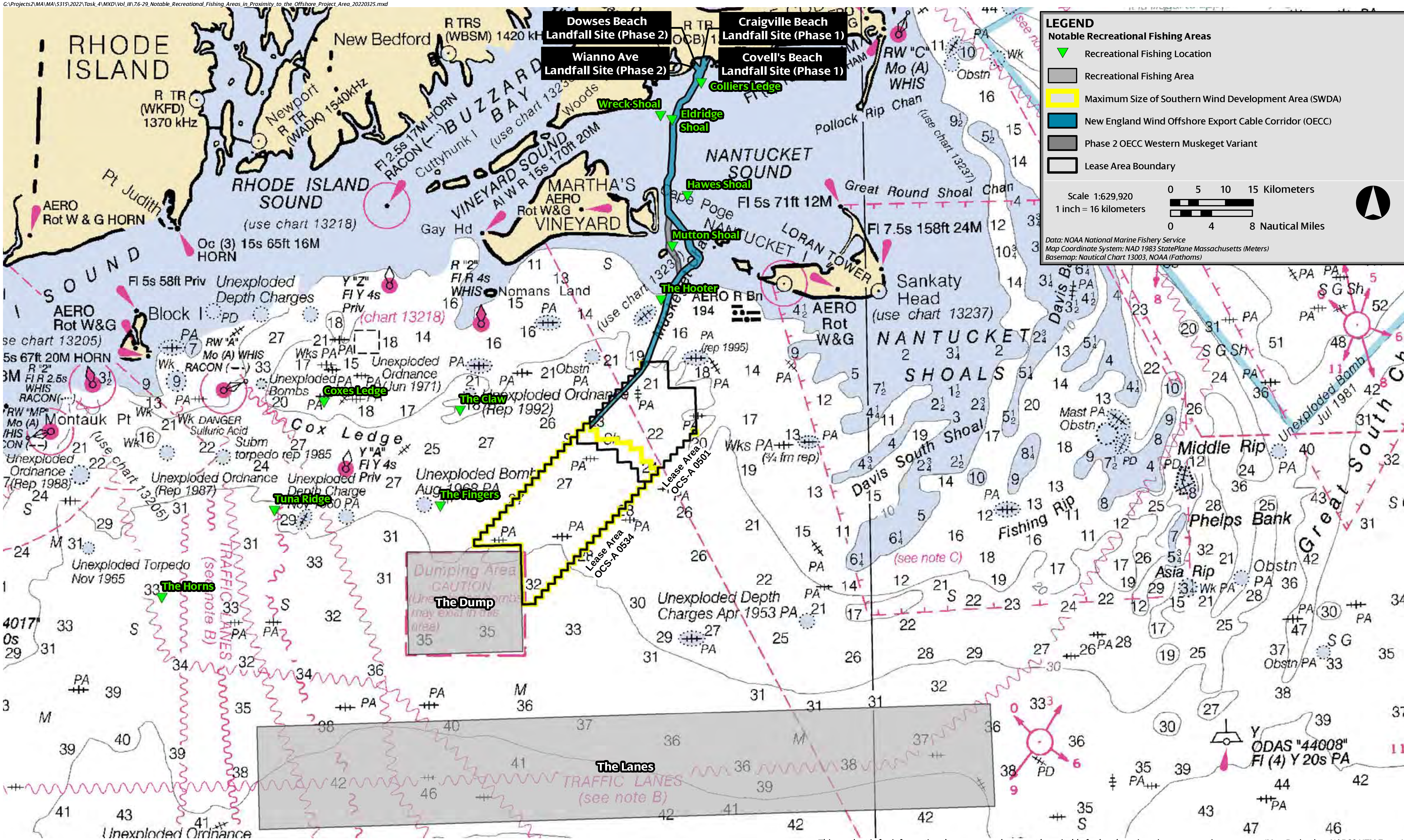


This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes (Map Projection: NAD83 UTM Zone 19N)

New England Wind
AVANGRID RENEWABLES

Figure 7.6-28
Notable Recreational Fishing Areas in Proximity to the Offshore Development Area

analyzing available data on recreational fishing effort over recent decades. Kneebone and Capizzano (2020) report that a total of 171 respondents took the survey; of those respondents, 136 were private anglers, 34 were charter/headboat captains, and one was an unknown category.

Kneebone and Capizzano (2020) describe that numerous highly migratory species (HMS) are present in the offshore waters in southern New England. Popular and commonly-caught HMS include bluefin tuna (*Thunnus thynnus*), yellowfin tuna (*Thunnus albacares*), albacore (*Thunnus alalunga*), mahi mahi (*Coryphaena hippurus*), white marlin (*Kajikia albida*), wahoo (*Acanthocybium solandri*), and "sharks," which include shortfin mako (*Isurus oxyrinchus*), blue shark (*Prionace glauca*), common thresher shark (*Alopias vulpinus*), porbeagle (*Lamna nasus*), tiger shark (*Galeocerdo cuvier*), and smooth hammerhead (*Sphyrna zygaena*).

Private and for-hire recreational fishing vessels target many of these HMS at popular fishing areas throughout southern New England. Kneebone and Capizzano (2020) determined that recreational effort for HMS is widespread throughout southern New England and that the greatest recreational fishing effort occurs west of the MA WEA and RI/MA WEA (i.e. west of the SWDA) in the waters south and east of Montauk Point and Block Island (Kneebone and Capizzano 2020). In particular, large amounts of recreational fishing occur in areas such as The Dump, Tuna Ridge, The Horns, and The Lanes (see Figure 7.6-28). Specifically, the three areas within the MA WEA and RI/MA WEA with the highest levels of recreational fishing activity for HMS were Coxes Ledge, The Fingers, and The Claw (see Figure 7.6-28). Finally, the study indicated that recreational fishermen primarily target bluefin tuna, shortfin mako, and "any tuna species" within Lease Areas OCS-A 0501 and OCS-A 0534, with trips primarily originating from Massachusetts and Rhode Island. Accordingly, while recreational fishing effort occurs within the SWDA, such effort is widespread throughout southern New England and is more highly concentrated in areas to the west of the SWDA. See also Figure 7.5-2 and Section 7.5.1.2 for a discussion of popular recreational fishing areas.

Along the OECC (including the Western Muskeget Variant) and as shown in Figure 7.6-28, notable recreational fishing areas are identified by Captain Seagull's Nautical Sportfishing Chart "Offshore: Nantucket Shoals and Georges Bank, MA" and include "The Hooter," which is a location named for the fairway buoy that makes a "hooting" sound and is a marker for the end of Muskeget Channel southwest of Martha's Vineyard. The Salty Cape website categorizes this area as a shoal that attracts striped bass and bluefish (*Pomatomus saltatrix*) in mid-May as well as Atlantic bonito ([bonito] *Sarda sarda)* and false albacore (*Euthynnus alletteratus*). Bluefin tuna is also "fairly common" in this area. According to Captain Seagull's, other popular areas along or close to the OECC (including the Western Muskeget Variant) include "Mutton Shoal" in Muskeget Channel, "Hawes Shoal" north of Muskeget Channel, and "Eldridge Shoal," "Wreck Shoal," and "Colliers Ledge" in Nantucket Sound. For-hire recreational charter fishing captains report that the most popular species to catch in these areas are striped bass, bluefish, false albacore and bonito as well as summer flounder, black sea bass, and scup.

The for-hire recreational fishing fleets contribute to the overall economy in the Northeast, not just through direct employment, income, and gross revenues of the for-hire businesses, but also through spending on products and services to maintain and operate their vessels, triggering further indirect multiplier effects that are dependent upon the initial demands of the for-hire fleet (Steinback & Brinson 2013).

The economic contribution of for-hire charter/headboat operators was assessed in July to November of 2013 along the Atlantic coast from Maine to Texas (Hutt and Silva 2015). In the Northeast, which includes the Atlantic coast from Maine to Virginia, it is estimated that there were 4,936 charter trips from July to November 2013 that targeted Atlantic HMS. Hutt and Silva (2015) estimated a total of $12.1 million in gross revenue in the Northeast from July to November 2013, of which $7.3 million was used for trip expenses (fuel, crew, bait, supplies, etc.) and $4.8 million was for owner net return and operation costs. The average fee in the Northeast per charter boat trip was $2,450; after accounting for expenditures, the average net return was estimated at $969 per charter boat trip. The average fee in the Northeast per headboat trip was $6,973; after accounting for expenditures, the average net return was estimated at $2,305 per headboat trip (Hutt and Silva 2015). Appendix A of Appendix III-N summarizes results of the economic exposure analysis of Massachusetts- and Rhode Island-based for-hire recreational fisheries to the Lease Area.

7.6.4.2 Impacts to For-Hire Recreational Fisheries

Impacts and measures to avoid, minimize, and mitigate impacts to recreational fishing practices and species targeted by for-hire recreational fishermen will be similar to those described for recreational fishing in Section 7.5.2 and commercial fishing in Section 7.6.3. As described further in those sections, temporary safety buffer zones may be established around construction activities, which may temporarily preclude for-hire recreational fishing in limited areas. However, there are many other popular recreational fishing locations in the immediate vicinity of the SWDA and OECC available to charter and headboat captains that would still be available. During O&M, the SWDA will be open to marine traffic; no permanent vessel restrictions are proposed within the SWDA or along the OECC (including the Western Muskeget Variant) during O&M for either Phase. The layout of New England Wind will facilitate ongoing transit and fishing activities. By providing additional structure for species that prefer hard, complex bottoms, the WTG and ESP foundations may function as fish aggregating devices (BOEM 2012) and provide a potential benefit to for-hire recreational fishermen. Additionally, anglers' interest in visiting the SWDA may also lead to an increased number of fishing trips out of nearby ports which could support an increase in angler expenditures at local bait shops, gas stations, and other shoreside dependents (Kirkpatrick et al. 2017).

7.7 Land Use and Coastal Infrastructure

This section describes New England Wind activities that may affect land use or coastal infrastructure. Potential impacts to land use are assessed within the Onshore Development Areas for Phase 1 (Park City Wind) and Phase 2 (Commonwealth Wind). For each Phase, the Onshore Development Area consists of the areas where the onshore facilities could be physically located, which includes the landfall sites, the Onshore Export Cable Routes, the onshore substation sites, the Grid Interconnection Routes, and the grid interconnection point.

Potential impacts to coastal infrastructure are assessed for the locations of potential port facilities that may be used for either Phase of New England Wind. Potential impacts to land use from port usage are not assessed separately, as each port facility being considered for New England Wind is either already located within an industrial waterfront area with sufficient existing infrastructure or is identified as an area where other entities intend to develop infrastructure with the capacity to host construction activities under the New England Wind development schedule (see Sections 3.2.2.5 and 4.2.2.5 of COP Volume I for a list of ports that may be used). Use of one or more of these port facilities is not anticipated to affect surrounding land use.

7.7.1 Description of the Affected Environment

Descriptions of land use impacts are provided for the Onshore Development Areas. All onshore facilities for each Phase of New England Wind will be located in the Town of Barnstable, Barnstable County, Massachusetts.

Descriptions of coastal infrastructure are provided for each county where port usage may occur. These potential port facilities for either Phase of New England Wind are located in Bristol County, Essex County, and Dukes County, Massachusetts; Providence County and Washington County, Rhode Island; Fairfield County and New London County, Connecticut; Albany County, Kings County, Rensselaer County, Richmond County, and Suffolk County, New York; and Gloucester County, New Jersey. These port facilities are summarized in Table 7.0-1 and fully described in Sections 3.2.2.5, 3.2.2.6, 4.2.2.5, and 4.2.2.6 of COP Volume I. In addition to the information provided on a county level, town-level details are described due to the highly localized nature of land use and coastal infrastructure impacts.

It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction and O&M. Some activities, such as refueling, restocking supplies, sourcing parts for repairs, vessel mobilization/demobilization, and potentially some crew transfer, may occur out of ports other than those identified. These activities would occur at industrial ports suitable for such uses and would be well within the realm of normal port activities.

7.7.1.1 Massachusetts

All onshore facilities for each Phase of New England Wind will be located in the Town of Barnstable, Barnstable County, Massachusetts. The Proponent may also use port facilities in Bristol County, Essex County, and Dukes County, Massachusetts.

7.7.1.1.1 Barnstable County

Each Phase of New England Wind is expected to connect to the ISO New England electric grid at the West Barnstable Substation in the Town of Barnstable,[125] Barnstable County, Massachusetts via separate onshore transmission systems. Accordingly, the Onshore Development Areas for Phases 1 and 2 consist of: (1) the landfall sites, (2) the Onshore Export Cable Routes, which are the onshore routes from the landfall sites to the onshore substation sites within which the onshore export cables will be installed, (3) the onshore substation sites, (4) the Grid Interconnection Routes, which are the onshore transmission routes that connect the onshore substations to the grid interconnection point, and (5) the grid interconnection point at the West Barnstable Substation. Potential landfall sites for each Phase will also be located within the Town of Barnstable.

The potential landfall sites, Onshore Export Cable Routes, onshore substation sites, and Grid Interconnection Routes for Phase 1 and Phase 2 are illustrated in Figure 3.1-2. No port usage is anticipated within Barnstable County.

Barnstable County comprises approximately 1,020 square kilometers (km^2) (242,057 acres) of land and approximately 2,362 km^2 (583,663 acres) of fresh and saltwater. The County encompasses all of Cape Cod, the geographic cape extending into the Atlantic Ocean from the southeastern corner of mainland Massachusetts where it meets the Cape Cod Canal. Barnstable County borders Plymouth County to the northwest and Dukes County and Nantucket County are located off its southern shore.

Town of Barnstable

The Town of Barnstable is the largest community on Cape Cod both in land area and population, and serves as the County seat. Most of the Town's residential development has occurred in the last 40 years and during this period of residential growth, wastewater, water supply, transportation improvements, recreational amenities, schools, and other government services have been developed (Town of Barnstable 2010). Figure 7.7-1 depicts land uses in the Town of Barnstable.

125 One or more Phase 2 offshore export cables may deliver power to a second grid interconnection point via the South Coast Variant if technical, logistical, grid interconnection, or other unforeseen issues arise. Under this scenario, Phase 2 could include one onshore transmission system in Barnstable and/or an onshore transmission system(s) in proximity to the second grid interconnection point (see Sections 4.1.3 and 4.1.4 of COP Volume I).

The Town of Barnstable's land use policy directs growth to the downtown Hyannis area, a major seasonal tourist destination and an active recreational and commercial boating harbor. Important regional assets located in Hyannis include: two ferry terminals with service to Nantucket and

Martha's Vineyard, the region's largest commercial airport, commercial areas on Route 132, and the region's primary medical facility, Cape Cod Hospital (Utile 2010). Barnstable's road network consists of three major regional east-west roads—Route 6A, Route 6, and Route 28—and four regional roads that connect to the east-west roads–Willow Street, Route 132, Phinney's Lane, and Route 149.

Barnstable has a large amount of open space, including inland and coastal wetlands, forest, and freshwater features. Substantial areas of low- to medium-density residential development surround corridors of commercial and industrial uses. An estimated 4 km^2 (978 acres) of land in Barnstable are in active agricultural use (Association to Preserve Cape Cod 2011).

The Town of Barnstable has approximately 160 kilometers (km) (100 miles [mi]) of coastline, more coastline than any other town in Massachusetts. The Town also has extensive salt-water wetland areas, including Great Marsh south of Sandy Neck and Cape Cod Bay, which account for approximately 27% of the County's salt marsh (Town of Barnstable 2010). Working waterfronts are a signature feature of Barnstable County and the Town of Barnstable's deep-water harbors have long-established infrastructure that supports both commercial fishing activities and the recreational boating public.

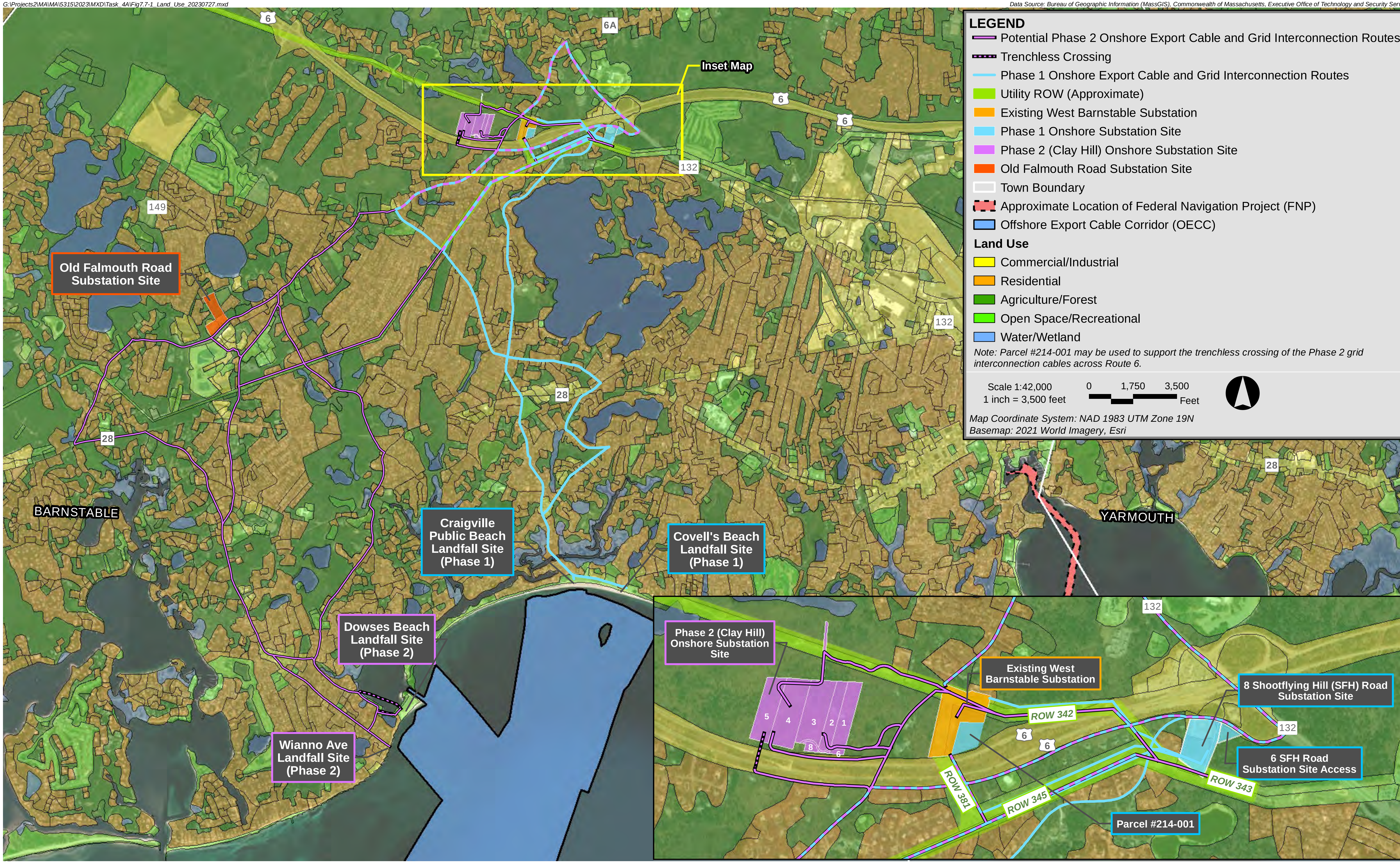
New England Wind activities will not occur proximate to Barnstable's northerly coastline fronting Cape Cod Bay. The following section, therefore, focuses on coastal infrastructure along the Town's southerly coastline, primarily from the Cotuit and Popponesset Bay area to the Hyannis and Hyannis Port area of the western portions of Lewis Bay.

Hyannis Harbor consists of an Outer Harbor, Middle Harbor (known as Lewis Bay), and Inner Harbor. The Inner Harbor, typical of working waterfronts, is developed with timber and steel sheet pile bulkheads to the extent of filled tidelands. Piers, wharves, docks, and other facilities are located along the perimeter of the Inner Harbor.

The Town of Barnstable operates two marinas in Hyannis Harbor: the Bismore Park Marina and the Gateway Marina and boat ramp. These facilities also provide dockage for commercial fishing vessels as well as tourist day boats and other recreational vessels. The Town of Barnstable manages an estimated 2,460 mooring permits issued to individual mooring permit holders. The Barnstable Harbormaster also operates land-based, semi self-service pump-out facilities, and a pump-out vessel. Several private marina operators offer dockage, fuel, and servicing within the Harbor. Hy-Line Cruises and The Woods Hole, Martha's Vineyard and Nantucket Steamship Authority (d/b/a The Steamship Authority), both passenger vessel and ferry service operators, have facilities located within the Inner Harbor.

G:\Projects2\MA\MA\5315\2023\MXD\Task_4A\Fig7.7-1_Land_Use_20230727.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



New England Wind

AVANGRID RENEWABLES

Figure 7.7-1
Land Use

The United States Army Corps of Engineers (USACE) maintains a Federal Navigation Project (FNP) within Hyannis Harbor. The FNP provides for:

- A 357 meter (m) (1,171 foot [ft]) long stone breakwater lying approximately 1.1 km (0.7 mi) offshore;
- An anchorage area dredged to -4.7 m (15.4 ft) below Mean Lower Low Water (MLLW) in a protected area behind the breakwater;
- An entrance channel dredged to -3.9 m (-13 ft) MLLW from deep water in Nantucket Sound to the entrance of the inner harbor area;
- A -3.9 m (-13 ft) MLLW and 4.5 m (15 ft) wide channel and a -3.9 m (-13 ft) MLLW deep turning basin in the inner harbor area; and,
- A 45 m (150 ft) wide channel dredged to -3.7 m (12 ft) MLLW and adjoining the -3.9 m (13 ft) MLLW deep entrance channel in the outer harbor area.

The FNP also provides for two additional 3.7 m (12 ft) MLLW anchorage areas adjacent to the Inner Harbor turning basin. The FNP also includes a 305 m (1,000 ft) long riprap jetty extending south from Dunbar Point. The US Coast Guard (USCG) maintains a series of aids to navigation delineating the Harbor approach, channel, and obstructions. As shown on Figure 7.7-1, the OECC and potential landfall sites for both Phases of New England Wind are outside of the FNP.

A Confined Aquatic Disposal (CAD) cell was created outside of Hyannis Harbor in 1998. The Hyannis CAD cell is located beneath the former harbor entrance channel adjacent to the Outer Harbor anchorage area. The suitable material removed during cell construction was placed on the beaches at Great Island and within the dikes built on Dunbar Point behind Kalmus Beach. Approximately 57,600 cubic meters (2.03 million cubic feet) of silty material from the Inner Harbor basin were disposed in the CAD cell from December 1998 to March 1999, when the cell was capped with clean sand from a prior Middle Harbor channel deepening project. As shown on Figure 7.7-1, the OECC does not enter Hyannis Harbor and therefore does not interact with the Hyannis CAD cell.

Four marinas and five marine service businesses are located west of Hyannis Harbor, including Prince Cove Marina, a facility owned and operated by the Town of Barnstable.

The relatively shallow water depth throughout much of the area west of Hyannis Harbor limits navigational capacity. Navigable depths appear to be maintained in marked channels; however, shoaling is often reported, and the Town of Barnstable has sponsored periodic maintenance dredging activities in these areas (Town of Barnstable 2009). Much of this area is characterized by small villages, marinas, and mooring areas set in coves and along marsh and beach areas. Public access facilities, including parking, pedestrian access, boat ramps, launch areas, and mooring access points are extremely limited and in heavy demand during the summer boating season, a common issue in the Commonwealth's coastal communities. The Town of Barnstable operates 16 boat launch ramps and associated facilities. Of these, only one boat ramp facility is located near the potential Phase 2 Onshore Export Cable and Grid Interconnection Routes. The Massachusetts Department of Fish and Wildlife also operates minimally improved public access property that provides shore fishing access at Popponesset Beach.

The Town of Barnstable maintains and operates four public beaches in proximity to Hyannis Harbor: Craigville Beach and Covell's Beach in Centerville Harbor; Keyes Beach (Sea Street) and Kalmus Beach in the Outer Harbor; and Veterans Park Beach in the Middle Harbor. These facilities also include public amenities and may be staffed on a seasonal basis.

The Town of Barnstable also hosts electric transmission and distribution infrastructure necessary to accommodate New England Wind. This infrastructure includes the West Barnstable Substation, which is the grid interconnection point for both Phases of New England Wind.

7.7.1.1.2 Bristol County

The Proponent may use port facilities at the New Bedford Marine Commerce Terminal ("New Bedford Terminal"), other areas in New Bedford Harbor, and/or at the Brayton Point Commerce Center in Bristol County.

The New Bedford Terminal, which is owned by the Massachusetts Clean Energy Center, may be used during both Phases of New England Wind. The 0.12 km^2 (29 acre) New Bedford Terminal is located on the City's extensive industrial waterfront and was purposely built to support offshore wind energy projects.

For each Phase, the Proponent may also use other areas in the Port of New Bedford, including, but not limited to, those identified by Massachusetts Clean Energy Center as potentially viable offshore wind ports, if necessary upgrades are made by the owner/lessor. For example, use of the Eversource Energy/Sprague Oil Site would be subject to the acquisition and redevelopment of the Sprague Terminal by a private and/or public entity. Rehabilitation work would include removing existing oil tanks and buildings to provide a finished, high bearing capacity graveled surface suitable for supporting offshore wind components, upgrades to the quayside, and dredging and filling operations to support mooring and berthing of specialized offshore wind vessels.

The Proponent may also use the Brayton Point Commerce Center, which is the site of the former coal-fired Brayton Point Power Plant, during Phase 1 or Phase 2. Brayton Point is a 1.2 km^2 (307 acre) property located in Mount Hope Bay, less than one mile from Interstate 195. The site owners, Commercial Development Company, Inc. and its affiliate Brayton Point, LLC, plan to transform the former power plant site into a world-class logistics port, manufacturing hub, and support center for the offshore wind industry. Commercial Development Company, Inc. has signed an agreement with Patriot Stevedoring + Logistics, LLC to manage operations of the marine commerce terminal.

Port of New Bedford

Coastal infrastructure in New Bedford, particularly within the New Bedford/Fairhaven Harbor, is substantial. According to the New Bedford/Fairhaven Municipal Harbor Plan, roughly 70% of the approximately 3.8 km^2 (939 acres) of harbor land area is on the New Bedford (west) side of the Harbor, with the remaining 30% in Fairhaven (east of the Harbor). Approximately 1.2 km^2 (307 acres) of the harbor land area is currently used for industrial and seafood processing activities, including coastal infrastructure on the Fairhaven side of the Harbor and inland areas with direct or indirect ties to the waterfront. Approximately 16% of harbor land is owned or directly controlled by municipal, county, state, or federal government entities, and many of these holdings are leased for marine industrial uses. About 7% of harbor land is used by commercial businesses that indirectly support the marine industry, and the remainder is open space, residential, parking and transportation services, and other businesses. In 2010, approximately 4% of harbor land was vacant. Generally, commercial and industrial activities are more densely clustered on the New Bedford side of the harbor, accounting for about 70% of harbor land uses (City of New Bedford 2010).

Portions of New Bedford Harbor are within a Designated Port Area, a classification under state policy and regulatory programs that seek to preserve and enhance the capacity of Designated Port Areas to accommodate water-dependent industrial uses, such as New England Wind and prevent significant impairment by non-industrial or non-water-dependent types of development.

The Port of New Bedford is a significant regional economic and cultural asset. It is a deep-water commercial port with direct access to important maritime corridors leading from the Massachusetts coast. The Port of New Bedford is approximately 32 km (20 mi) from the Cape Cod Canal, 133.5 km (83 mi) south of Boston Harbor, and 267 km (166 mi) north of New York (New Bedford Port Authority 2016). By landed value, the Port is the primary fishing port in the nation, with commercial fishing operations generating economic activity in excess of $9.8 billion and related employment of more than 36,000 people. The fishing fleet of approximately 500 vessels lands over 122 million pounds of product, annually leveraging $322 million in direct sales (New Bedford Port Authority 2016).

The 0.12 km^2 (29 acre) New Bedford Terminal is located in the Port of New Bedford on the industrial waterfront where it serves as a multi-purpose, heavy-lift cargo facility designed to support the construction, assembly, and deployment of offshore wind projects. It is also designed to handle bulk, break-bulk, container shipping, and large specialty marine cargo. The New Bedford Terminal provides easy access to open water for both domestic and international shipping routes as well as interstate transportation networks for land-based logistics.

The USACE's New Bedford Hurricane Protection Barrier lies across the entrance to the New Bedford and Fairhaven Harbors, protecting approximately 5.6 km^2 (1,400 acres) of land in New Bedford, Fairhaven, and nearby communities from tidal flooding associated with coastal storms. The Hurricane Protection Barrier consists of three principal features: a barrier extending across

New Bedford and Fairhaven Harbor with an extension dike on the mainland, the Clarks Cove Dike in New Bedford, and the Fairhaven Dike in Fairhaven. Across the Harbor entrance, the Hurricane Protection Barrier is a 1.37 km (4,500 ft) long earthen fill dike with stone slope protection. It has a maximum elevation of 6 m (20 ft) above mean sea level and a 46 m (150 ft) wide gated opening to accommodate vessel traffic. An Extension Dike starts at the western end of the main dike and stretches for 1.40 km (4,600 ft) along Rodney French Boulevard East, in New Bedford. The Clarks Cove Dike is 1.77 km (5,800 ft) long and extends around the north and east sides of the Clarks Cove. The Fairhaven Dike starts at high ground near the foot of Lawton Street in Fairhaven and runs easterly for approximately 0.94 km (3,100 ft).

The USACE manages and maintains the New Bedford and Fairhaven FNP. The FNP consists of a 106 m (350 foot) wide navigation channel, dredged to approximately -9 m (-30 ft) MLLW extending 8 km (5 mi) from Buzzards Bay to a point above the New Bedford-Fairhaven Bridge (i.e. Route 6). Northwest of Palmer Island (along the New Bedford main waterfront) and above the New Bedford-Fairhaven bridge, the navigation channel has areas of increased widths for anchorage and maneuvering purposes. A second channel is dredged to -7.6 m (-25 ft) MLLW and from 61–76 m (200–250 ft) wide extending 320 m (1,050 ft) from the lower maneuvering area along the New Bedford waterfront to the vicinity of Fish Island and the swing bridge.

A separate channel along the Fairhaven waterfront extends approximately 1,128 m (3,700 ft) northward from Pierce and Kilburn. From Pierce and Kilburn Wharf to Old South Wharf, the channel is dredged to -4.5 m (-15 ft) MLLW and ranges from 45–122 m (150–400 ft) wide. From Old South Wharf to a point 304 m (1,000 ft) south of the old causeway pier, the channel is -3 m (-10 ft) MLLW and 46 m (150 ft) wide. The USACE also maintains a 0.68 km^2 (165 acre) triangular-shaped anchorage dredged to -7.6 m (-25 ft) MLLW along the east side of the main channel and north of Palmer Island.

New Bedford's inner harbor and the main working port extends north from the Hurricane Barrier to a fixed highway bridge on Interstate 195. New Bedford harbor is up to 1,150 m (3,800 ft) wide and 3.62 km (2.25 mi) long and is bisected by the Route 6 causeway and its three bridges. Two of the causeway bridges are fixed spans with vertical clearances of 1.8 m (6 ft) at Mean High Water (MHW). The third bridge is a swing span that crosses the main shipping channel. When the span is in the open position, the bridge provides access to the northern half of the inner harbor through two openings, each slightly less than 29 m (95 ft) in width. These openings restrict the size of vessels that can reach the Harbor's northern-most facilities.

Passenger ferry operations serving over 100,000 passengers each year operate from New Bedford Harbor. The Port of New Bedford supports a growing tourism sector, and the Harbor is a port of call for American Cruise Lines and other locally-owned harbor tour operators. A number of marine service operators are also located in the Harbor, and these facilities offer Travelift and marine rail launch/haul services for vessels up to 1,000-metric tons (1,102-US tons), along with comprehensive maintenance, repair, and refit services. The Harbor is a significant intermodal shipping center for the northern US market and offers Roll-on/Roll-off, including ship-to-rail, bulk, break-bulk, and containerized cargo facilities. The Harbor also has immediate access to approximately 127,400 cubic meters (4.5 million cubic feet) of cold storage, Foreign Trade Zone #28, and direct links to the Interstate Highway System as well as regional air and rail networks.

Six marinas in New Bedford Harbor are located in Fairhaven and provide more than 580 boat slips for recreational vessels. The Fairhaven Harbormaster permits approximately 70 public and private moorings, and the Town of Fairhaven also operates and maintains a public boat ramp and dinghy dock at Pease Park.

Brayton Point Commerce Center

The Brayton Point Commerce Center is located on the site of the former coal-fired Brayton Point Power Plant. Brayton Point is a 1.2 km^2 (307 acre) property located in Mount Hope Bay less than 1.6 km (1 mi) from Interstate 195. Commercial Development Company, Inc. and its affiliate Brayton Point, LLC are in the process of transforming the former power plant site into a world-class logistics port, manufacturing hub, and support center for the offshore wind industry. Commercial Development Company, Inc. has signed an agreement with Patriot Stevedoring + Logistics, LLC to manage operations of the marine commerce terminal (Froese 2019).

Coastal infrastructure at Brayton Point, remaining from the former Brayton Point Power Plan, include a 213.4 m (700 ft) wood-decked marginal wharf with hard-points and dolphin tie-points for bulk carriers, and a fuel off-loading pier for oil tankers and liquid product delivery vessels. Vessels can access the site from its eastern side by a privately maintained channel dredged to 10.5 m (34.5 ft) MLLW that approaches the site from the southeast. Anchorages on either side of the channel have been maintained to a depth of -7.6 m (-25 feet) MLLW.

Vessels transiting to Brayton Point enter Narragansett Bay and transit north into Mount Hope Bay, leaving the main ship channel just south of Borden Flats and enter the privately maintained channel that runs northwest to the site's quay.

Beyond the infrastructure described above, very little coastal infrastructure has been developed in the area immediately surrounding Brayton Point. Currently, the surrounding area largely consists of residential uses and public access open space.

7.7.1.1.3 Dukes County

The Proponent may use port facilities in Vineyard Haven Harbor, Dukes County during construction of each Phase of New England Wind. Additionally, the Proponent expects to use one or more facilities in support of operations and maintenance (O&M) activities for Phases 1 and 2, including port facilities in Vineyard Haven Harbor. As described further in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I, the O&M facilities may include management and administrative team offices, a control room, office and training space for technicians and engineers, and/or warehouse space for parts and tools. The O&M facilities are also expected to include pier space for crew transfer vessels and/or other larger support vessels, such as service operation vessels (SOVs).

Vineyard Haven Harbor

Vineyard Haven Harbor is Martha's Vineyard year-round working port and is home to most of the Island's boatyards. It is used regularly by small coastal tankers and ferries transporting freight, vehicles, and passengers. Vineyard Haven Harbor is located approximately 6.4 km (4 mi) southeast of Woods Hole and 35 km (22 mi) southeast of New Bedford.

The USACE maintains an FNP in Vineyard Haven Harbor that includes a navigation fairway at the head of the Harbor between Steamboat Wharf and a breakwater built and maintained by the Commonwealth of Massachusetts. This triangular-shaped area is dredged to -5 m (-17 ft) MLLW, is approximately 46–84 m (150–275 ft) wide, and 304 m (1,000 ft) long. The FNP also includes a -3.7 m (-12 ft) MLLW anchorage behind the breakwater, immediately north of the fairway area, which hosts a mooring field operated by the Town of Tisbury. Areas of the inner harbor, south of the fairway, have dockage at pile-supported piers. Much of the inner Harbor, however, remains coastal beach and limited wharfing space is currently available. Additional marine services are available within Lagoon Pond, south of the inner harbor, and along the Beach Road causeway.

In addition to Vineyard Haven Harbor, Martha's Vineyard has three other primary harbors: Menemsha Basin, Edgartown, and Oak Bluffs. Along with Vineyard Haven Harbor, these harbors are home to the Martha Vineyard's fishing fleet and commercial vessels that handle passenger and cargo services from the mainland, and they are important destinations for tourists and recreational boaters alike and offer full-service facilities for recreation boaters. The Steamship Authority carries more than two million passengers and almost 500,000 vehicles to and from Martha's Vineyard each year on ferries operating from Woods Hole to Vineyard Haven and Oak Bluffs. There are also close to 300,000 passenger trips on private passenger ferries linking Martha's Vineyard and Gosnold (on the Elizabeth Islands) to various mainland ports.

7.7.1.1.4 Essex County

The Proponent may use port facilities at Salem Harbor in Essex County.

Salem Harbor

When the recently commissioned Salem Harbor Power Station natural gas power plant replaced a coal and oil plant in 2018 along the Salem waterfront, it opened 0.17 km^2 (42 acres) for development. The Salem Harbor Power Station mostly bisects the area available for development; the north side of the site is approximately 0.06 km^2 (13.7 acres) and the south side is approximately 0.12 km^2 (29 acres). The site 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 approximately 700 m (2,300 ft) of frontage on Salem Harbor, which hosts active commercial, recreational, and water transportation facilities. The site is located approximately 35 km (22 miles) northeast of Boston.[126]

7.7.1.2 Rhode Island

Port facilities in Providence County and/or Washington County in the state of Rhode Island may be used for each Phase of New England Wind.

7.7.1.2.1 Providence County

The Proponent may use port facilities at the Port of Providence and/or South Quay Terminal in Providence County.

Port of Providence

The Port of Providence is Rhode Island's principal commercial port, handling over 70% of the cargo entering Narragansett Bay. The Port of Providence is an intermodal port that offers interstate highway access as well as rail service that reaches inland to major connections throughout the US and is of particular importance, both locally and regionally, for its role in supplying energy products to southern New England.

The Port of Providence (ProvPort) is a privately-owned marine terminal located within the City of Providence that occupies approximately 0.47 km^2 (115 acres) along the Providence River. ProvPort provides 1,280 m (4,200 ft) of berthing space, 12,077 square meters (130,000 square feet) of covered storage, and more than 0.08 km^2 (20 acres) of open lay down area. ProvPort also has on-dock rail service and is located 1.6 km (1 mi) from the interstate (ProvPort 2020).

Marine transportation into ProvPort is facilitated by a federally maintained navigational channel, which was dredged in 2005 to -12.2 m (-40 ft) mean low water, allowing the port to accommodate deep-draft vessels (RICRMC 2010).

Marine transportation into ProvPort is facilitated by a federally maintained Providence River and Harbor navigational channel, which was dredged in 2005 to -12.2 m (-40 ft) mean low water, allowing the ProvPort to accommodate deep-draft vessels. The deep-draft channel and the Port's intermodal capabilities, connecting water, rail, and land transportation makes the Port attractive to both domestic and international vessels (ProvPort 2009).

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[126] During appropriate time periods, New England Wind-related vessels traveling to/from Salem Harbor will transit at 18.4 km per hour (10 knots) or less within National Oceanic and Atmospheric Administration (NOAA)-designated North Atlantic right whale critical habitat and outside critical habitat.

South Quay Terminal

The South Quay Terminal is an over 0.12 km^2 (30 acre) greenfield site located on the Providence River in East Providence. Waterfront Enterprises, LLC has announced plans to develop a staging area for offshore wind construction at the site as well as other mixed uses (Faulkner 2020).

Currently, there isn't sufficient infrastructure to support marine industrial uses from the South Quay Terminal; however, Phase 1 or Phase 2 of New England Wind may use the South Quay Terminal if that infrastructure is developed by RI Waterfront Enterprises, LLC.

7.7.1.2.2 Washington County

The Proponent may use the Port of Davisville in Washington County.

Washington County, locally referred to as "South County," comprises the towns of North Kingstown, South Kingstown, Exeter, Narragansett, Charlestown, Hopkinton, Richmond, Westerly, and New Shoreham. Washington County is largely undeveloped with communities ranging from rural farming enclaves to seasonal beach communities, low-density residential development.

Port of Davisville

The Port of Davisville is located within Quonset Business Park in North Kingstown. The 13 km^2 (3,212 acre) Quonset Business Park is comprised of the former Quonset Naval Air Station, which closed in 1974, and the former Davisville Construction Battalion Center, which closed in 1994.

The Port of Davisville offers five terminals, 1,372 linear meters (4,500 linear feet) 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. The Port of Davisville also has heavy lift capacity, including a 150 metric ton (165.3 US ton) mobile harbor crane. Located near the mouth of Narragansett Bay, vessels access the Port of Davisville through a shipping channel that is not maintained by the USACE (QDC 2019). Ongoing renovations to the Port's Pier 2 include construction of a new steel bulkhead, dredging Narragansett Bay to accommodate larger ships, and extending Pier 2 by 71 m (232 ft), which will create a third berth to increase the port's overall capacity and provide necessary infrastructure for the offshore wind industry (King 2020).

Vineyard Fast Ferry, which operates a seasonal ferry between Quonset Point and Martha's Vineyard, operates a small ferry terminal in the Quonset Business Park. Other marine industrial uses at the Quonset Business Park include Senesco Marine, a barge, tug, and vessel-building company, and General Dynamics Electric Boat, which builds submarine components for the US Navy (RICRMC 2010). Seafreeze, Ltd. leases 0.02 km^2 (5.9 acres) and 153 linear meters (500 linear feet) of bulkhead space along the two piers at Davisville for cold storage and distribution of seafood, vessel loading and unloading, and administrative support activities. There are several recreational boating facilities also within the Quonset Business Park, located to the north of the Port's facilities.

7.7.1.3 Connecticut

Port facilities in Fairfield County and/or New London County in the state of Connecticut may be used for each Phase of New England Wind.

7.7.1.3.1 Fairfield County

The Proponent may use port facilities in areas in Bridgeport, Fairfield County, such as Barnum Landing and another port facility off of Seaview Avenue just north of Barnum Landing, which could be used for Phase 1 or Phase 2, if the necessary upgrades are made by the owner/lessor.

The Proponent will likely establish a long-term SOV O&M base in Bridgeport to support Phase 1. The SOV O&M base would be the primary homeport for the SOV and would be used for some crew exchange, bunkering, spare part storage, and load-out of spares to the SOV and/or other vessels. Related support infrastructure, warehousing, and a control room may also be located near the SOV O&M base. One of the existing industrial ports listed in Table 3.2-8 of COP Volume I and described in this section may be needed as an alternative SOV O&M base on interim basis if the facilities in Bridgeport, Connecticut are not available by the start of Phase 1 O&M. For Phase 2, the Proponent will likely use O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor. Additionally, the Proponent may use any of the ports listed in Table 4.2-8 of COP Volume I and described in this section to support O&M activities.

Bridgeport Harbor

Bridgeport Harbor is one of Connecticut's three deep-water ports, though the Port of Bridgeport is comprised of two natural harbors, Bridgeport Harbor and Black Rock Harbor. The City of Bridgeport has a long history of industrial manufacturing and water-dependent uses along its waterfront.

Bridgeport Harbor's FNP includes entrance, main and branch tributary channels, anchorages, a turning basin, and two stone breakwaters at the entrance to the harbor. The main channel has an authorized depth of -10.7 m (-35 ft) MLLW, although the lack of maintenance dredging has resulted in shoaling and a reduction in the controlling depth, as reported by the USACE in the 2008 Bridgeport Dredge Material Management Plan. For example, the entrance and main channels are about -9.1 m (-30 ft) MLLW, and similar reductions in the controlling depth of the channels in various tributaries have also been reported (Moffatt and Nichol 2012). Consequently, shallow harbor conditions can require shippers to unload goods before entering the harbor, use smaller vessels to transport goods, wait for high tide before entering the harbor, or use other harbors, which is the case with petroleum vessels (USACE 2010).

The Port of Bridgeport has several private cargo facilities that handle a range of goods, including petroleum products, break bulk cargo, and sand, gravel, and coal. The Bridgeport Port Authority owns Bridgeport Regional Maritime Complex, a 0.18 km^2 (44 acre) industrial site dedicated for water-dependent uses.

The Barnum Landing site owned by the McAllister Towing and Transportation Company, Inc. consists of approximately 0.06 km^2 (15 acres) of industrial waterfront property along Bridgeport Harbor. The Proponent may use the site to accommodate secondary steel fabrication and final outfitting and storage of transition pieces as well as a long-term SOV O&M base. In addition, another port facility off Seaview Avenue just north of Barnum Landing could be used for Phase 1 or Phase 2, if the necessary upgrades are made by the owner/lessor.

7.7.1.3.2 New London County

The Proponent may use port facilities at New London State Pier in Washington County.

New London Harbor

The City of New London occupies 14.2 km^2 (3,519 acres) of land situate along the Thames River and Long Island Sound. New London Harbor, separating the City of New London from the Town of Groton to the east, is one of Connecticut's three deep-water ports.

The City of New London has approximately 30.5 km (19 mi) of coastline along Long Island Sound and the Thames River, and its coastline features tidal and freshwater wetlands, beaches, and rocky shorefronts (City of New London 2017). The majority of New London's downtown waterfront is developed and consists of water-dependent uses including piers, docks, marinas, port facilities, shipyards, and ferry terminals. The City of New London owns and leases facilities to passenger ferry service operators on the New London side of the port.

The USACE maintains an FNP in New London Harbor as well as the Thames River Navigation Project upstream of the Harbor. The Thames River Navigation Project consists of a channel dredged to -7.5 m (-25 ft) MLLW extending about 16.9 km (10.5 mi) from the area east of Mamacoke Cove in New London to the Town of Norwich, Connecticut at the mouth of the Shetucket River. The channel is 76.2 m (250 ft) wide from Mamacoke Cove to Bartlett Crossover, approximately 6.4 km (4 mi) upstream of the New London Highway Bridge. The channel narrows to 61 m (200 ft) wide from Bartlett Crossover to Norwich, Connecticut. In 1980, the Department of the Navy deepened the channel north of the Interstate 95 bridge to US Naval Submarine Base in Groton to -11 m (-36 ft) MLLW.

Within New London Harbor the USACE maintain a 152.4 m (500 ft) wide channel dredged to -12.2 m. (40 ft) MLLW extending approximately 4.8 km (3 mi.) from the New London Ledge Light in Long Island Sound to a widened approach at the State Pier. A 122 m (400 ft) wide channel, dredged to -7 m (-23 ft) MLLW provides access from the main navigation channel to Shaw's Cove, the downtown New London waterfront, and the westerly portions of the State Pier. The USCG Academy, General Dynamics Electric Boat shipyard and the US Navy's submarine base in Groton have facilities along the Thames River at New London and utilize the same navigation channels as commercial vessels and ferries.

The Port of New London includes two 305 m (1,000 ft) long cargo piers, the Admiral Harold E. Shear State Pier ("State Pier") and the Central Vermont Railroad Pier which are located approximately 6.1 km (3.8 mi) from Long Island Sound via the main navigational channel. The State Pier will be redeveloped for offshore wind through a private-public partnership between the Connecticut Port Authority, Eversource, and Ørsted. The approximately 0.12 km^2 (30 acre) site has no air draft restrictions, direct access to the federally maintained deep-water channel, and access to rail and highway. The Proponent may use the state-owned State Pier for Phase 1 or Phase 2 if the site is developed and available.

7.7.1.4 New York

Port facilities in Albany County, Kings County, Rensselaer County, Richmond County, and Suffolk County in the state of New York may be used for each Phase of New England Wind.

7.7.1.4.1 Albany County

The Proponent may use port facilities at the Port of Albany and/or Coeymans in Albany County.

The Hudson River FNP authorizes a channel 121.9 m (400 ft) wide through Albany County to just south of the Mall Bridge (Dunn Memorial Bridge) in the City of Albany, with a turning basin at Albany. The channel and turning basin are authorized to depths of -9.8 m (-32 ft) in soft material and 10.4 m (-34 ft) in rock. North of the Mall Bridge the Hudson River FNP is authorized to -4.3 m (-14 ft) deep and generally 121.9 m (400 ft) wide, to the Federal Lock at the City of Troy; and thence -4.3 m (-14 ft) deep and 61 m (200 ft) wide, to the southern limit of the State Barge Canal at the Town of Waterford (Saratoga County). The Hudson River FNP also authorizes widening of the channel at bends in the Hudson River, generally, and in front of the cities of Troy and Albany to form harbors with depth to -3.7 m (-12 ft). The total length of the Hudson River FNP, from New York City to the Town of Waterford, is approximately 249 km (155 mi).

The Port of Coeymans is an existing 1.63 km^2 (400 acre) privately-owned marine terminal on the Hudson River, located approximately 18.5 km (11.5 mi) south of Albany. It is a heavily industrialized waterfront terminal that is used for large-scale construction projects and bulk commodities, break-bulk, heavy lift items, and containers. Phase 1 or Phase 2 may use the Port of Coeymans if the necessary upgrades are made by the owner/lessor.

The Port has 1,006 m (3,300 ft) of waterfront that can accommodate vessels up to 228.5 m (750 ft) and a has a dockside draft of -9.14 m (-30 ft). Vessels access the Port of Coeymans from the Hudson River FNP. Vessels are anticipated to berth at the site's heavy load wharf along the north shoreline of the site in parallel to the Hudson River FNP. The berthing area is to be dredged to match the authorized depth of the Hudson River FNP.

Lafarge North America also operates vessel berthing facilities that serve the Lafarge Holcim Ravenna cement plant. The Lafarge berthing facilities are located approximately 609.6 m (2,000 ft) to the north of the Port of Coeymans.

Approximately 21.7 km (13.5 mi) north of the Port of Coeymans, the Albany Port District Commission is proposing to expand the Port of Albany by developing approximately 0.33 km^2 (81.5 acres) of riverfront property on Beacon Island in Glenmont, New York that could be used as a staging area for offshore wind farm components. The Beacon Island site is currently undeveloped former industrial land.

At the Beacon Island site, the Port District Commission is proposing to construct an industrial park with warehouse space and laydown area and a bulkhead along Hudson River for on and offloading of equipment and materials. The facility could be accessed from the Hudson River FNP but currently there is not sufficient infrastructure to support marine industrial uses from the Beacon Island site. Phase 1 or Phase 2 of New England Wind may use the facility if that infrastructure is developed by Albany Port District Commission.

7.7.1.4.2 Kings County

The Proponent may use port facilities at the South Brooklyn Marine Terminal and/or GMD Shipyard in Kings County.

Phase 1 or Phase 2 of New England Wind may use the South Brooklyn Marine Terminal. The approximately 0.26 km^2 (65 acre) South Brooklyn Marine Terminal has two piers with 1,950 m (6,400 ft) of water frontage on the Upper Bay of New York Harbor. The port is proposed to be upgraded to support staging, installation, and maintenance of offshore wind farms (Kassel 2020).

The Terminal, which is located along the Bay Ridge Channel, in the Sunset Park industrial district of Brooklyn, in the Port of New York and New Jersey. The Bay Ridge Channel is authorized to a depth of -12.2 m (-40 ft) MLLW and is accessed from the Anchorage Channel at The Narrows. Berthing areas at the terminal are dredged to -10.7 m (35 ft).

The existing site hosts multiple parking lots, utility buildings, warehouses, and an operational railroad. The waterfront part of the site is protected by steel sheet pile bulkhead and revetment. Although the Terminal is located in a heavily industrialized waterfront area, there are residential and commercial uses nearby.

Phase 1 or Phase 2 of New England Wind may use the GMD Shipyard, a full-service shipyard located within the Brooklyn Navy Yard on the East River. The shipyard, approximately 335 m (1,100 ft) of wet berth, and numerous cranes. Vessels access the GMD Shipyard through the East River Channel, which is dredged to -12.2 m (-40 ft) MLLW.

7.7.1.4.3 Rensselaer County

The Proponent may use the New York Offshore Wind Port in Rensselaer County.

The New York Offshore Wind Port in East Greenbush, New York is being proposed for development to support the needs of the offshore wind industry. The site consists of approximately 0.45 km^2 (112 acres) with over 1,188 m (3,900 ft) of riverfront (NYoffshorewind 2019). The facility could be accessed from the Hudson River FNP, but, currently, there isn't sufficient infrastructure to support marine industrial uses at the site. Phase 1 or Phase 2 of New England Wind may use the facility if that infrastructure is developed by the owner/lessor.

7.7.1.4.4 Richmond County

The Proponent may use port facilities at Arthur Kill and/or Homeport Pier in Richmond County.

The proposed Arthur Kill Terminal is a greenfield site on Staten Island that would be developed into an over 0.13 km^2 (32 acre) port facility designed for the staging and assembly of offshore wind farm components. The proposed facility would have a 396 m (1,300 ft) quayside and a warehouse for equipment and spare part storage (Atlantic Offshore Terminals 2020). Phase 1 or Phase 2 of New England Wind may use the terminal if that infrastructure is developed others.

The Terminal could be accessed from the New York and New Jersey Channels of the Arthur Kill, but, currently, there isn't sufficient infrastructure to support marine industrial uses from the Site. The Arthur Kill Terminal site is presently undeveloped land located south of the Outerbridge Crossing. Surrounding land uses are highly developed, including low-density commercial uses and marine industrial facilities, both active and disused.

The New York and New Jersey Channels of the Arthur Kill are federally authorized to a depth of -10.7 m (-35 ft) MLLW. Vessels entering Arthur Kill do so from Raritan Bay. The USCG operates a mandatory Vessel Traffic Services system in New York Bay, including the waters of Raritan Bay. Under normal conditions, Vessel Traffic Services New York will manage traffic by informing mariners of traffic to expect along their intended transit and monitoring passing arrangements between vessels to ensure they are occurring, and can continue to occur, as intended (USCG 2019). The Arthur Kill is mainly an industrial area and there is not a large volume of recreational traffic (USCG 2016).

Homeport Pier is located on Staten Island just north of the Verrazano-Narrows Bridge and is the former site of a 0.14 km^2 (35 acre) Naval Base with a 430 m (1,410 ft) pier. New York City Economic Development Corporation has requested expressions of interest from parties interested in developing the facility for the offshore wind industry (Waterwire 2019). Phase 1 or Phase 2 of New England Wind may use this facility if it is developed by others and available to meet the schedule and project needs.

Vessels access Homeport Pier from Lower New York Bay via the Ambrose Federal Navigation Channel, passing under the Verrazano-Narrows Bridge and into the "The Narrows" of New York Harbor. The Ambrose Channel connects to the Anchorage Channel at the Narrows which, in turn, connects to channels leading to vessel terminals within the Port of New York. The Anchorage Channel is authorized to a depth of -15.2 m (-50 ft) MLLW. A designated anchorage area is located between the Pier and the Anchorage Channel.

7.7.1.4.5 Suffolk County

The Proponent may use port facilities at Shoreham or Greenport Harbor in Suffolk County. Greenport Harbor is not expected to be used for construction activities but may be used for O&M activities.

The 2.8 km^2 (700 acre) site of the decommissioned Shoreham Nuclear Power Plant has been identified by the New York State Energy Research and Development Authority as a potential site for offshore wind port facilities. The site, located adjacent to Long Island Sound on Long Island, would require significant investment and upgrades because the facility is not currently a functioning waterfront terminal. The site would only be used by Phase 1 or Phase 2 if such improvements were made by the owner/lessor.

According to the New York State Energy Research and Development Authority (2017), an inlet and jetties were constructed to facilitate the construction and operation of the Shoreham Nuclear Plant. The entrance channel would have to be deepened and straightened to provide suitable access for most vessel expected to be used for construction and installation activities. Significant upgrades and potential environmental remediation would be required to develop this facility for offshore wind purposes. Adjacent to the inlet to the north is a creek and marshlands; residential properties occupy the land to the south and west of the inlet.

Greenport Harbor, located on the tip of Long Island, is home to numerous commercial docks that could be rented to offshore wind developers and used for provisioning, crew changes, weather standby, repairs, equipment change, and possibly fuel and water delivery.

7.7.1.5 New Jersey

Port facilities in Gloucester County in the state of New Jersey may be used for each Phase of New England Wind.

7.7.1.5.1 Gloucester County

The Proponent may use port facilities at Paulsboro in Gloucester County.

The Paulsboro Marine Terminal, located on the Delaware River at the site of a former British Petroleum oil terminal, may become the site of a monopile foundation factory (Stromsta 2019). Thus, Phases 1 or 2 may use port facilities in the vicinity of the proposed factory if those facilities were developed by the owner/lessor in time for Phase 1 or Phase 2. The Paulsboro Marine Terminal opened several years ago and is operated by the South Jersey Port Corporation.

Although still under construction, at full buildout, the terminal may feature three berths on the Delaware River and a barge berth on Mantua Creek (South Jersey Port Corporation 2020). The site is accessed from the Delaware River main navigation channel, which is currently being dredged to -13.7 m (-45 ft) MLLW.

7.7.2 Potential Impacts of New England Wind

Potential impacts to lane use and coastal infrastructure are most closely related to New England Wind offshore and onshore development as a whole; therefore, this assessment considers the full buildout of Phases 1 and 2 of New England Wind. The potential impact producing factors are presented in Table 7.7-1.

Table 7.7-1 Impact Producing Factors for Land Use and Coastal Infrastructure

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Onshore traffic			•	•	•	•
Land disturbance			•	•	•	•
Port utilization	•	•		•	•	•

7.7.2.1 Construction and Installation

New England Wind components will be installed in onshore and offshore environments. Existing land uses and coastal infrastructure may experience temporary, short-term impacts during the construction and installation of New England Wind.

7.7.2.1.1 Impacts to Land Use (Phases 1 and 2)

As described in Section 1.3 of COP Volume I, New England Wind will be constructed in two Phases. Each Phase of New England Wind will have a separate onshore transmission system but both Phases will connect to the ISO New England electric grid at the same grid interconnection point at the West Barnstable Substation.

For Phase 1, the potential landfall sites, Onshore Export Cable Routes, onshore substation site, and Grid Interconnection Routes within the Phase 1 Onshore Development Area are illustrated in Figure 3.2-11 of COP Volume I and described in Section 3.2.2 of COP Volume I. For Phase 2, the potential landfall sites, Onshore Export Cable Routes, onshore substation sites, and Grid Interconnection Routes within the Phase 2 Onshore Development Area are illustrated in Figure 4.1-2 and described in Section 4.2.2 of COP Volume I.

Landfall Sites

The Phase 1 offshore export cables will transition onshore via horizontal directional drilling at one of two potential Phase 1 landfall sites in the Town of Barnstable described in Section 3.2.2.1 of COP Volume I.

The Phase 1 Craigville Public Beach Landfall Site is located within a 0.014 km^2 (3.5 acre) paved parking area associated with a public beach that is owned and managed by the Town of Barnstable. The landfall site is situated in the central part of the Centerville Harbor bight in an area where the shoreline is relatively stable. Adjoining land uses include homes along the north side of Craigville Beach Road, a private beach club (Craigville Beach Club) and associated parking to the west, a private bathhouse and parking to the east (owned by the nearby Christian Campground), and some open space. The area is most heavily used during the summer season.

Alternatively, the Phase 1 landfall site may be located at Covell's Beach (the landfall site used for Vineyard Wind 1), which is approximately 0.6 km (0.4 mi) east of Craigville Public Beach. The Covell's Beach Landfall Site is situated in a paved parking area associated with Covell's Beach, a residents-only public beach that is owned and managed by the Town of Barnstable. Ultimately, a single landfall site will be used for Phase 1.

The Proponent will restore the Phase 1 horizontal directional drilling staging area to match existing conditions. Any paved areas that have been disturbed will be properly repaved. Additionally, activities at the landfall site where transmission will transition from offshore to onshore are not expected to be performed from June through September unless authorized by the Town of Barnstable.

Unless technical or grid interconnection issues arise, all Phase 2 offshore export cable(s) will come ashore at one or both of the following landfall sites in the Town of Barnstable as described in Section 4.2.2.1 in COP Volume I.

The Phase 2 Dowses Beach Landfall Site is located within a 0.01 km^2 (2.5 acre) paved parking area at Dowses Beach, which is a residents-only beach that is owned and managed by the Town of Barnstable. Dowses Beach is situated on a peninsula between East Bay and the Centerville Harbor. Existing uses in and around the landfall site include recreational use of the beach area, seasonal residential use, and recreational boating in the East Bay Area to the northwest of the Dowses Beach. At Dowses Beach, the offshore export cables' ocean-to-land transition will be made using HDD. From Dowses Beach, the onshore export cables would either continue beneath public roadway layouts or, using a trenchless crossing, travel beneath East Bay to one of two potential locations on East Bay Road (see Figure 4.1-2 of COP Volume I). The Dowses Beach Landfall Site has adequate space for an HDD/trenchless crossing staging area and favorable route options to the onshore substation sites.

Alternatively, the Phase 2 offshore export cable(s) may make landfall at a 462 m^2 (4,970 ft2) paved parking area where Wianno Avenue turns and becomes Sea View Avenue. As described further in Section 4.3.1.8.2 in COP Volume I, the Wianno Avenue Landfall Site is less suited for HDD than open-trenching due to the elevated onshore topography and slope of the parking lot. This landfall site is suitable for open-trenching because the shoreline has already been altered by the installation of a riprap seawall, a portion of which would be temporarily removed and replaced following cable installation. The Proponent only expects to use the Wianno Avenue Beach Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all or some of the Phase 2 offshore export cables.

Construction and installation at the Phase 1 and Phase 2 landfall sites may require construction staging locations, which may temporarily affect parking and access to facilities in the immediate vicinity of the operation. Impacts are expected to be short-term, as activities at the landfall sites may be completed within a matter of months. Construction activities will be sequenced to avoid the summer season, as further described in Section 7.7.2.1.3 below.

Onshore Export Cable Routes and Grid Interconnection Routes

The Phase 1 and Phase 2 onshore export cables and grid interconnection cables will primarily be installed within public roadway layouts or utility rights-of-way. The Phase 1 and Phase 2 onshore export cables and grid interconnection cables will be installed within an underground duct bank, except for possibly at the Phase 1 Centerville River crossing as described in Section 3.3.1.10.2 of COP Volume I.

The Phase 1 onshore export cables will follow one of two potential Onshore Export Cable Routes (with variants) from the Craigville Public Beach Landfall Site or Covell's Beach Landfall Site to the Phase 1 onshore substation site:

- Shootflying Hill Road Onshore Export Cable Route
- Oak Street Onshore Export Cable Route

The Phase 1 Onshore Export Cable Routes are approximately 6.5 to 10.5 km (4 to 6.5 mi) in length. These routes are shown on Figure 3.2-11 of COP Volume I and described in Section 3.2.2.2 of COP Volume I.

From the onshore substation, the onshore grid interconnection cables will follow one of two potential Grid Interconnection Routes (with variants) to the existing West Barnstable Substation:

- ROW #343 to #381 Grid Interconnection Route
- In-Road Grid Interconnection Route

The Grid Interconnection Route will be 0.9 to 2.9 km (0.6 to 1.8 mi) long. These routes are shown on Figure 3.2-11 of COP Volume I.

The Phase 2 onshore export cables and grid interconnection cables will be installed underground along any of the potential Onshore Export Cable Routes and Grid Interconnection Routes identified in Figure 4.1-2 of COP Volume I and described in Section 4.2.2.2 of COP Volume I.

Cable installation activities along the Phase 1 and Phase 2 Onshore Export Cable Routes and Grid Interconnection Routes may temporarily disturb neighboring land uses through construction noise, vibration, and dust. Onshore export cable installation activities may also impact traffic on roads within the vicinity of the Phase 1 and Phase 2 Onshore Export Cable Routes. Impacts are expected to be short-term and limited to discrete areas, as onshore export installation at any one location along a public road may be completed within a matter of days. Construction activities will be sequenced to avoid the highest traffic periods, as further described in Section 7.7.2.1.3 below.

Overall, installation of the onshore export cables and grid interconnection cables is expected to be completed without significant permanent alteration to any land use or existing infrastructure upon completion of construction and installation. All disturbed areas will be restored upon completion of construction.

Onshore Substations and Grid Interconnection at West Barnstable Substation

The Proponent will construct onshore substations in the Town of Barnstable that are in proximity to the Onshore Export Cable Routes and/or the West Barnstable Substation. The potential substation sites that are under consideration are summarized here and further described in Section 3.2.2.3 and Section 4.2.2.3 of COP Volume I.

The Phase 1 onshore substation will be constructed on a 0.027 km^2 (6.7 acre) privately-owned parcel located at 8 Shootflying Hill Road (see Figure 3.2-11 of COP Volume I). The 8 Shootflying Hill Road onshore substation site is southwest of the Route 6-Route 132 highway interchange, located approximately 1.3 km (0.8 mi) east of the West Barnstable Substation. The onshore substation site has frontage on Shootflying Hill Road and direct access to ROW #343. The northern part of the site currently contains a motel building, while the southern part consists of wooded land. The onshore substation site is in a residentially zoned area and is bordered to the west by residential parcels, to the north by Shootflying Hill Road, to the east by land owned by the Chamber of Commerce and MassDOT, and to the south by ROW #343. The Phase 1 onshore substation site was selected, in part, because existing land uses are compatible with the proposed onshore substation and there will be no impacts to coastal infrastructure.

The Proponent plans to plant a vegetated screening on the western and northern boundaries of the onshore substation site; the vegetated screening along the western edge would provide visual screening for existing residences. The eastern boundary may be utilized for part of the perimeter access drive, and the abutting land is undeveloped wooded land. Since the southern property line extends into ROW #343, no vegetated screening will be possible in that location. Substation construction may require initial clearing of the entire site, but revegetation along the onshore substation site boundaries would occur outside of the substation boundary/screening wall. The entire site will have a perimeter access fence, and the westerly side may have a sound attenuation wall, if necessary.

The Proponent has secured an option to purchase a 0.004 km^2 (1 acre) parcel at 6 Shootflying Hill Road, which is located immediately northeast of the proposed substation site at 8 Shootflying Hill Road (see Figure 3.2-11 of COP Volume I). Assuming that the Proponent is able to acquire the property, the Proponent will use 6 Shootflying Hill Road for an improved access road to the onshore substation site in lieu of an access road from the northeast corner of 8 Shootflying Hill Road. The access road on 6 Shootflying Hill Road will allow for a wider turning radius into the substation site from Shootflying Hill Road (improving access for construction vehicles, emergency vehicles, and heavy equipment transport) and locates this vehicular traffic further from residential abutters west of the substation. The improved access road also allows site elevations to be reduced by up to 3 m (10 ft), which will reduce or eliminate the need to import fill onto the site and may generate material to be exported from the site.

In addition, the Proponent has secured an approximately 0.011 km^2 (2.8 acre) parcel of land, assessor map parcel #214-001 ("Parcel #214-001"), located immediately southeast of the West Barnstable Substation (see Figure 3.2-11 of COP Volume I). Parcel #214-001 is entirely forested and is surrounded by Route 6 to the south, Eversource's West Barnstable Substation property to the west and north, and undeveloped land to the east; there are no residences or other sensitive receptors in proximity to the parcel.

Outdoor lighting at the onshore substation site, 6 Shootflying Hill Road, and Parcel #214-001 will typically be equipped with light shields to prevent light from encroaching into adjacent areas. There are typically a few lights illuminated for security reasons on dusk–to-dawn sensors as well as a few on motion-sensing switches, depending on the application needed for the site. The majority of lights will be used for emergency situations only. The Proponent will work closely with the Town of Barnstable to ensure the lighting scheme complies with Town requirements.

The Phase 2 onshore export cables will connect to one new onshore substation in the Town of Barnstable. The Clay Hill Site generally meets the siting considerations for the proposed substation and, importantly, the Proponent was able to secure an option to purchase the parcels and thus has site control. Therefore, the Clay Hill Site is the proposed substation site for Phase 2. Aside from a single residence, the Clay Hill Site is not located near other residences or businesses and is surrounded by undeveloped forested land and Route 6. To the west, the Site is bordered by undeveloped land. To the north, the Site is bordered by the existing Eversource utility ROW #342 and two protected parcels that are part of the Spruce Pond Conservation Area owned by the Town of Barnstable and managed by the Conservation Commission and Falcon Road Conservation Area. To the south is the Route 6 layout managed by MassDOT. The Clay Hill Site is located approximately 0.25 miles west of the existing West Barnstable Substation. The Phase 2 onshore substation site was selected, in part, because existing land uses are compatible with the proposed onshore substation and there will be no impacts to coastal infrastructure.

7.7.2.1.2 Impacts to Coastal Infrastructure (Phases 1 and 2)

During construction and installation, the Proponent may use ports in Massachusetts, Rhode Island, Connecticut, New York, and/or New Jersey. The construction and installation process will make use of existing or planned port facilities. The Proponent will not implement any port improvements that may be made.

The Proponent is identifying a wide range of ports that could be used for each Phase because numerous entities have publicized plans to develop or upgrade port facilities to support offshore wind construction in the time frame of Phase 1 or Phase 2. The Proponent also anticipates an increased demand for ports by other northeast offshore wind developers in the timeframe of Phase 1 or Phase 2 construction. These factors lead to uncertainty regarding which ports may be available under the Phase 1 schedule. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final commercial agreements and construction logistics planning. By identifying a wide range of ports, the Proponent expects to avoid or minimize any potential conflicts over port usage with other northeast offshore wind developers.

During construction, vessel operations may increase in the areas surrounding the potential ports, navigational channels, inshore traffic zones, and any traffic separation scheme along the selected route to the SWDA. Impacts to marine navigation are described in Section 7.8.

7.7.2.1.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Proponent's onshore construction schedule minimizes impacts to land uses to the greatest extent practicable by limiting onshore construction activities during peak summer months and other times when demands on these resources are elevated. For Phase 1 and Phase 2, the Proponent will adhere to the general summer limitations on construction activities on Cape Cod. Activities at the landfall site where transmission will transition from offshore to onshore are not expected to be performed during the months of June through September unless authorized by the Town of Barnstable. Activities along the Onshore Export Cable Route and Grid Interconnection Route (particularly where the route follows public roadway layouts) will also likely be subject to construction limitations from Memorial Day through Labor Day unless authorized by Barnstable but could extend through June 15 subject to consent from the Department of Public Works. The Proponent will consult with the Town of Barnstable regarding the construction schedule for both Phase 1 and Phase 2.

Prior to construction, the Proponent will work closely with the Town of Barnstable to develop a Traffic Management Plan (TMP) for construction for each Phase. The TMP will be submitted for review and approval by appropriate municipal authorities (typically Department of Public Works/Town Engineer and Police). The TMP will be a living document such that any unanticipated change in construction location, timing, or method previously identified will result in revision of the TMP and approval by the appropriate authorities before any construction changes are implemented. The Proponent will utilize various methods of public outreach prior to and during construction to keep residents, business owners, and officials updated on the construction schedules, vehicular access, lane closures, detours, and other traffic management information, local parking availability, emergency vehicle access, construction crew movement and parking, laydown areas, staging, and equipment delivery, nighttime or weekend construction, and road repaving.

7.7.2.2 Operations and Maintenance

Impacts associated with operations and maintenance of New England Wind are not anticipated to have adverse effects on the surrounding communities and will not disrupt the communities' routine functions. Most of the systems for New England Wind will be monitored remotely. The intended O&M facilities for New England Wind are within areas of compatible water-dependent uses, ranging from commercial and retail marine operations to heavy marine-industrial uses. As with construction, other ports that may be used for O&M are expected to be existing ports or ports developed by others to support offshore wind.

7.7.2.2.1 Impacts to Land Use (Phases 1 and 2)

Periodic maintenance or repair of O&M facilities, onshore export and grid interconnection cables, and other onshore facilities may be necessary over the anticipated life of New England Wind. The Phase 1 and Phase 2 onshore facilities will be primarily monitored and controlled remotely. In the event monitors determine repair work is necessary, a crew would be dispatched to the identified location to complete repairs and restore normal operations. Repairs typically involve work on the onshore export cables and grid interconnection cables, which are accessed through manholes at installed splice vaults. As a result, repairs can be completed within the installed transmission infrastructure without impacting surrounding land uses or coastal infrastructure. Likewise, repairs needed at the substation sites for either Phase are expected to typically occur within the fenced perimeter of the substation, without impacting surrounding land uses or coastal infrastructure.

Aside from temporary disturbance that may result in the unexpected case of a repair, O&M will have no impacts on land use at the landfall sites or along the Onshore Export Cable Routes and Grid Interconnection Routes, as most New England Wind components in these locations will be buried.

In addition, the Proponent is designing its proposed onshore substations in a manner that will avoid and minimize impacts to adjacent land uses. For the Phase 1 substation, the Proponent plans to plant a vegetated screening on the western and northern boundaries of the onshore substation site; the vegetated screening along the western edge would provide visual screening for existing residences. The entire site will have a perimeter access fence, and the westerly side may have a sound attenuation wall, if necessary. For Phase 2, views of the Clay Hill onshore substation site are limited and represent a de minimis alteration to the existing visual character of the local landscape. Lower height electrical equipment and buildings associated with the substation will not be directly visible from any off-site vantage point. In areas where lightning masts are predicted to be visible; the lightning masts will be low within the intervening tree line. Land and tree clearing will be minimized to the extent practicable and an existing forested buffer around the substation will be maintained for visual screening.

7.7.2.2.2 Impacts to Coastal Infrastructure (Phases 1 and 2)

Similar to construction, the Proponent may use ports in Massachusetts, Rhode Island, Connecticut, New York, and/or New Jersey.

For Phase 1, the Proponent will likely establish a long-term SOV O&M base in Bridgeport, Connecticut. In addition to the SOV O&M base, the Proponent has worked with its local partner, Vineyard Power, and the communities of Martha's Vineyard with the intention to base certain O&M activities on Martha's Vineyard. Current plans anticipate that crew transfer vessels (CTVs) and/or SOV's daughter craft may operate out of Vineyard Haven and/or New Bedford Harbor during O&M. Although the Proponent plans to operate Phase 1 O&M facilities in Bridgeport, New Bedford Harbor, and/or Vineyard Haven, the Proponent may use other ports described above to support O&M activities. In support of O&M activities for Phase 2, the Proponent will likely use O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor. Similar to Phase 1, the Proponent may also use other ports described above to support O&M activities for Phase 2. For both Phases, some activities such as refueling, restocking supplies, sourcing parts for repairs, vessel repairs, vessel mobilization/demobilization, and potentially some crew transfer (activities well within the realm of normal port activities) may occur out of ports other than those listed above.

During O&M, vessel operations are not anticipated to impact the areas surrounding the potential ports, navigational channels, inshore traffic zones, and any traffic separation scheme along the selected route to the SWDA. Impacts to marine navigation are described in Section 7.8.

7.7.2.2.3 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The Proponent will utilize vegetated screening, perimeter fencing, and a sound attenuation wall (if required) at the Phase 1 substation site and, if needed, at the Phase 2 substation site. Impacts associated with scheduled periodic onshore maintenance activities O&M are expected to only require temporary disturbance to limited areas.

7.7.2.3 Decommissioning

As currently envisioned, decommissioning of New England Wind is largely the reverse of the construction and installation process as described in COP Volume I. It is anticipated that equipment, vessel, and personal requirements for decommissioning will be similar to those utilized during construction and installation. The splice vaults, duct bank, and onshore substations may remain as valuable infrastructure that could be available for future offshore wind or other projects. The O&M facilities can be easily repurposed for continued use by the Proponent or another site operator. Additionally, vessel operations will increase in the area surrounding the potential ports. Impacts to land use and coastal infrastructure from decommissioning are expected to be generally similar to the impacts experienced during construction and installation.

7.8 Navigation and Vessel Traffic

This section describes New England Wind activities that may affect navigation and vessel traffic within the Offshore Development Region. With respect to navigation and vessel traffic, the Offshore Development Region is the broader offshore geographic region surrounding Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]), the corridor identified for routing the offshore export cables (referred to as the Offshore Export Cable Corridor [OECC]), and ports that could be affected by New England Wind-related activities. This includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), and waters surrounding potential vessel routes to the ports identified for use by New England Wind.

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the option to install one or two Phase 2 cables[127] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[128] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

A detailed Navigation Safety Risk Assessment (NSRA) for New England Wind is included as Appendix III-I. The NSRA conforms to United States Coast Guard (USCG) guidance for Offshore Renewable Energy Installations contained in Navigation Vessel Inspection Circular 01-19.

7.8.1 Description of the Affected Environment

New England Wind construction, operations and maintenance (O&M), and decommissioning activities may impact vessels navigating to and from ports in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey and in the vicinity of the SWDA and OECC.[129] This section

[127] It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

[128] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

[129] Although some components, materials, and vessels could come from Canadian and European ports (see Sections 3.2.2.5 and 4.2.2.5 of COP Volume I), impacts to vessel traffic and navigation are only assessed for New England Wind activities within United States (US) waters.

describes the maritime navigation and vessel traffic characteristics of both the broader Offshore Development Region and, more specifically, within the Offshore Development Area. The Offshore Development Area is the offshore area where the Proponent's offshore facilities are physically located, which includes the SWDA and the OECC.

7.8.1.1 Vessel Traffic

Vessels in the Offshore Development Region make use of waterways, ports, and other coastal infrastructure to move goods and passengers and are essential for the Northeast region's economy and security. A variety of vessel types operate in the Offshore Development Region, ranging from passenger cruise ships to articulated tug-barges moving liquid petroleum. Each of these vessel types operate differently and may have unique operational and navigational requirements.

Vessel traffic in the Offshore Development Region is typically quantified using Automated Identification System (AIS) and Vessel Monitoring System (VMS) data. AIS is a shipborne mobile equipment system that allows vessels to monitor marine traffic in their area and broadcast their location to other vessels with AIS equipment onboard. Although AIS data are generally only available for vessels larger than 20 meters (m) (65 feet [ft]), as they are required to have AIS transponders,[130] AIS data is the best dataset available to quantitatively analyze vessel tracks' spatial and temporal characteristics in the Offshore Development Region. AIS data can also be supplemented by VMS data collected by the National Marine Fisheries Service. VMS data are collected through a satellite monitoring system that is primarily used for monitoring the location of certain commercial fishing vessels working in United States (US) federal waters. See Section 7.6 for additional discussion of AIS and VMS data.

Based on an analysis of 2017 and 2018 AIS data in and around the Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) (together the WEAs), the highest density of vessel traffic in the Offshore Development Region occurs *outside* the WEAs and primarily within the traffic separation schemes (TSS), fairways, precautionary areas, and recommended routes, as described in Section 7.8.1.2 (Baird 2019). Most cargo, tanker, and passenger vessels transit around the WEAs along these vessel routing measures (Baird 2019). Although AIS data indicate a reasonable density of recreational vessel traffic through the WEAs across a series of northwest-to-southeast transit routes, recreational vessels (pleasure and sail vessels) primarily operate close to shore, well away from the WEAs (Baird 2019).

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[130] Federal regulations require self-propelled commercial fishing vessels greater than 20 m (65 ft) in length to operate an AIS Class B device to broadcast vessel information (see 33 CFR § 164.46). Smaller commercial vessels may be required to have AIS or operators may choose to install them.

The majority of the AIS vessel traffic through the MA WEA and RI/MA WEA is fishing vessels; however, much of the fishing vessel traffic either skirts the WEAs or intersects with perimeter areas of the WEAs (Baird 2019). The volume of traffic transiting through the middle of the WEAs is limited. There is a concentration of fishing vessel traffic along a southwest/northeast corridor near the northwestern edge of the WEAs (Baird 2019). Based on a USCG analysis of AIS data for 2015–2018, 13,000 to 46,900 vessel transits occur annually in the WEAs and surrounding region[131] (USCG 2020). Vessel traffic within the WEAs is seasonally dependent; AIS data suggest that vessel density in the WEAs quadruples during the summer months as compared to the winter months of January and February (USCG 2020).

Specific to the Offshore Development Area (i.e. the SWDA and OECC), vessel traffic was assessed for the NSRA using AIS data from 2016–2019 (inclusive) and VMS data. Based on this assessment, vessel traffic in the Offshore Development Area includes cargo vessels, tankers, passenger vessels, tugs-barges, military vessels, recreational vessels, and fishing vessels.

Within the SWDA, analyses of 2016–2019 AIS data indicate that historical vessel traffic levels are relatively low (see Appendix III-I). The vessel traffic is seasonal in nature with approximately 0.5 vessels every day on average in the winter months, increasing to a peak of 6.4 vessels per day on average in the month of August. An evaluation of vessel proximity indicates that two or more vessels are present within the SWDA simultaneously for only 124 hours per year on average (1.4% of the year). There was one short period (a few hours) in September 2016 during which up to 14 vessels were present in the SWDA.

Of the relatively low volume of vessel transits within the SWDA, the NSRA established that the most common type of vessels in the SWDA are commercial fishing vessels (either in transit or actively fishing). Table 7.8-1 summarizes the types of vessels that transited the SWDA based on 2016–2019 AIS data. Figure 7.8-1 through Figure 7.8-6 show vessel traffic density plots and/or individual historical vessel tracks for vessels that transited the SWDA based on 2016–2019 AIS data for all vessels, cargo vessels, tankers, passenger vessels, tug-barges (also referred to as towing vessels), military vessels, recreational vessels, fishing vessels (while in transit), and fishing vessels (while fishing). While a track plot provides an indication of the range of historical vessel transits, the vessel traffic density plots, which indicate the number of AIS data points ("pings") per specified area (0.01 degree grid cell) annually, better illustrate the relative volume of vessel traffic in the vicinity of the Offshore Development Area. As illustrated in Figure 7.8-1, the majority of vessels that transited the SWDA had a heading of southeast/northwest, east southeast/west northwest, or south southeast/north northwest. See the NSRA provided as Appendix III-I for a detailed description of vessel traffic within the SWDA.

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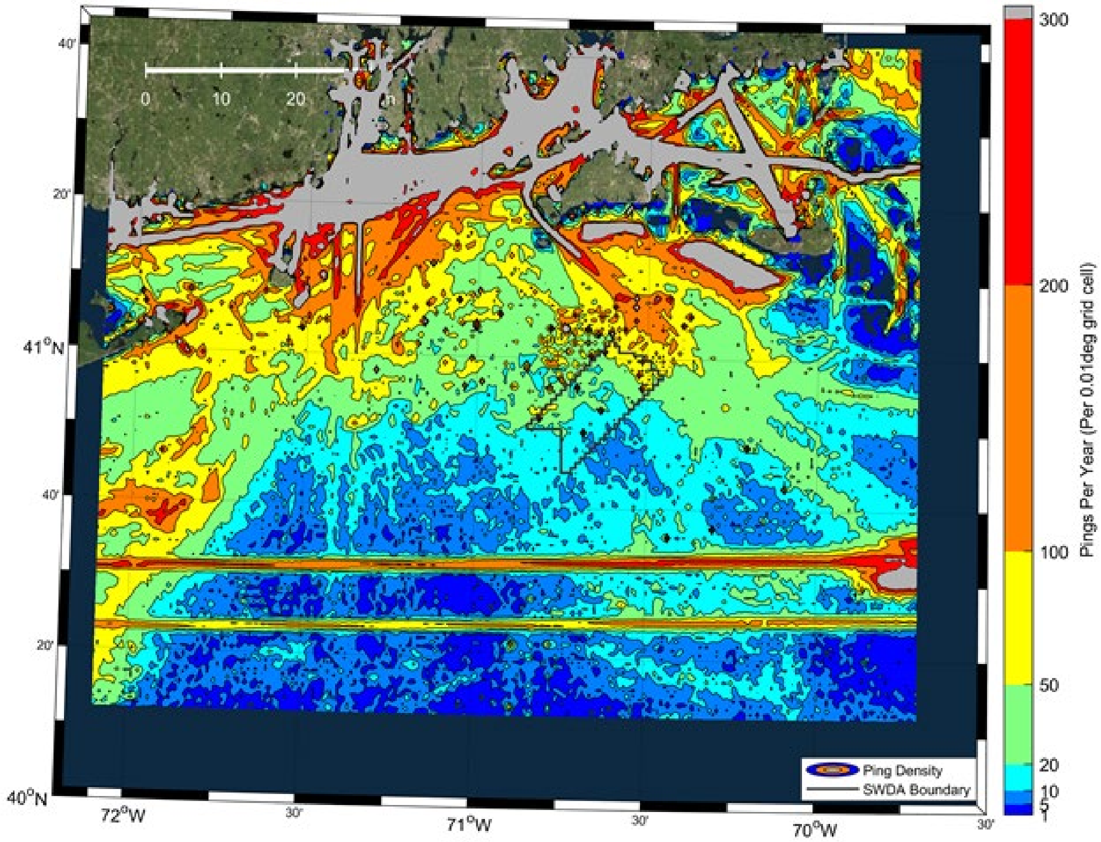
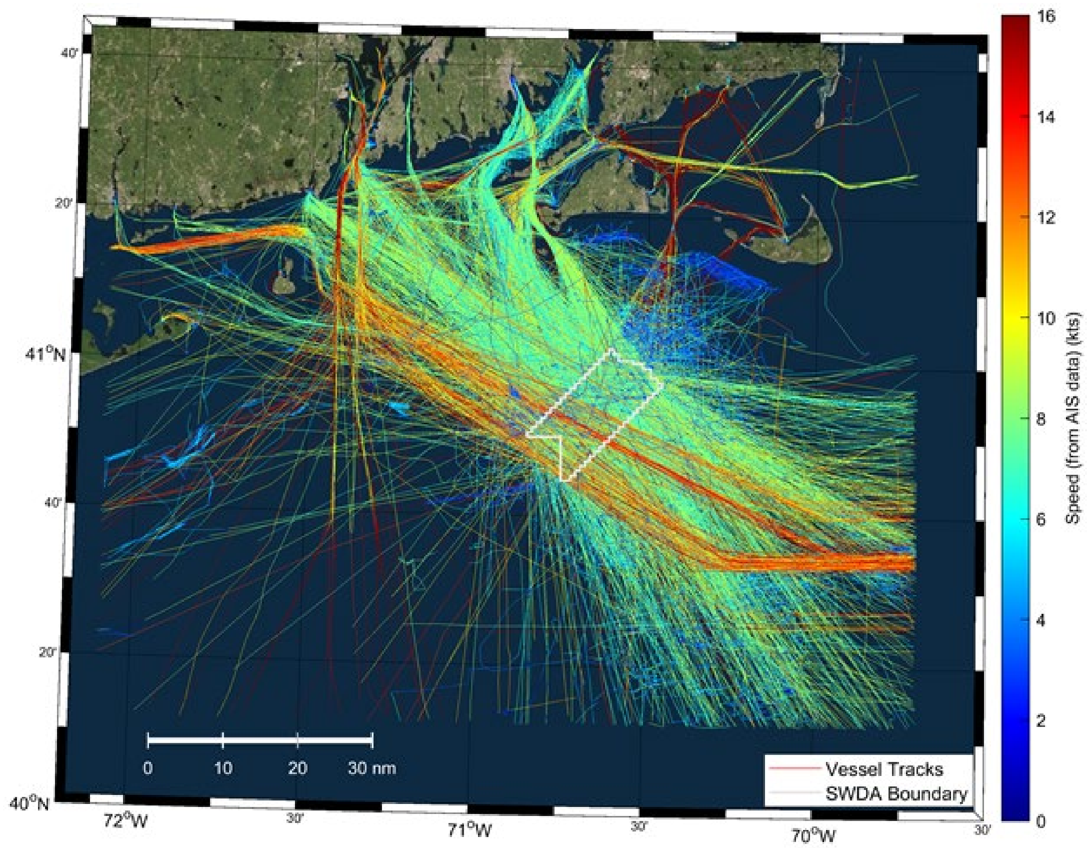
131 The USCG analysis of AIS data was conducted for the entire study area evaluated in the Massachusetts and Rhode Island Port Access Route Study (MARIPARS), which includes areas outside the MA WEA and RI/MA WEA.



AIS Vessel Traffic Density Plot – All Vessels



Vessel Tracks Through the SWDA – All Vessels

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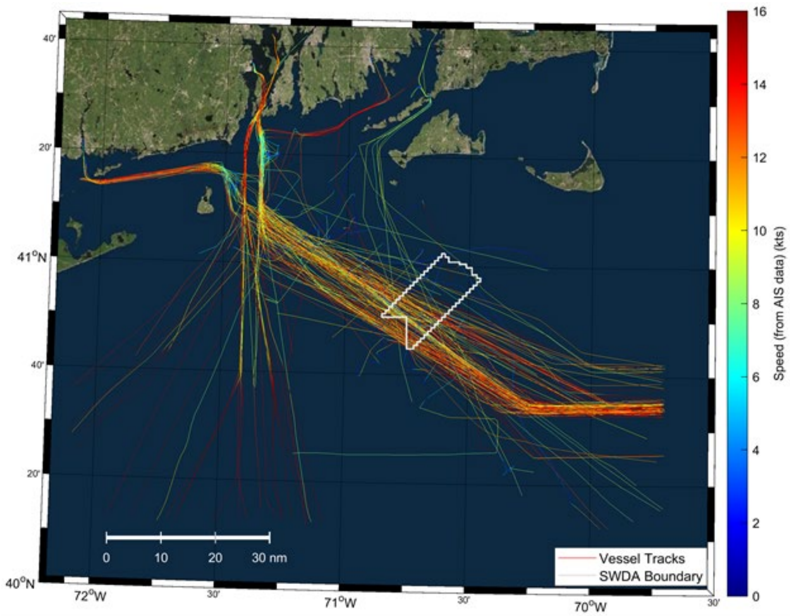
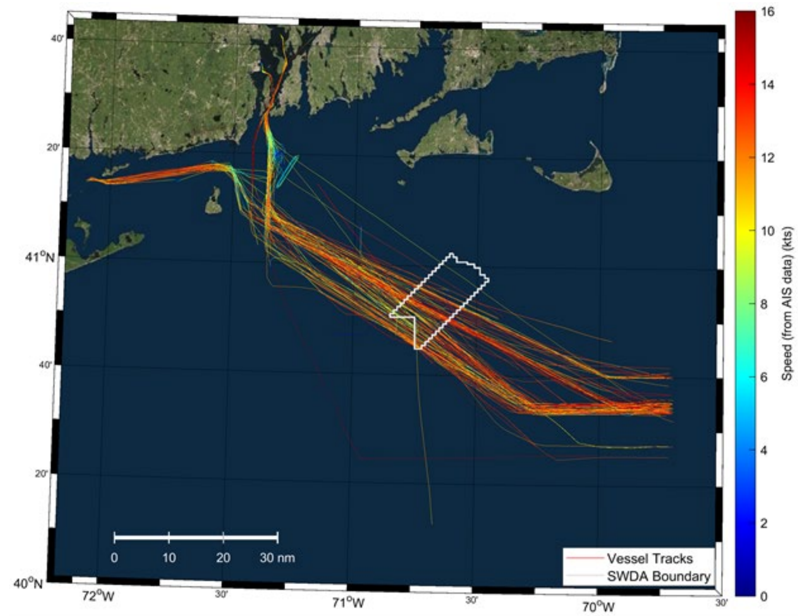
Figure 7.8-1

All Vessel Traffic in the SWDA (2016-2019)

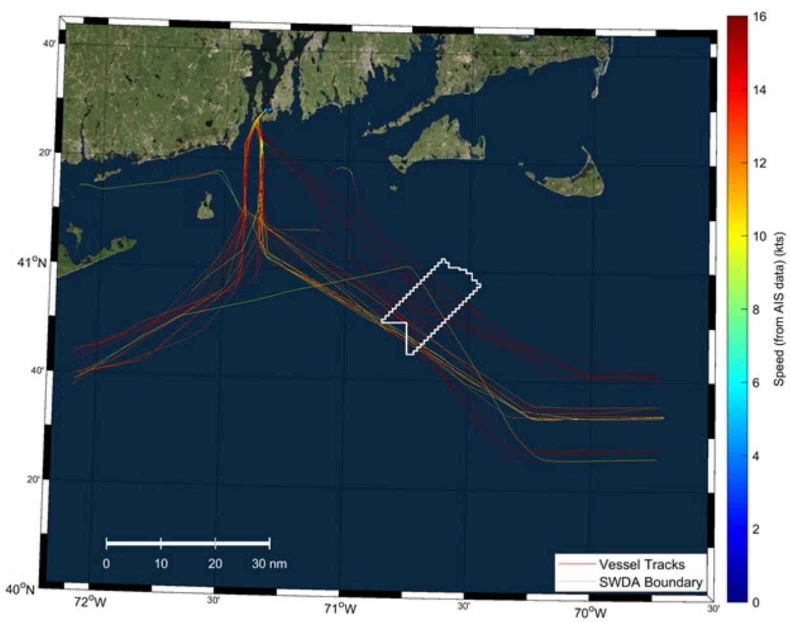
Vessel Tracks Through the SWDA – Cargo Vessels



Vessel Tracks Through the SWDA – Tanker Vessels



Vessel Tracks Through the SWDA – Passenger Vessels



Vessel Traffic Density Plot – All Vessels

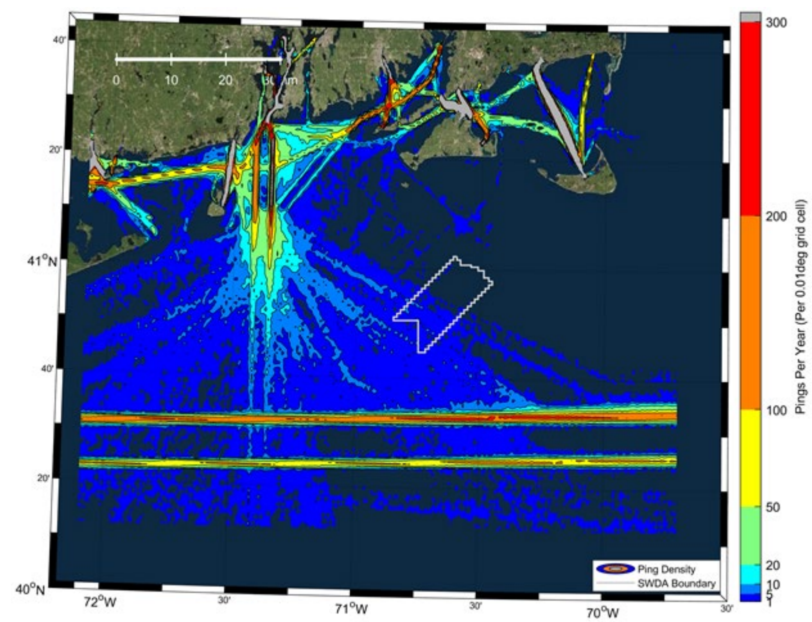


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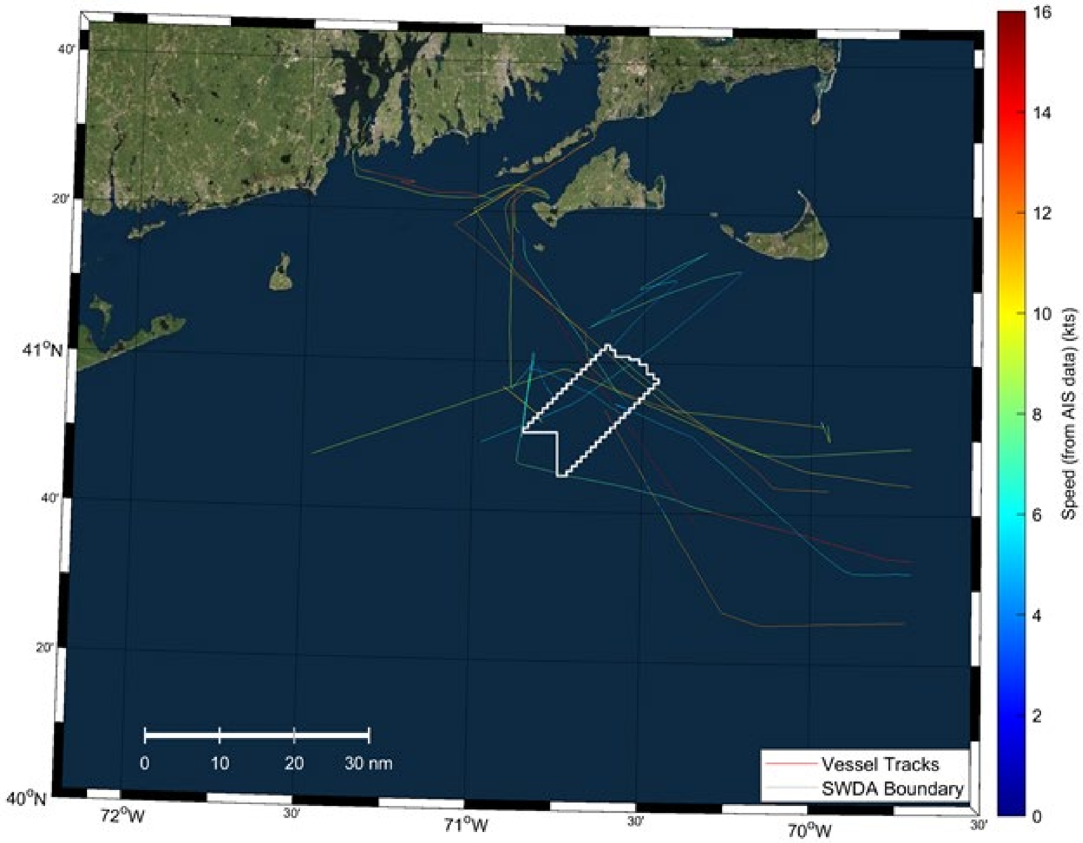
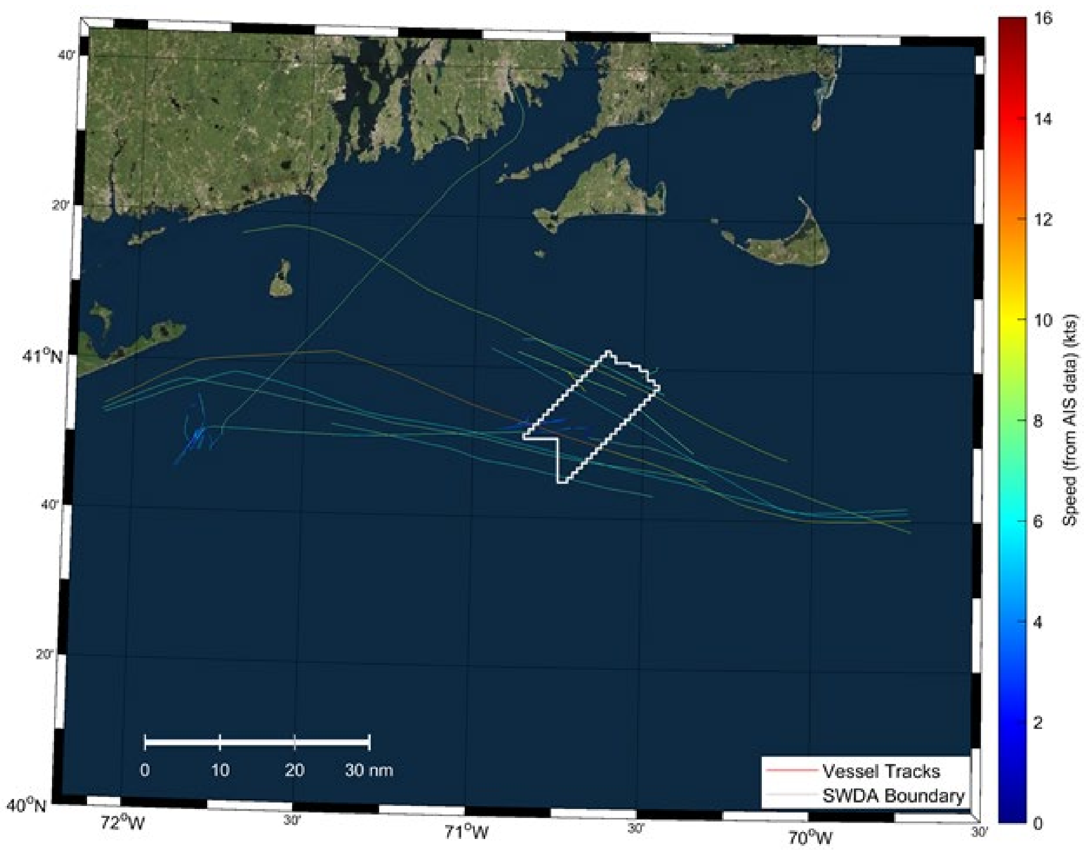
Figure 7.8-2

Cargo Vessel, Tanker Vessel, and Passenger Vessel Traffic in the SWDA (2016-2019)



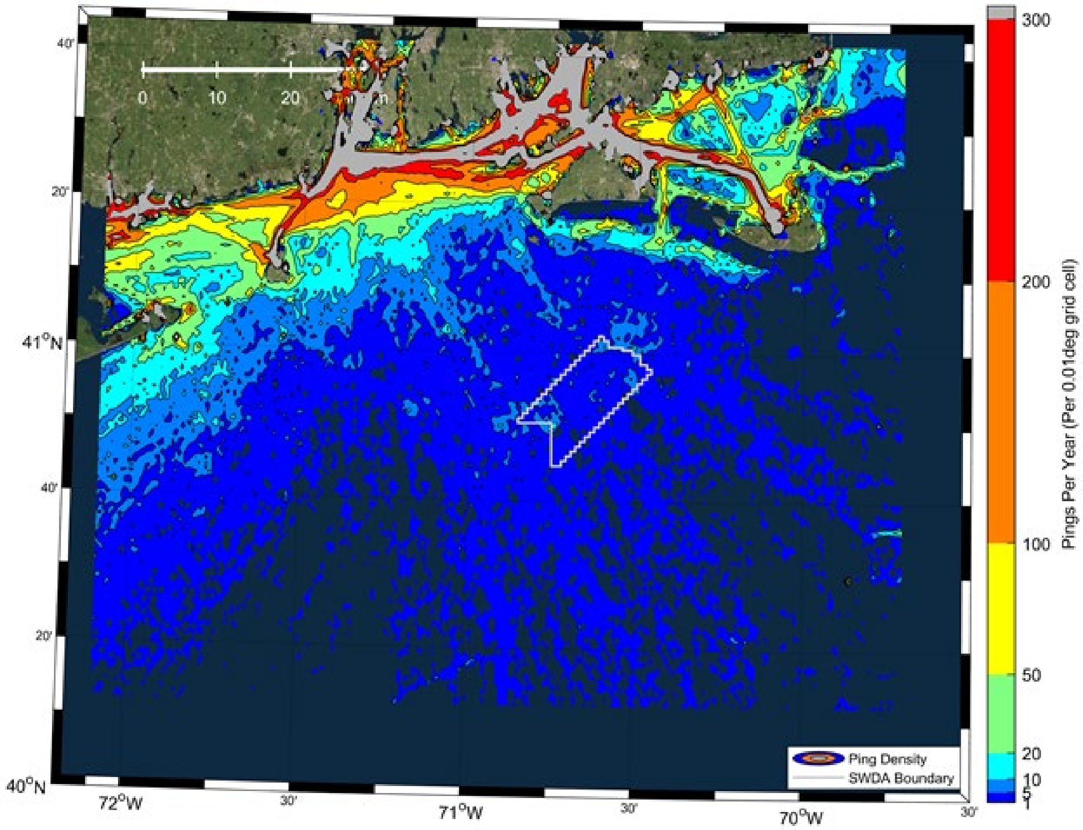
Vessel Tracks Through the SWDA – Military Vessels



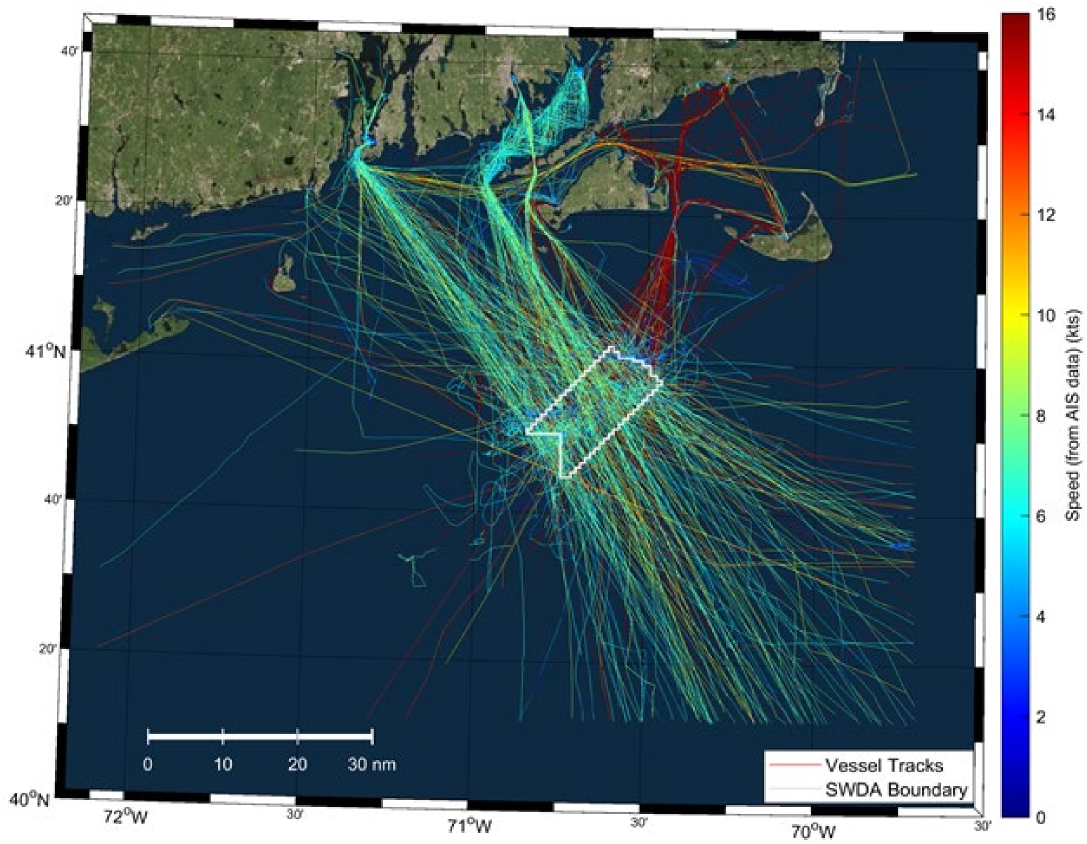
Vessel Tracks Through the SWDA – Tug-Barge Vessels

Figure 7.8-3

Tug-Barge Vessel and Military Vessel Traffic in the SWDA (2016-2019)



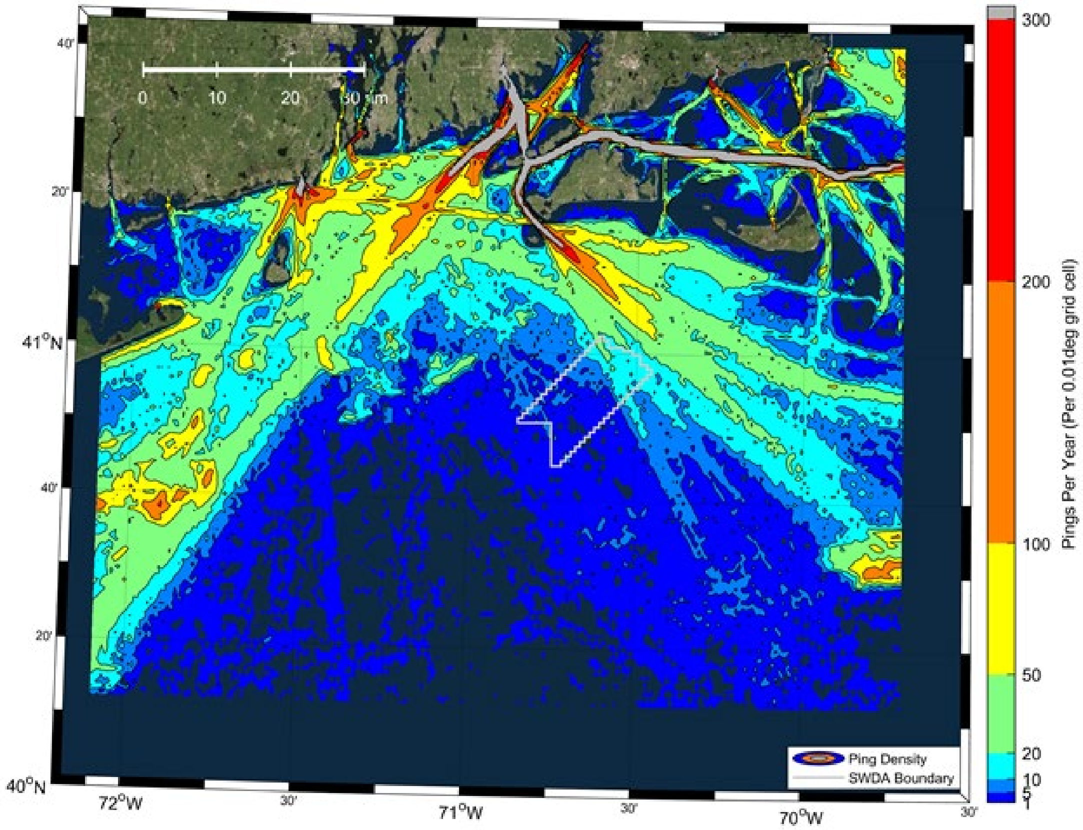
Vessel Traffic Density Plot – Recreational Vessels



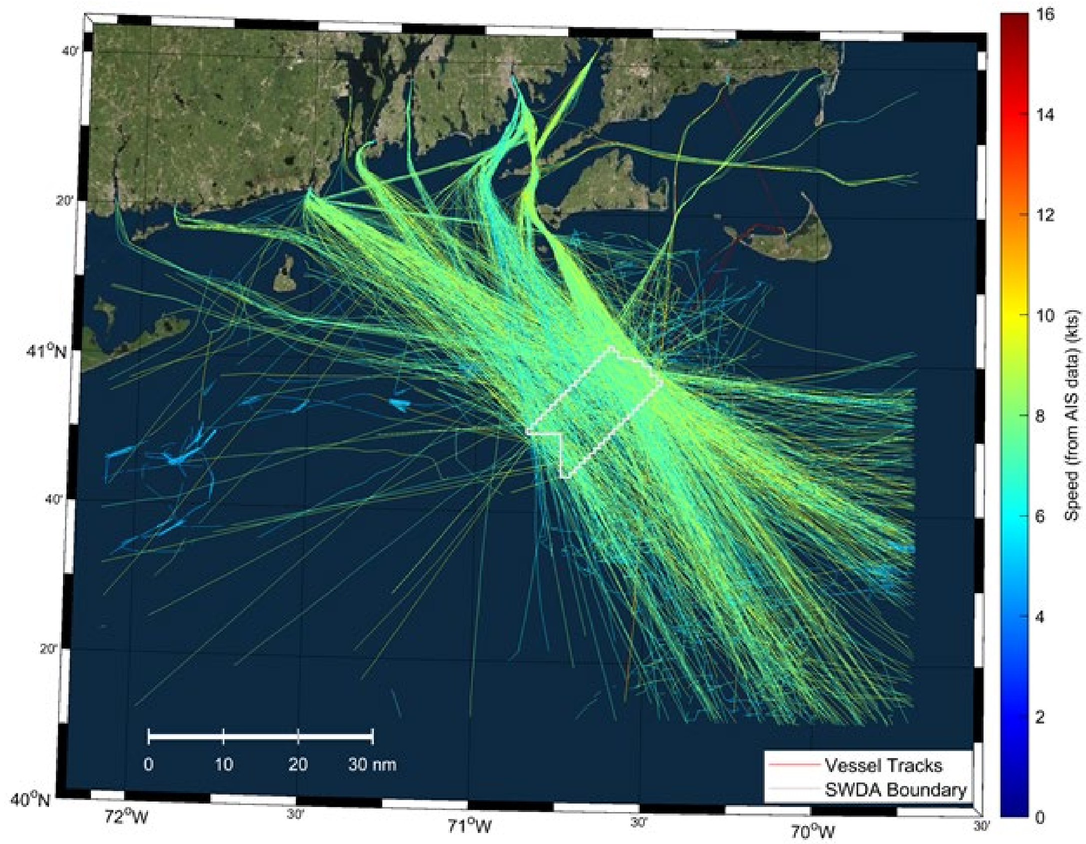
Vessel Tracks Through the SWDA – Recreational Vessels

Figure 7.8-4

Recreational Vessel Traffic in the SWDA (2016-2019)



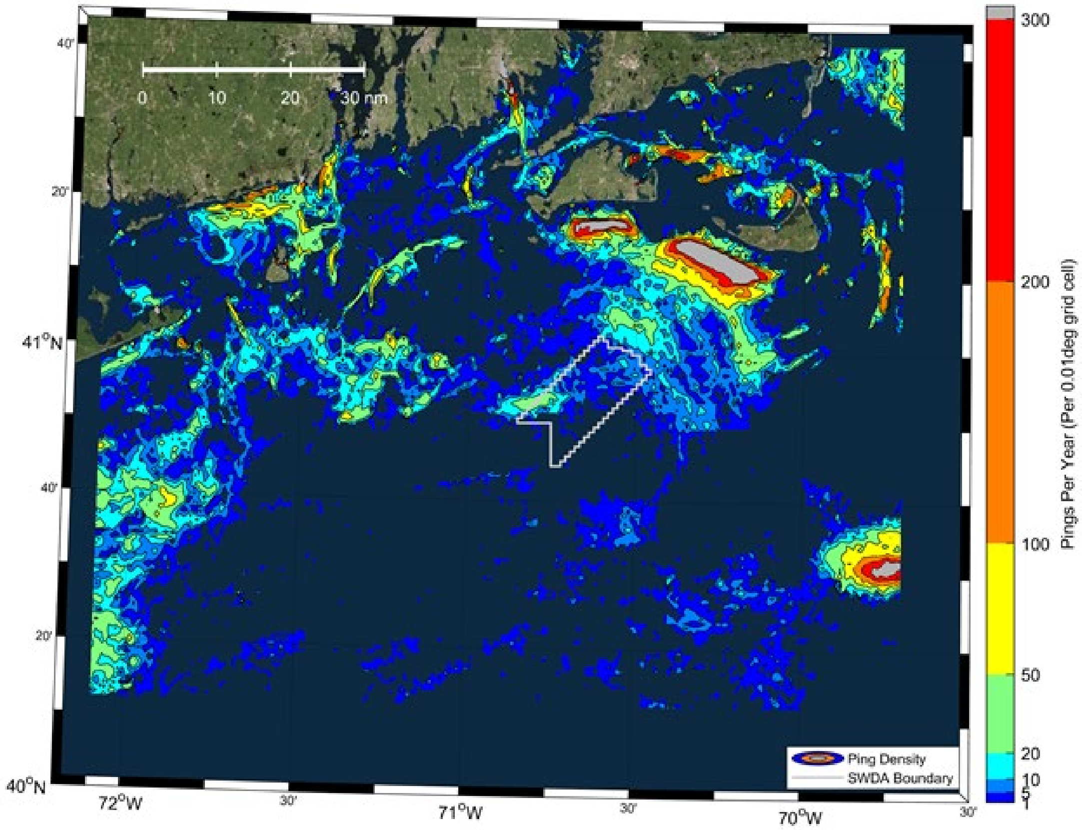
Vessel Traffic Density Plot – Fishing Vessels (Transiting)



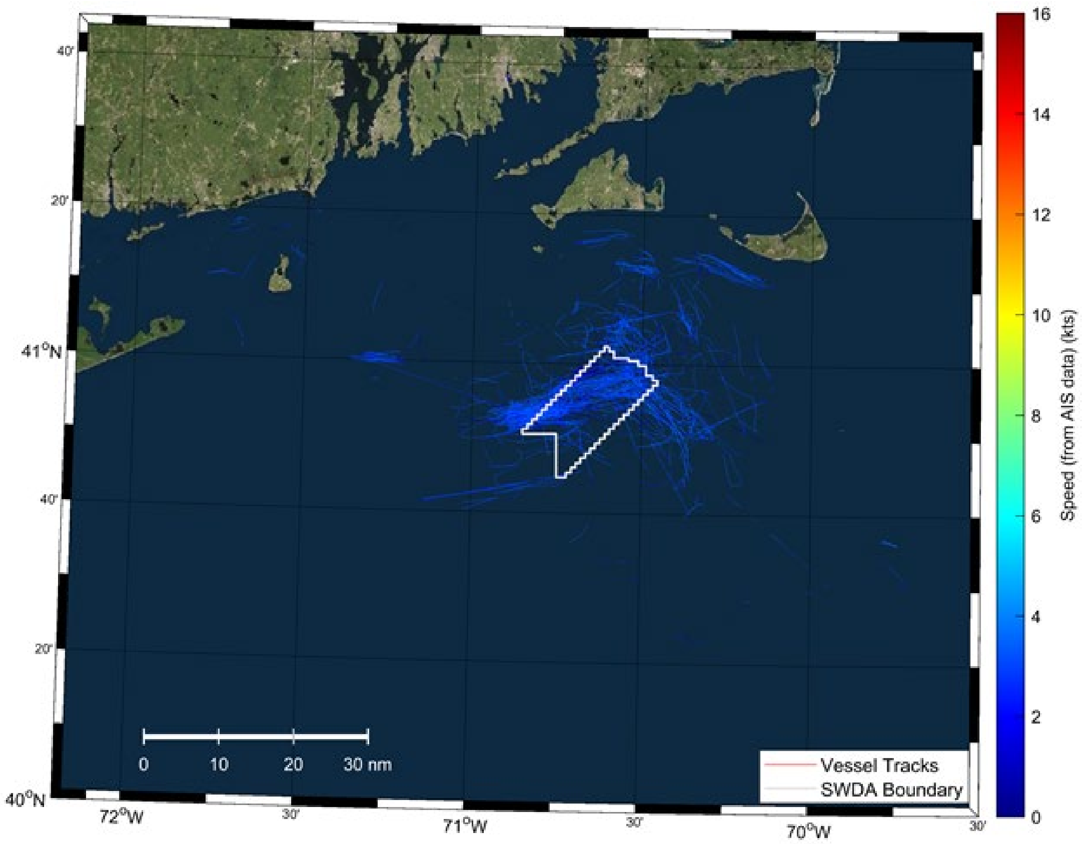
Vessel Tracks Through the SWDA – Fishing Vessels (Transiting)

Figure 7.8-5

Fishing Vessel (Transiting) Traffic in the SWDA (2016-2019)



Vessel Traffic Density Plot – Fishing Vessels (Fishing)



Vessel Tracks Through the SWDA – Fishing Vessels (Fishing)

Figure 7.8-6

Fishing Vessel (Fishing) Traffic in the SWDA (2016-2019)

Table 7.8-1 Vessel Types within the SWDA Based on 2016–2019 AIS Data[1]

Vessel Type	Unique Vessels Entering the SWDA		Number of Unique Vessel Tracks in the SWDA	
	Number	Percentage	Number	Percentage
Cargo Vessels	112	13%	196	6%
Tankers	85	10%	169	5%
Passenger Vessels	17	2%	48	1%
Tug-barge Vessels	12	1%	15	0.4%
Military Vessels	7	1%	11	0.3%
Naval Sail Training Vessels2	2	0.2%	2	0.06%
Recreational Vessels	325	39%	697	20%
Fishing Vessels, In Transit	228	27%	1688	49%
Fishing Vessels, Fishing	92	11%	582	17%
Other Vessels	42	5%	172	5%
Total (2016–2019)	841	100%	3449	100%
Annual Average Vessel Tracks	-	-	862	-

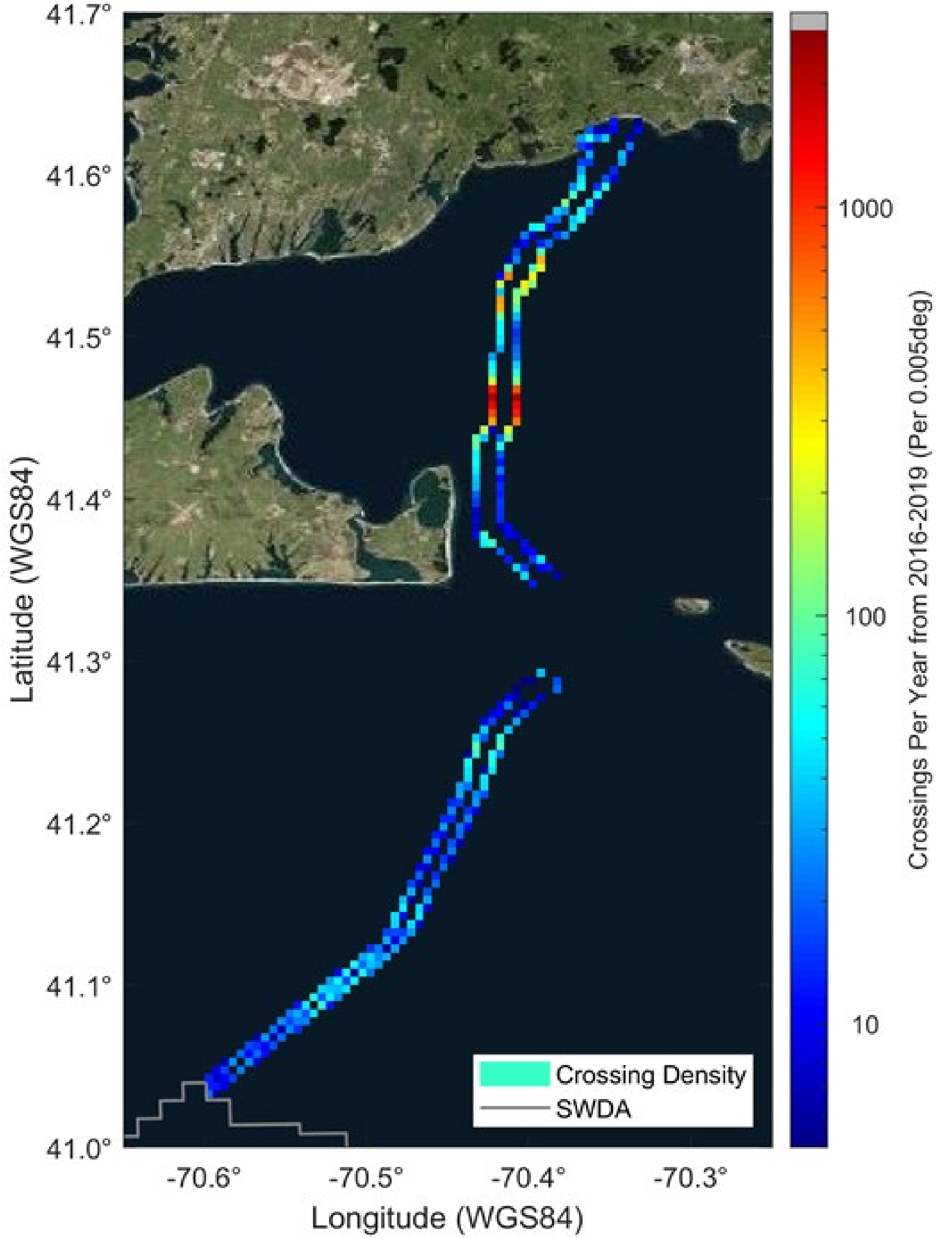
Notes:

1. There is some double counting of vessels between transiting and fishing. For the purposes of this analysis, it is assumed that fishing vessels with speeds less than 4 knots (~2 meters per second) are trawling, while those with speeds greater than 4 knots are transiting the SWDA. Some fishing vessels have speeds both above and below 4 knots while in the SWDA and thus are counted as both in transit and trawling.
2. Refers to tall sailing ships that are registered to the USCG and Portuguese Navy.

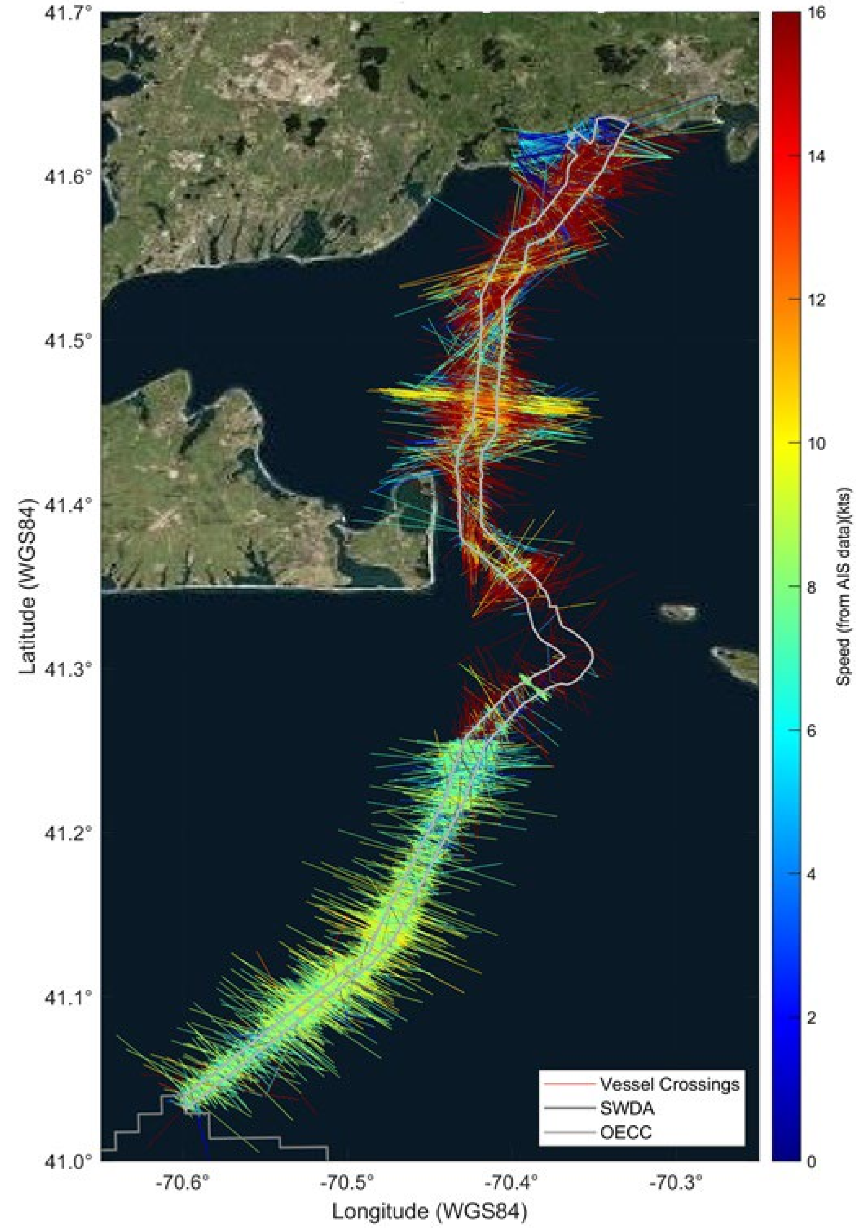
AIS data from 2016–2019 were also used to assess the density of vessel traffic along the OECC (based on all AIS vessel tracks that cross the OECC) and the Western Muskeget Variant. Overall, vessel traffic density along the OECC and the Western Muskeget Variant is relatively low, with the highest concentration of traffic midway through Nantucket Sound (see Figures 7.8-7 and 7.8-8). Existing vessel traffic along the OECC and the Western Muskeget Variant is further described in the NSRA provided as Appendix III-I.

7.8.1.2 Navigation

Private Aids to Navigation (PATONs), federal Aids to Navigation (ATONs), and radar transponders are located throughout the Offshore Development Region. These aids to navigation consist of lights, sound horns, buoys, and onshore lighthouses. Most are marked on National Oceanic and Atmospheric Administration (NOAA) nautical charts and are intended to serve as a visual reference to support safe maritime navigation. ATONs are developed, established, operated, and maintained by the USCG in order to assist navigators in determining their position, help navigators identify a safe course, and warn navigators of dangers and obstructions. Likewise, PATONs, which are owned and maintained by individuals or organizations other than the USCG, are used to facilitate the safe movement of vessel traffic.



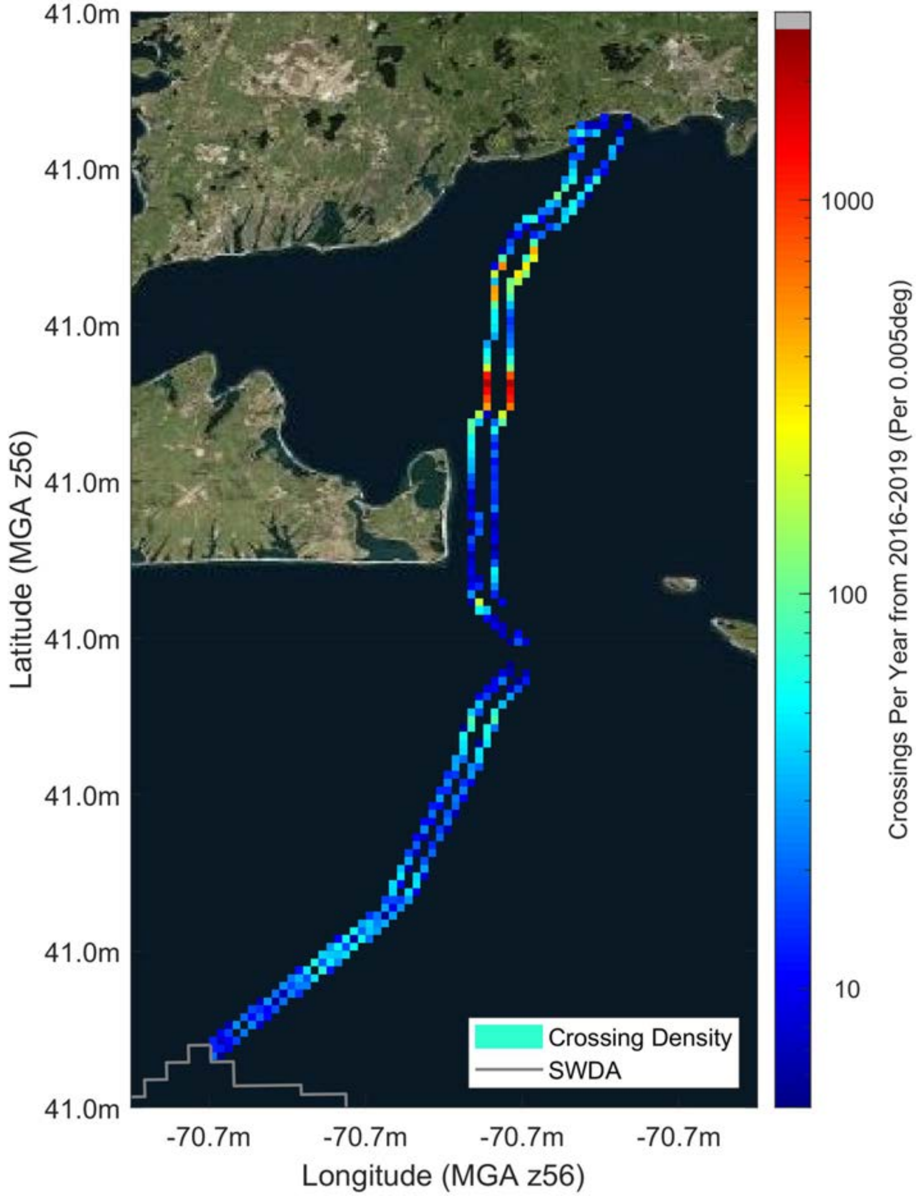
Vessel Traffic Density Plot – All Vessels



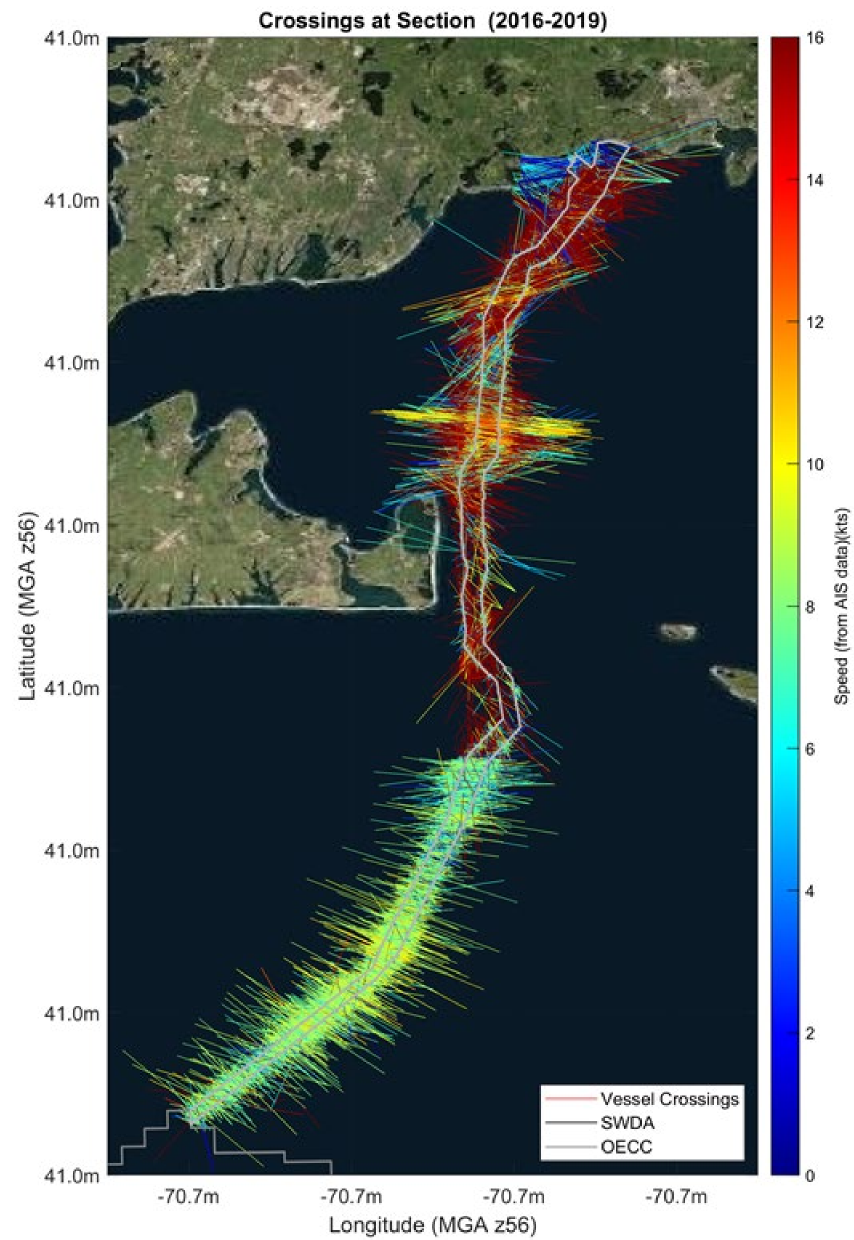
Vessel Tracks Across the OECC – All Vessels

Figure 7.8-7

All Vessel Traffic Crossing the OECC (2016-2019)



Vessel Traffic Density Plot – All Vessels



Vessel Tracks Across the Western Muskeget Variant – All Vessels

Figure 7.8-8

All Vessel Traffic Crossing the Western Muskeget Variant (2016-2019)

There are numerous ATONs and PATONs throughout the Offshore Development Region. For example, a red and white bell buoy is present near the southern entrance to the Muskeget Channel and a green can buoy indicates the narrow channel clearance to Nantucket Sound from the south. Within the MA WEA and RI/MA WEA, there are several PATONs (namely buoys) installed by offshore wind developers or research/educational institutions for data collection. As offshore wind projects are constructed in the WEAs, wind turbine generators (WTGs) and electrical service platforms (ESPs) are likely to serve as PATONs. The Bureau of Ocean Energy Management (BOEM) also issued guidance on the lighting and marking of structures supporting renewable energy development in April 2021 (BOEM 2021).

The Offshore Development Region also includes several vessel routing measures including, but not limited to, precautionary areas, TSS, fairways, recommended routes, two-way routes, and areas to be avoided (see Figure 7.8-9). Precautionary areas are defined areas within which vessels must exercise particular caution and should follow the recommended direction of traffic flow. TSS are one of several routing measures adopted by the International Maritime Organization to facilitate safe navigation in areas where dense, congested, and/or converging vessel traffic may occur or where navigation (particularly for deep-draft vessels) is constrained. A TSS separates opposing streams of vessel traffic by creating separate unidirectional traffic lanes and is typically designed to safely guide commercial vessels transiting in and out of major ports. A TSS is not necessarily marked by an ATON, but it is marked on NOAA nautical charts. Fairways are corridors in which no artificial islands or fixed structures (temporary or permanent) are permitted so that vessels will have unobstructed approaches to major US ports. Recommended routes are corridors of undefined width, which are often marked by centerline buoys. Two-way routes aim to provide safe passage of ships through waters where navigation is difficult or dangerous by establishing two-way traffic within defined limits.

Cargo vessels, tankers, cruise ships, and other deep-draft vessels approaching and departing ports in the Offshore Development Region are expected to use recommended routes, fairways, and TSS. While there are vessel routing measures in the Offshore Development Region, there are no vessel routing measures within the MA WEA or RI/MA WEA. The closest vessel routing measures to the WEAs are located ~2 kilometers (km) (~1 nautical mile [NM]) south of the MA WEA for the approach to New York Harbor and ~1 km (~0.5 NM) northwest of the RI/MA WEA for the approaches to Narragansett Bay and Buzzards Bay. Vessel routing measures for the approach to Boston Harbor are located ~75 km (40 NM) east of the WEAs (see Figure 7.8-9).

To the south of the WEAs, the “Off New York” TSS provides vessel routing measures between the precautionary area southeast of Nantucket Shoals and New York Harbor (see Figure 7.8-9). The TSS consists of two precautionary areas and four approaches: (1) the Eastern Approach; (2) the Eastern Approach, Off Nantucket; (3) the South-eastern Approach; and (4) the Southern Approach. Each approach includes a separation zone and two traffic lanes of varying widths. The “Eastern Approach” at the entrance to New York Harbor is connected to the “Eastern Approach, Off Nantucket” by two fairways (*Ambrose-to-Nantucket Safety Fairway* and *Nantucket-to-*

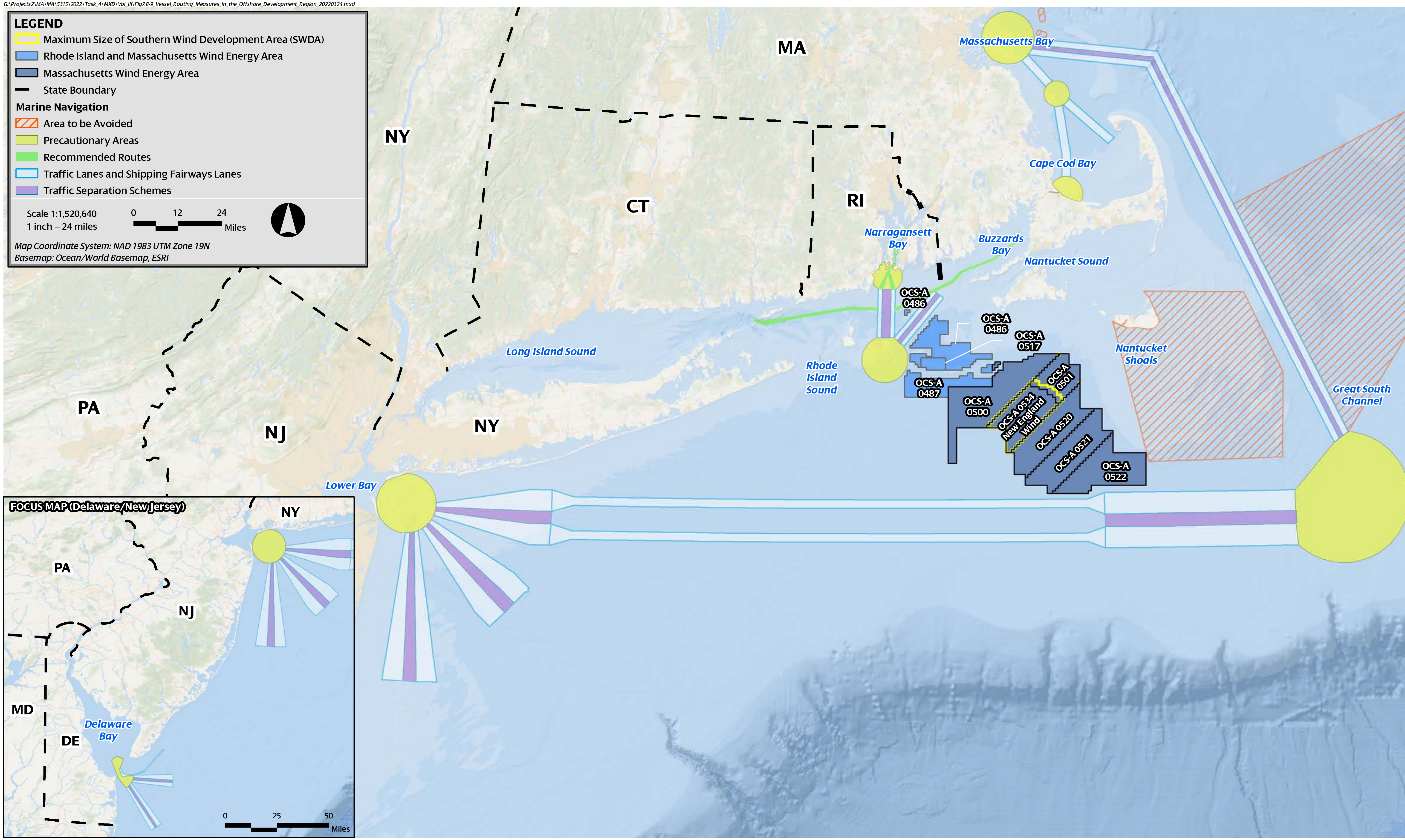


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Figure 7.8-9
Vessel Routing Measures in the Offshore Development Region

Ambrose Safety Fairway). The fairways provide an east/west corridor for vessels traveling to Narragansett Bay, Buzzards Bay, Long Island Sound, and New York Harbor. In addition to the 25 km (13.5 NM) precautionary area described above, a second precautionary area with a radius of 11.3 km (6.1 NM) is located at the entrance to New York Harbor where the Eastern, South-eastern, and the Southern approaches converge (see 33 CFR §§ 167.150 through 167.155 and 33 CFR § 166.500).

As shown in Figure 7.8-9, northwest of the WEAs, an additional TSS services the approaches to Narragansett Bay and Buzzards Bay and consists of four parts: two precautionary areas and two approaches (a Narragansett Approach and a Buzzards Bay Approach). The precautionary areas have radii of 5.7 km (3.1 NM) and 8.7 km (4.7 NM) and are located at the northern and southern ends of the Narragansett Bay Approach, respectively. The Narragansett Bay Approach has a separation zone that is 3.2 km (1.7 NM) wide whereas the Buzzards Bay Approach has a 1.6 km (0.87 NM) wide separation zone. Both approaches have 1.6 km (0.87 NM) wide traffic lanes on each side of the separation zones (see 33 CFR §§ 167.100 through 167.103).

To the east of the WEAs, the "In the Approach to Boston, Massachusetts" TSS follows the deep bathymetry of the Great South Channel, a deep-water passage between Nantucket and Georges Bank (see Figure 7.8-9). This TSS, located east of Nantucket and Cape Cod, enables deep-draft vessels to safely travel south from Boston Harbor past Cape Cod and the dangerously shallow waters of the Nantucket Shoals. The inbound and outbound lanes of the "In the Approach to Boston, Massachusetts" TSS, each approximately 2.9 km (1.6 NM) wide, are separated by a 1.6 km (0.87 NM) wide separation zone to enable vessels to safely enter and exit the TSS, although most vessels enter a TSS at its terminus. A precautionary area with a radius of 25 km (13.5 NM) is located southeast of the Nantucket Shoals where the "In the Approach to Boston, Massachusetts" TSS intersects with the "Off New York" TSS (at the "Eastern approach, off Nantucket") (see 33 CFR §§ 167.75 through 167.77).

At the entrance to Delaware Bay located over ~300 km (~170 NM) southwest of the WEAs, the "Off Delaware Bay Approach" TSS consists of four parts: an Eastern Approach, a Southeastern Approach, a Two-Way Traffic Route, and a precautionary area (see 33 CFR §§ 167.170 through 167.174). Each approach includes a separation zone and two unidirectional traffic lanes of varying widths. The approaches converge at an irregularly shaped precautionary area between Cape May, New Jersey and Cape Henlopen, Delaware (see Figure 7.8-9). The Two-Way Traffic Route begins in the precautionary area and extends northeast around the tip of Cape May. The Two-Way Traffic Route is recommended for use predominantly by tug and tow traffic transiting to and from the northeast to separate such traffic from large, inbound vessel traffic.

7.8.1.3 USCG Search and Rescue

The USCG uses both vessels and aviation assets to conduct search and rescue (SAR) missions within the MA WEA and RI/MA WEA (USCG 2020). However, given the distance and time required for USCG vessels to reach the WEAs, the USCG will rely more heavily on helicopters during SAR operations. Analysis of SAR data in support of the USCG's (2020) Massachusetts and Rhode Island Port Access Route Study (MARIPARS) found that an average of 9.5 incidents occurred annually within or near the WEAs from 2005 through 2018.[132] SAR missions within the SWDA are discussed further in the NSRA (see Appendix III-I). Section 7.9 provides additional description of USCG operations in the Offshore Development Region.

7.8.2 Potential Impacts of New England Wind

Impacts to navigation and vessel traffic were analyzed for the offshore construction, operations, and decommissioning of New England Wind as a whole. This assessment considers impacts from the full buildout of 130 WTG/ESP positions within the SWDA and the installation of five cables within the OECC without a specific focus on the sizes of offshore components. The impact producing factors for navigation and vessel traffic are summarized in Table 7.8-2 and are discussed in more detail in this section and the NSRA provided as Appendix III-I.

This section discusses impacts to all vessels operating in the Offshore Development Region. See Sections 7.5 and 7.6 for discussion of impacts specific to recreational and commercial fishing vessels.

Table 7.8-2 Impact Producing Factors for Navigation and Vessel Traffic

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Navigation hazard	•			•	•	•
Vessel traffic	•	•		•	•	•

7.8.2.1 Construction and Installation

7.8.2.1.1 Temporary Impacts to Vessel Traffic and Port Activities (Phases 1 and 2)

Construction of New England Wind will require the use of construction and support vessels in the SWDA and along the OECC (including the Western Muskeget Variant). These vessels will transit within the SWDA, along the OECC, and along vessel routes between the SWDA, OECC, and one or more ports. The Proponent has identified several port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for major construction staging activities.

[132] The analyzed SAR records may not include responding USCG assets that transited through the WEAs to reach a SAR location, SAR cases that drifted into the confines of the WEAs, and subjects of SAR cases which were towed or otherwise transported through the WEAs from points originating outside of the WEAs (USCG 2020).

In addition, some components, materials, and vessels could come from Canadian and European ports. See Sections 3.2.2.5 and 4.2.2.5 of COP Volume I for a complete list of ports that may be used for major construction staging activities.

At the early planning stages of New England Wind, it is challenging to precisely quantify the number of vessels and vessel trips associated with the construction of New England Wind. These estimates are highly dependent on the final construction schedule for each Phase, the number of WTGs and ESPs installed, the final design of the offshore facilities, the ports ultimately used, and the logistics solution used to achieve compliance with the Jones Act. For these reasons, the estimates of vessel counts and vessel trips provided below are likely conservative and subject to change.

During the offshore construction of each Phase, assuming the maximum design scenario, it is estimated that an average of ~30 vessels would operate at the SWDA or along the OECC at any given time.[133] Commencement of the WTG installation and commissioning phase typically represents the most intense period of vessel traffic in the Offshore Development Area, with foundations, inter-array cables, and WTGs being installed and commissioned in parallel. During the most active period of construction, which is expected to occur in the summer/fall, it is conservatively estimated that a maximum of approximately 60 vessels could operate in the Offshore Development Area at one time.

Specific to offshore export cable installation, an approximate average of seven vessels are expected to be used for cable laying activities along the OECC (including the Western Muskeget Variant) in any given month, although as many as approximately 15 vessels may be used for cable laying activities in any one month. Since many of the cable installation activities are sequential, these vessels would not all operate along the OECC simultaneously.

Additional vessel traffic may occur within the ports identified for use during construction of New England Wind (see Sections 3.2.2.5 and 4.2.2.5 of COP Volume I). Each port facility under consideration for New England Wind is either already located within an industrial waterfront area with sufficient existing infrastructure or is identified as an area where other entities intend to develop infrastructure with the capacity to host construction activities under the New England Wind schedule. The Proponent expects to use one or more of these ports for frequent crew transfer and to offload/load shipments of components, store components, prepare them for installation, and then load components onto vessels for delivery to the SWDA. Some component

[133] It is possible that Phase 2 construction could begin immediately following Phase 1 construction. While each major construction activity would be sequential for the two Phases (e.g. Phase 2 foundation installation would immediately follow Phase 1 foundation installation), there could be some overlap of different offshore activities between Phase 1 and Phase 2 (e.g. Phase 2 foundation installation could occur at the same time as Phase 1 WTG installation). The number of vessels present at the SWDA or along the OECC accounts for the possibility of Phase 1 and Phase 2 vessels being present at the same time.

fabrication and assembly may also occur at these ports. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning. Some activities such as refueling, restocking supplies, vessel repairs, sourcing parts for repairs, vessel mobilization/demobilization, some crew transfer, and other construction staging activities may occur out of ports other than those listed in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. These activities would occur at industrial ports suitable for such uses and would be well within the realm of normal port activities.

Many construction vessels will remain at the SWDA or OECC for days or weeks at a time, potentially making infrequent trips to port for bunkering and provisioning as needed. Therefore, although an average of approximately 30 vessels would be present in the Offshore Development Area during the construction of each Phase, fewer vessels will transit to and from port each day. Assuming the maximum design scenario for each Phase individually, approximately 3,200 total vessel round trips (an average of six round trips per day) are expected to occur for Phase 1 construction and approximately 3,800 total round trips (an average of seven round trips per day) are expected to occur for Phase 2 construction.[134] Due to the range of buildout scenarios for Phases 1 and 2, the Proponent expects the total number of vessel trips from both Phases of New England Wind combined to be less than the sum of vessel trips estimated for each Phase independently. During the most active month of construction, it is anticipated that an average of approximately 15 daily vessel round trips will occur.

Estimates of vessel traffic associated with both Phases of New England Wind construction are summarized in Table 7.8-3 below, assuming that Phase 2 construction begins immediately following Phase 1 construction.[135]

In this scenario, each major construction activity would be sequential for the two Phases (e.g. Phase 2 foundation installation would immediately follow Phase 1 foundation installation). However, there could be some overlap of different offshore activities between Phase 1 and Phase 2 (e.g. Phase 2 foundation installation could occur at the same time as Phase 1 WTG installation). As a result, although offshore construction of each individual Phase could take ~18 months, for the purposes of estimating vessel trips, it was assumed that the total duration of offshore construction for both Phases (combined) was 31 months. A total of ~6,700 vessel trips over a 31-month construction period results in an average of ~215 vessel trips per month.[136]

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[134] For the purposes of estimating vessel trips, tugboats and barges are considered one vessel.

[135] In this scenario, each major construction activity would be sequential for the two Phases (e.g. Phase 2 foundation installation would immediately follow Phase 1 foundation installation). However, there could be some overlap of different offshore activities between Phase 1 and Phase 2 (e.g. Phase 2 foundation installation could occur at the same time as Phase 1 WTG installation).

[136] Values do not align perfectly due to rounding.

There is a high degree of uncertainty regarding which port may be used for any given activity. Table 7.8-3 provides the maximum scenario for all ports combined and each port individually. More specifically, for each port grouping, the "Expected Average Round Trips Per Day," "Average Round Trips Per Month," and "Approx. Total Round Trips" are the maximum number of vessel trips that could occur from each individual port listed in that grouping (not the maximum number of vessel trips for all ports in the grouping combined) and are not additive among the ports under consideration. For example, in a maximum-case scenario, Bridgeport could have up to ~5,500 vessel trips, or Vineyard Haven could have up to 5,500 vessel trips of the ~6,700 total vessel trips estimated during construction (for both Phases, combined). Up to ~1,200 vessel trips would occur out of one or more other ports (including other ports within the Bridgeport-Vineyard Haven-Davisville-South Quay grouping) for each of these examples, such that estimated maximum total number of vessel trips would still be approximately ~6,700.

Table 7.8-3 New England Wind-Related Vessel Traffic during Construction

Ports	Peak Construction Period		Over Construction Period		
	Expected Average Round Trips per Day	Average Round Trips per Month	Expected Average Round Trips per Day	Average Round Trips per Month	Approx. Total Round Trips
All Ports	15	443	8	215	6,700
New Bedford Harbor	15	443	7	209	6,500
Bridgeport Vineyard Haven Port of Davisville South Quay Terminal	13	376	6	177	5,500
ProvPort Brayton Point Commerce Center Fall River New London State Pier Staten Island Ports South Brooklyn Marine Terminal GMD Shipyard Shoreham	6	162	3	68	2,100
Salem Harbor	2	46	1	20	610
Canadian Ports	2	38	1	21	620
European Ports	2	31	1	13	400
Capital Region Ports Paulsboro	1	6	1	3	100

Vessel traffic associated with the construction of each Phase of New England Wind is not anticipated to represent a significant increase over the current levels of vessel traffic throughout the Offshore Development Region. As noted in Section 7.8.1.1, the highest density of vessel traffic in the Offshore Development Region occurs *outside* the WEAs and primarily within TSS, fairways, precautionary areas, and recommended routes.

AIS data suggest that existing vessel traffic levels within the SWDA are relatively low (see Section 7.8.1.1 and Appendix III-I). As described Appendix III-I, because the SWDA is not heavily trafficked, construction and installation activities are not anticipated to significantly affect the limited vessel traffic within the SWDA. The Proponent will continue to work with ferry operators, harbor pilots, and other vessel operators to ensure any impacts to commercial vessel traffic are minimized to the greatest extent practicable (see Section 7.8.2.1.5).

Near port facilities or adjacent waterways, New England Wind vessels may require other vessels transiting navigation channels or other areas of confined navigation (e.g. the New Bedford hurricane barrier) to adjust course, where possible, or adjust their departure/arrival times to avoid navigational conflicts. However, with the mitigation measures described in Section 7.8.2.1.5, the increased vessel traffic is not anticipated to result in significant disruption of vessel traffic in and around the ports.

7.8.2.1.2 Temporary Impacts to Navigation (Phases 1 and 2)

Temporary impacts to navigation may occur from vessel traffic associated with New England Wind. During Phases 1 and 2, the construction and installation vessels operating in the SWDA or along the OECC (including the Western Muskeget Variant) may temporarily preclude other vessels from transiting in the immediate vicinity of construction vessels or cause vessels to make adjustments to planned routes or transit times to avoid the construction area. Temporary safety buffer zones may be established around work areas during the construction of each Phase. Temporary safety buffer zones are expected to improve safety in the vicinity of active work areas and would not affect the entire SWDA or OECC (including the Western Muskeget Variant) at any given time.

Near ports and adjacent waterways, New England Wind vessels may require other vessels transiting within navigation channels, in close proximity to obstructions, or within other areas of confined navigation (e.g. the New Bedford hurricane barrier) to adjust course, where possible, or adjust their departure/arrival times to avoid navigational conflicts. However, navigational conflicts are not anticipated to be a common occurrence. As described in Section 7.8.2.1.5 below, the Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue Notices to Mariners (NTMs) advising other vessel operators of construction and installation activities. The Proponent will also coordinate with state and local law enforcement, marine patrol, port authorities, and commercial operators.

As discussed in Section 7.8.1.2, there are no vessel routing measures within the SWDA that would be impacted by the construction of New England Wind. Construction and installation activities will cause a modest increase in vessel traffic in the Offshore Development Region, including within the precautionary areas and TSS approaches to ports in Rhode Island, Massachusetts, Connecticut, New York, and New Jersey that may be used by New England Wind vessels. As described in Appendix III-I, New England Windis expected to have little to no impact on a mariner's ability to see and use ATONs, including lighthouses and channel marker buoys.

In summary, aside from temporary safety buffer zones and the potential for increased vessel traffic, no significant disruption of the Offshore Development Region's established navigation patterns or aids to navigation is anticipated due to the presence of construction and installation vessels during the construction of either Phase of New England Wind. See the NSRA in Appendix III-I for further evaluation of the potential impacts to navigation during construction of New England Wind, including an assessment of the risk for vessel collisions or allisions.

7.8.2.1.3 Temporary Impacts to Vessels' Marine Radar (Phases 1 and 2)

Radar systems are commonly used in maritime applications to detect and monitor other vessels' positions and movements near a radar-equipped vessel. Radar systems also provide information regarding a vessel's position relative to fixed objects such as ATONs. Although fishing vessels are not currently required to have a navigation radar unless they carry 16 or more persons onboard or are engaged in the Aleutian trade,[137] the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)[138] suggest that proper use of a radar is required if the vessel is fitted with one (USCG 2020). Increased vessel traffic due to New England Wind construction activities is expected to have little to no effect on the operation of marine radar systems.

As WTGs and ESPs are installed, they will produce new radar signals. An evaluation of the effects of WTGs on marine radar systems operated near the United Kingdom's (UK) Kentish Flat Offshore Wind Farm (BWEA 2007) indicates that the expected impacts of offshore WTGs on marine radar systems depends on a number of variables, including vessel size, a vessel's proximity to the WTGs,

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137 Aleutian trade means " the transportation of cargo, including fishery related products, for hire on board a fish tender vessel to or from a place in Alaska west of 153 degrees West longitude and east of 172 degrees East longitude if that place receives weekly common carrier service by water, to or from a place in the United States, except a place in Alaska." See 46 CFR § 28.50.

138 COLREGS Rule 5 states that, "Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision." Rule 7a requires all vessels to use "all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists" and Rule 7b states that, "Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected object."

a vessel's angle of travel in relation to the wind farm, and the position of the radar systems onboard a vessel. Additional information on marine radar systems is provided in Section 7.8.2.2.3 and Appendix III-I.

7.8.2.1.4 Temporary Impacts to USCG Search and Rescue (Phases 1 and 2)

The presence of New England Wind construction vessels and partially constructed foundations, WTGs, and ESPs are not expected to significantly affect SAR operations in the SWDA, and may in fact facilitate operations as partially constructed structures will be marked and lighted and construction vessels will continuously be within the SWDA. Impacts to USCG SAR operations during construction of New England Wind are analyzed in the NSRA (see Appendix III-I). See Section 7.8.2.2.4 for discussion of New England Wind's impacts on SAR operations once the WTGs and ESPs are fully constructed. The Proponent will coordinate with the USCG on mitigation measures aimed at reducing impacts to SAR (see Section 7.8.2.2.5).

7.8.2.1.5 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

Coordination among the USCG, port authorities/operators, ferry operators, local pilots, and other entities will be necessary to ensure that impacts from New England Wind's construction and installation vessels are minimized. The Proponent is committed to working with each stakeholder to address navigation and other concerns during each Phase of New England Wind. As part of this effort, the Proponent plans to develop and implement a marine communications plan to engage these stakeholders.

The Proponent employs a Marine Operations Liaison Officer who serves as the strategic maritime liaison between the Proponent's internal parties and all external maritime partners and stakeholders (e.g. USCG, US Navy, port authorities, state and local law enforcement, marine patrol, commercial operators, etc.) for all of the Proponent's projects. The Marine Operations Liaison Officer is also expected to be responsible for coordinating and issuing Offshore Wind Mariner Update Bulletins to notify maritime stakeholders of the Proponent's offshore activities (see Sections 3.3.4.2 and 4.3.4.2 of COP Volume I).

During construction of each Phase of New England Wind, the Proponent will also employ a Marine Coordinator to manage all construction vessel logistics and implement communication protocols with external vessels at the harbor and offshore. During construction, the Marine Coordinator will be the primary point of contact for day-to-day operations with the USCG, port authorities, state and local law enforcement, marine patrol, and commercial operators (see Sections 3.3.4.2 and 4.3.4.2 of COP Volume I). As such, the Marine Coordinator will be responsible for coordination with USCG regarding any required NTMs. The Marine Coordinator will operate from a marine coordination center that is established to control vessel movements throughout the Offshore Development Area. Daily meetings will be held by the Proponent to coordinate between contractors and avoid unnecessary simultaneous operations at the port facilities and routes to the Offshore Development Area.

As noted above, the Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue NTMs advising other vessel operators of New England Wind's construction and installation activities. Local port communities and local media will also be notified and kept informed as the construction progresses. The Proponent's website will be updated regularly to provide information on the construction activities and specific New England Wind information. The WTGs and ESPs will also be clearly identified on NOAA nautical charts.

To minimize hazards to navigation, all New England Wind -related vessels and equipment will display the required navigation lighting and day shapes. The WTGs and ESPs will become PATONs once they are installed. Vineyard will implement a uniform system of marine navigation lighting and marking, which is currently expected to include yellow flashing lights on every WTG foundation and ESP, unique alphanumeric identifiers on the WTGs, ESPs, and/or their foundations, and high-visibility yellow paint on each foundation. Temporary marine navigation lighting and marking may need to be installed on the foundation structures as they are being constructed, depending on the timing and sequence of foundation installation. Current plans for the uniform system of lighting and marking are discussed further in Section 7.8.2.2.5 and Appendix III-I.

The Proponent is committed to working with the USCG to mitigate safety concerns during construction. This may include temporary safety buffer zones around construction activities. The temporary safety buffer zones would be adjusted as construction work areas change within the SWDA or along the OECC, allowing fishermen and other stakeholders to use portions of the Offshore Development Area not under construction. When feasible, the Proponent may deploy one or more safety vessels to monitor vessel traffic approaching the offshore facilities while under construction. Additional resources (e.g. safety vessels, personnel) will be in close proximity to construction and installation activities to respond to safety or environmental concerns, as they may arise.

7.8.2.2 Operations and Maintenance

7.8.2.2.1 Impacts to Vessel Traffic and Port Activities (Phases 1 and 2)

For Phase 1 O&M, the Proponent will likely establish a long-term service operation vessel (SOV) O&M base in Bridgeport, Connecticut (see Section 3.2.2.6 of COP Volume I). The SOV O&M base would be the primary homeport for the SOV and would likely be used for crew exchange, bunkering, spare part storage, and load-out of spares to the SOV and/or other vessels. In addition to the SOV O&M base, the Proponent has worked with its local partner, Vineyard Power, and the communities of Martha's Vineyard with the intention to base certain Phase 1 O&M activities on Martha's Vineyard. Current plans anticipate that crew transfer vessels and/or the SOV's daughter craft would operate out of Vineyard Haven and/or New Bedford Harbor during O&M. For Phase 2 O&M, the Proponent will likely use O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor (see Section 4.2.2.6 of COP Volume I). For either Phase, the Proponent may use other ports to support O&M activities, as necessary (see Sections 3.2.2.6 and 4.2.2.6 of COP Volume I).

During the O&M period of each Phase, the number of New England Wind-related vessels operating in the Offshore Development Area depends on the timing and frequency of activities, the number of WTGs and ESPs installed, the final design of the offshore facilities, and the logistics solution used during O&M. For these reasons, the estimates of vessel counts and vessel trips provided below are likely conservative and subject to change.

For each Phase individually, during the busiest year of O&M, an average of approximately five vessels are anticipated to operate in the Offshore Development Area at any given time; additional vessels may be required during certain maintenance or repair scenarios. Approximately 290 vessel round trips are estimated to take place annually during the O&M of each Phase, assuming each Phase's maximum design scenario.

However, due to the range of buildout scenarios for Phases 1 and 2, the Proponent expects the total number of vessel trips during simultaneous operation of both Phases to be less than the sum of vessel trips estimated for each Phase independently. During O&M of both Phases, it is anticipated that an average of approximately seven vessels will operate in the Offshore Development Area on any given day. In certain maintenance or repair scenarios, additional vessels may be required, which are estimated to result in a maximum of ~15 vessels operating within the SWDA or along the OECC at one time (although due to the unpredictable nature of corrective maintenance, the maximum number of vessels is difficult to accurately predict). Approximately 530 vessel round trips are estimated to take place annually during the simultaneous operation of both Phases, which equates to an average of less than two vessel round trips per day.

As described Appendix III-I, because the SWDA is not heavily trafficked, vessel activities during O&M are not anticipated to significantly affect the limited vessel traffic occurring within the SWDA. O&M vessels will operate at the OECC (including the Western Muskeget Variant) infrequently, primarily to conduct inspections of the offshore export cables on a scheduled maintenance timetable (see Sections 3.3.2 and 4.3.2 of COP Volume I). The vessels used for such inspections are similar in size and operational requirements as other vessels frequently operating in the Offshore Development Region. Therefore, few impacts to existing vessel traffic, including passenger vessel traffic, are anticipated from O&M activities along the OECC (including the Western Muskeget Variant).

Regarding port usage during O&M, New England Wind vessels will primarily travel between the O&M facilities (likely located in Bridgeport, Vineyard Haven, and/or New Bedford Harbor) and the SWDA. Because an average of fewer than two O&M vessels will transit to and/or from the O&M facility on any given day, vessel activities at the O&M facility are not expected to adversely affect other commercial or recreational vessel traffic.

7.8.2.2.2 Impacts to Navigation (Phases 1 and 2)

The SWDA will be open to marine traffic, and no permanent vessel restrictions are proposed within the SWDA or along the OECC (including the Western Muskeget Variant) during O&M for either Phase. If in-water maintenance activities are required, there could be temporary safety buffer zones established around work areas in limited areas of the SWDA or along the OECC (including the Western Muskeget Variant), though it is expected that most maintenance activities will not require in-water work but will instead be based from the WTGs and ESP structures themselves.

During O&M, increased risks to safe navigation may result from the presence of WTGs and ESPs in the SWDA where only open ocean previously existed. As described in Section 2.3 of COP Volume I, the SWDA will contain up to 130 total WTG/ESP positions oriented in fixed east-to-west rows and north-to-south columns with one nautical mile spacing between WTG/ESP positions. This grid layout provides 1 NM (1.85 km) wide corridors in the east/west and north/south directions as well as 0.7 NM (1.3 km) wide corridors in the northwest/southeast and northeast/southwest directions.[139] The corridors created by the 1 x 1 NM WTG/ESP layout are illustrated in Figure 7.8-10.

If co-located ESPs are used, each ESP's monopile foundation would be located within 76 m (250 ft) of one of the potential ESP locations. Additionally, the maximum topside of each ESP is 100 m (328 ft) long by 60 m (197 ft). In the most conservative case, 50 m (164 ft) (i.e., half of the topside) could extend into one of the transit corridors. Thus, the maximum incursion into a transit corridor is therefore the sum of 76 m (250 ft) + 50 m (164 ft), which is equal 126 m (414 ft). This is a reduction in the transit corridor of 0.07 NM. In effect, the resulting transit corridor would be 0.63 NM on the diagonal corridor and 0.93 NM on the east-west and north-south corridors.

The 1 x 1 NM WTG/ESP layout of New England Wind is consistent with the USCG's recommendations contained in the MARIPARS published in the Federal Register on May 27, 2020 (USCG-2019-0131). The USCG initiated the MARIPARS on March 26, 2019 to determine what, if any, navigational safety concerns exist with vessel transits in the study area (a region encompassing all seven lease areas within the MA WEA and RI/MA WEA) and to evaluate the need to modify existing or create new vessel routing measures, including regional transit lanes, within the WEAs. The study solicited several rounds of public input from maritime community representatives, fishing industry representatives, developers, environmental groups, and other interested stakeholders in order to reconcile the need for safe access routes with other reasonable waterway uses, including the construction and operation of renewable energy facilities, to the extent practicable.

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[139] In the northwest/southeast and southwest/northeast directions, the corridors would be 0.7 NM wide for the purpose of maintaining a constant heading; however, the closest distance between any two WTGs on either side of a vessel using a northwest/southeast or southwest/northeast corridor would be 1.4 NM (2.6 km).

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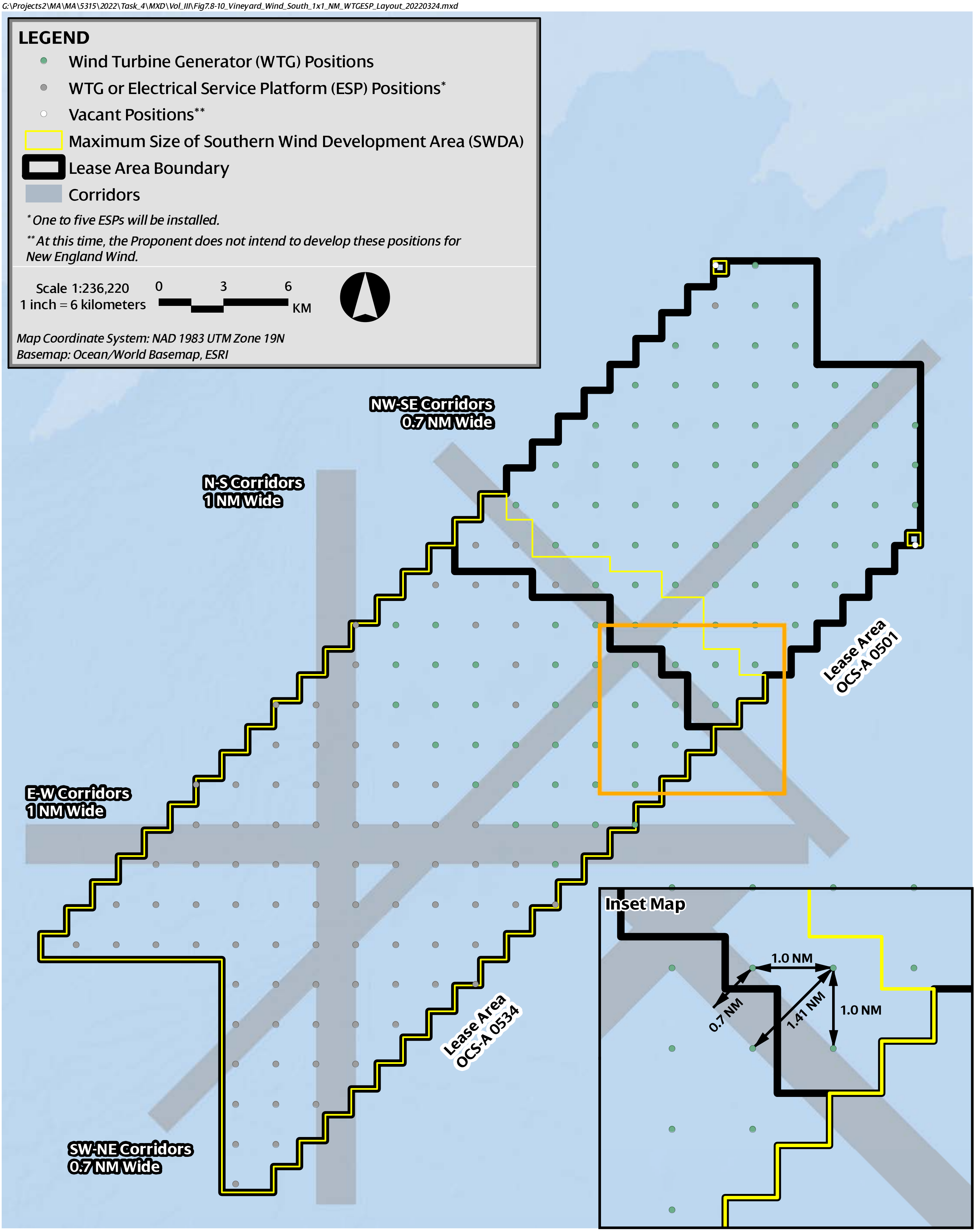

New England Wind
AVANGRID RENEWABLES

Figure 7.8-10
New England Wind 1 x 1 NM WTG/ESP Layout

The MARIPARS evaluated the appropriate distance between WTGs necessary to accommodate vessel transits, traditional fishing operations, and USCG SAR operations within the MA WEA and RI/MA WEA. The MARIPARS 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."[140] More specifically, the USCG recommended:

- **WTG Corridors for Vessel Transits:** WTG corridors should be 0.6 to 0.8 NM (1.1 to 1.5 km) wide oriented in a northwest-to-southeast direction to allow vessels to maneuver in accordance with COLREGS while transiting through the WEAs. Based on European guidance on navigation within offshore wind farms, the USCG (2020) found that corridors 0.6 to 0.8 NM wide would preserve space for a navigation path, a collision avoidance zone, a safety margin, and a possible future safety zone around individual WTGs when taking into consideration a "standard"[141] vessel and traffic density within the WEAs. According to AIS data analyzed by the USCG, corridors in a northwest-to-southeast orientation (and in the reciprocal direction) would align with the direction of most fishing vessel traffic through the WEAs.

- **WTG Corridors for Search and Rescue:** 1 NM wide WTG corridors should be oriented in a north-to-south and east-to-west direction to ensure two lines of orientation for USCG helicopters conducting SAR operations. The USCG determined that "One NM spacing between WTGs allows aircrews to safely execute turns to the adjacent lane using normal flight procedures in visual conditions" and "may allow sufficient navigational room for aircrews to execute USCG missions in diverse and challenging weather conditions or deal with an aircraft emergency and/or navigational malfunction."[142] The USCG found that multiple orientations of 1 NM spacing between WTGs would provide more flexible options for SAR search patterns (especially when constricted by adverse weather).

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[140] The "MA/RI WEA" as used in the USCG's (2020) MARIPARS includes all seven adjacent lease areas on the Outer Continental Shelf south of Martha's Vineyard, Massachusetts, and east of Rhode Island, which are referred to in the COP as the "MA WEA and RI/MA WEA."

[141] Since fishing vessels are the predominant users of the MA WEA and RI/MA WEA, the USCG used the length of the largest fishing vessel routinely transiting the WEAs. Based on AIS data analyzed by the USCG, the largest fishing vessel routinely found in the WEAs was 44 m (144 ft) in length.

[142] As described in the MARIPARS, "the USCG will continue to evaluate WTG impacts to SAR capabilities and recommend additional mitigation strategies to enhance SAR mission effectiveness" (USCG 2020).

- **WTG Corridors for Commercial Fishing Vessels (While Fishing):** WTG corridors 1 NM wide should be oriented in an east-to-west direction to accommodate commercial fishing vessels actively engaged in fishing. As explained in the MARIPARS, creating 1 NM corridors in the east-to-west orientation would meet the needs of state coastal resource offices and fishing vessel interest groups who have consistently requested a minimum of 1 NM spacing in an east-to-west orientation to continue to safely fish in the WEAs.

- In general, the USCG found that a standard grid array with multiple lines of orientation would improve safe navigation by increasing the number of directional options for vessels to transit through the WEAs and alleviate concerns about funneling vessel traffic into a navigation safety corridor by providing sufficient spacing and multiple options to transit safely through the WEAs. Ultimately, the USCG 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."

Additional analysis of the 1 x 1 NM WTG/ESP layout conducted using international design guidance from World Association for Waterborne Transport Infrastructure (PIANC 2014; 2018) found that vessels up to 122 m (400 ft) in length overall (LOA) and/or with an effective beam of 53 m (175 ft)[143] can safely operate within the layout (Baird 2019). To determine the minimum required channel width for two-way traffic when transiting or trawling within a WTG corridor, calculations were carried out using guidance provided by PIANC (2014). These calculations found that: (1) a transiting cargo/tanker vessel with a 47 m (155 ft) beam would require a channel width of 0.52 km (0.28 NM); (2) a transiting fishing vessel with an effective beam of 53 m (175 ft) would require a 0.61 km (0.33 NM) wide channel; and (3) and a trawling vessel with a 53 m (175 ft) effective beam would require a 0.59 km (0.32 NM) wide channel for safe two-way traffic. Thus, the minimum 0.7 NM (1.3 km) wide corridors created by 1 x 1 NM WTG/ESP layout are sufficient for two-way transit of fishing or other vessels (up to 122 m [400 ft] LOA) based on PIANC (2014; 2018) guidelines, allowing vessels to safely pass and overtake in opposite directions (Baird 2019).

In an emergency situation, such as an imminent collision, vessels may be required to execute a very rapid turn. Although merchant vessels are designed to turn within a tactical turn diameter of five times the length of the vessel, an allowance of six times vessel length (LOA) is often used for design purposes (PIANC 2018). Based on this criterion and assuming a vessel travelling down the center of the minimum WTG corridor width (0.7 NM) created by the 1 x 1 NM WTG/ESP layout, a vessel up to 107 to 122 m (350 to 400 ft) LOA can safely enter the SWDA (Baird 2019). Such a vessel executing a rapid turn in the 1 NM corridors would have additional buffer room on either side of the corridor. It is important to recognize that the above analyses assume that vessels

[143] Representing a fishing trawler (also potentially transiting) with a beam of 10.7 m (35 ft) with two outriggers each having a length of 21 m (70 ft).

cannot cross WTG rows when in reality, the WTGs are spaced 1 NM apart and there is room for the vessel to maneuver between the WTGs (Baird 2019). See Appendix III-I for further discussion of vessel navigation within the 1 x 1 NM WTG/ESP layout.

As described in Section 7.8.1.1, analyses of AIS data from 2016 to 2019 have indicated that historical vessel traffic levels within the SWDA are relatively low. Overall, based on this historical level of traffic, the risk of collision between vessels is relatively low (see Section 8.1 and Appendix III-I). Nevertheless, the USCG recommended in the MARIPARS that mariners transiting in the WEAs should use extra caution and ensure proper watch. See the NSRA in Appendix III-I for a detailed assessment of the risk of collision and allision due to New England Wind.

Although it is anticipated that some mariners will opt to continue transiting through, fishing in, or recreating within the SWDA, AIS data indicate that most of the vessels transiting the Offshore Development Region currently choose to navigate outside of the MA WEA and RI/MA WEA even when no WTGs or ESPs are present (see Section 7.8.1.1; Baird 2019). Of those vessels transiting the WEAs, many travel just inside the edge of the WEAs. While the MARIPARS found that "A standard and uniform grid pattern for offshore structures with multiple straight orientations throughout the MA/RI WEA would maximize safe navigation within the MA/RI WEA" additional vessel operators may select routes that avoid the SWDA or may travel at reduced speeds through the SWDA, which could result in extended travel time. Feedback received during the MARIPARS indicated that:

- ♦ Based on early discussions with the pilots and industry trade groups, USCG believes that most large commercial ships will avoid WTG arrays in the WEAs and follow the traditional deep-draft lanes. This is consistent with the USCG's review of UK guidance, which suggests that large commercial vessels tend not to navigate through wind farms.
- ♦ Although the USCG's analysis of AIS data indicated there was no significant commercial ferry traffic through the WEAs, based on feedback provided to the USCG, larger commercial passenger vessels (mostly cruise ships) would divert around the WTG arrays in the WEAs.
- ♦ Some small passenger vessel operations may opt to travel into the WEAs to conduct sightseeing tours in or around the WTGs. See Section 7.5 for a discussion of recreational opportunities provided by the SWDA.

To aid mariners navigating within and near the SWDA, each WTG and ESP will be maintained as a PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. Each WTG and ESP will be lit and marked with unique alphanumeric identifiers. Mariner Radio Activated Sound Signals (MRASS) and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety; the number, location, and type of MRASS and AIS transponders will be determined in consultation with the USCG. The WTGs and ESPs will also be clearly identified on NOAA nautical charts. See Section 7.8.2.2.5 for further description of measures intended to aid mariners navigating in and around the SWDA.

Finally, the submarine cables within the SWDA and along the OECC (including the Western Muskeget Variant) are not anticipated to preclude vessel activities. The target burial depth for all inter-array, inter-link, and offshore export cables is 1.5 to 2.5 m (5 to 8 ft) below the seafloor, which is more than twice the burial depth that is required to protect the cables from fishing activities (e.g. the use of bottom trawl gear) and also provides a maximum of 1 in 100,000 year probability of anchor strike, which is considered a negligible risk (see Appendix III-P). Except for limited areas where sufficient cable burial is not achieved and use of cable protection is required, the inter-array, inter-link, and offshore export cables are not anticipated to interfere with any typical fishing practices (see Sections 3.2.1.5.4 and 4.2.1.5.4 for a description of cable protection methods). Navigational impacts to recreational and commercial fishing during O&M of New England Wind are discussed in greater detail in Sections 7.5 and 7.6.

7.8.2.2.3 Impacts to Vessels' Marine Radar (Phases 1 and 2)

Radar is an electromagnetic system that uses radio waves and/or microwaves for the detection, location, and recognition of objects. Typical marine radar systems work by producing an electromagnetic signal that is transmitted by an antenna in a particular direction and detecting the return of the signal as it is reflected off of objects in the signal's path. The reflected electromagnetic waves that are detected by the radar system provide information about an object's location and speed. See Appendix III-I for additional description of marine radar systems.

Several studies have assessed the impact of European wind farms on radar signals, including at the Horns Rev and North Hoyle wind farms in Denmark and the UK, respectively (Howard and Brown 2004). To date, the most comprehensive study concerning the possible effects of wind farms on radar was conducted by the British Wind Energy Association (BWEA) in 2005 at the Kentish Flat Offshore Wind Farm (BWEA 2007). The Kentish Flat studies gathered field data on marine radar systems in proximity to an operating offshore wind farm. Data was sourced from marine radar systems installed in various vessel types, including the types of vessels and radar systems currently operating in the Offshore Development Region. The study was designed to determine if particular types of vessels, radar, or antennae are more susceptible to effects from wind farms. The data collected were intended to facilitate the preparation of more informed navigational risk assessments and to assist in the development of appropriate mitigation measures.

During the study, marine radar systems were observed as vessels passed in proximity to the wind farm. Approximately one-third of the vessels participating in the study experienced no discernable effects on their radar system when passing near the wind farm (BWEA 2007). Of those radar systems that were affected, a proportion of the interference observed was related to false or multiple echoes of the vessel's superstructure (i.e. radar signals bouncing back and forth between the transmitting vessel and WTGs, causing weak false echoes of the transmitting vessel to appear on the radar screen as a series of faint targets). These false or multiple echoes appeared when the vessel was near the wind farm and disappeared as the vessel moved past the wind farm and the angle of the radar signal to the wind farm changed.[144] BWEA (2007) noted that while unwanted effects were recorded on vessel radar systems, the radar operators were able to readily identify the false echoes and could safely navigate in and around the wind farm. The study also identified that the radar scanner was often installed at a poorly selected location on the ships, accentuating the spurious echoes due to the proximity of the ship structures (BWEA 2007).

In 2009, the USCG considered the potential impacts to radar navigation from WTGs (USCG 2009). The USCG concluded that the WTGs would not significantly adversely impact a mariner's ability to detect another ship located outside the wind farm, but could impact a mariner's ability to detect another ship located inside the wind farm. The USCG (2009) found that it was feasible to discern other vessels within the wind farm, but the radar operator would likely have to pay closer attention to the radar scope to distinguish between a valid and false radar return.

An investigation of the potential impact of the five-turbine Block Island Wind Farm (BIWF) on marine radar systems was conducted in 2015 (QinetiQ 2015). QinetiQ used numerical modelling to assess the radar reflection characteristics of BIWF's proposed WTGs and the potential effect on ship radar systems using two reference vessels (a small fishing vessel and larger commercial vessel). The QinetiQ (2015) radar study of BIWF found that radar systems exhibit the usual clutter and spurious echo artifacts when utilized at maximum sensitivity, but that this clutter could be decreased by reducing the gain on the radar systems without losing the ability to detect reference vessels behind the WTGs. The study also found that shadows created by the WTGs would not affect detection of the reference vessels; shadowing occurred in 100 m (328 ft) wide strips behind the WTGs and would only be significant for detecting small vessels at a large distance from the WTGs.

Most recently, the USCG's (2020) MARIPARS reviewed several studies (including the 2007 BWEA study and the 2015 BIWF study) on the correlations between offshore renewable energy installations and marine radar interference. After reviewing these studies, the USCG concluded that, "To date, the USCG is not aware of an authoritative scientific study that confirms or refutes the concern that WTGs will degrade marine radar." According to the MARIPARS, UK studies show that, "additional mitigation measures, such as properly trained radar operators, properly installed and adjusted equipment, marked wind turbines and the use of AIS, enable safe navigation with minimal loss of radar detection."

While the potential for marine radar interference is site specific and depends on many factors such as the size, number, and layout of the WTGs, construction material(s), and the types of vessels impacted, New England Wind's WTGs are likely to have similar effects on marine radar

[144] Radar system settings and the location of the radome onboard the vessels are among the factors that influence radar signals.

systems as those described in the above studies. The New England Wind WTGs may affect some shipborne radar systems, potentially creating false targets and clutter on the radar display. As discussed above, it is possible to reduce this effect through adjustment of the radar gain control. Vessels navigating within the SWDA may become "hidden" on the radar systems due to shadowing created by the WTGs. However, as noted above, the effectiveness of radar systems and any impacts from WTGs will vary from vessel to vessel based on several factors, including radar equipment settings and installation.

In order to mitigate potential effects on marine radar systems, some WTGs may be equipped with AIS transponders, with others identified virtually. The AIS scheme is being discussed with the USCG in relation to the Vineyard Wind 1 project and will likely extend to New England Wind as well. Based on a review of various studies, the New England Wind WTGs are expected to have little impact on VHF communications or AIS (see Appendix III-I). Additional mitigation measures are described in Section 7.8.2.2.5.

BOEM is currently sponsoring a study by the National Academies of Sciences, Engineering, and Medicine to evaluate impacts of WTGS on marine vessel radar and identify potential mitigation measures. The study will consist of a literature review and may also include modeling, in order to better characterize potential effects and identify actions to reduce impacts. Additional mitigation measures for potential radar impacts will be assessed following completion of this study.

7.8.2.2.4 Impacts to USCG Search and Rescue (Phases 1 and 2)

According to the USCG's (2020) MARIPARS, "SAR capabilities in the WEA will be impacted by the presence of structures in the ocean where before there were no such structures." As described in the NSRA, the presence of the New England Wind WTGs and ESPs can increase the risk of incident with SAR vessels and the presence of WTGs may affect the USCG's airborne SAR assets.

However, as described in Section 7.8.2.2.2, the 1 x 1 NM WTG/ESP layout of New England Wind is consistent with the USCG's WTG spacing recommendations to accommodate SAR operations contained in the MARIPARS. The MARIPARS found that, "One NM spacing between WTGs allows aircrews to safely execute turns to the adjacent lane using normal flight procedures in visual conditions" and "may allow sufficient navigational room for aircrews to execute USCG missions in diverse and challenging weather conditions or deal with an aircraft emergency and/or navigational malfunction." In fact, New England Wind may facilitate SAR operations as the WTGs and ESPs will be marked and lighted and New England Wind vessels will operate frequently within the SWDA. According to the MARIPARS, a standard and uniform WTG/ESP layout will assist SAR in favorable weather conditions. See the NSRA provided as Appendix III-I for additional discussion of the impacts of New England Wind on USCG SAR missions.

As described in Section 7.8.2.2.5, the Proponent will work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations.

7.8.2.2.5 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

As described in Section 7.8.2.2.2, New England Wind's 1 x 1 NM WTG/ESP layout is consistent with USCG's recommendations that WTG layouts within the WEAs should be developed along a standard and uniform grid pattern with at least three lines of orientation and standard spacing. As stated in the USCG's (2020) MARIPARS, "A standard and uniform grid pattern for offshore structures with multiple straight orientations throughout the MA/RI WEA would maximize safe navigation within the MA/RI WEA."

To aid mariners navigating within and near the SWDA, each WTG and ESP will be maintained as a PATON in accordance with USCG's PATON marking guidance for offshore wind facilities in First District-area waters. Based on USCG's current *ME, NH, MA, RI, CT, NY, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* contained in District 1 Local Notice to Mariner (LNM) 44/20, the Proponent expects to implement a uniform system of marine navigation lighting and marking that includes yellow flashing lights on every WTG foundation and ESP and alphanumeric identifiers (as close to 3 m [10 ft] high as possible) on the WTGs, ESPs, and/or their foundations. The lights and alphanumeric identifiers would be visible from all directions. the Proponent also anticipates that the WTG's air draft restriction will be indicated on the foundation and/or tower and that each foundation will be coated with high-visibility yellow paint (above sea level). MRASS and AIS transponders are included in the offshore facilities' design to enhance marine navigation safety. The number, location, and type of MRASS and AIS transponders will be determined in consultation with USCG. Further information on marine navigation lighting and marking can be found in the NSRA (see Appendix III-I).

As with during construction, all New England Wind -related vessels and equipment will display the required navigation lighting and day shapes.

The Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue NTMs advising other vessel operators of O&M activities. The Proponent's website will be regularly updated to provide information on the O&M activities occurring in the Offshore Development Area. The WTGs and ESPs will also be clearly identified on NOAA nautical charts.

To mitigate potential impacts to SAR aircraft operating in the SWDA, the Proponent will work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations. The protocol will include formal procedures that will enable efficient, effective processes for communicating and engaging the braking mechanism requests during SAR operations and other emergency response situations.

Finally, the Proponent will continue to work with the USCG, BOEM, and other stakeholders to maintain safe navigation within the Offshore Development Area and to identify additional potential mitigation measures, as necessary.

7.8.2.3 Decommissioning

Decommissioning of New England Wind's offshore facilities, as described in Sections 3.3.3 and 4.3.3 of COP Volume I, will include removal of the WTGs, ESPs, foundations, associated scour protection, and possibly the offshore cables and associated cable protection (if required) from the SWDA and OECC. Impacts from these activities will be similar to those associated with construction activities, as described in Section 7.8.2.1. As part of the decommissioning process, all obstructions and PATONs will be removed from the SWDA.

Impacts associated with decommissioning activities will be adequately mitigated through the implementation of best management practices, where practicable. Avoidance, minimization, and mitigation measures are anticipated to be similar to those described above in Section 7.8.2.1.5.

7.9 Other Uses (National Security, Aviation, Offshore Energy, Marine Minerals, Cables and Pipelines, Radar, and Scientific Research)

This section describes other uses within the Offshore Development Region and Onshore Development Region that may be affected by New England Wind. These "other uses" include national security and military uses, cables and pipelines, aviation, marine mineral extraction, offshore energy projects (other than New England Wind), radar systems, and scientific research and surveys. This section is primarily focused on other uses that occur offshore but also includes onshore uses, such as aviation and radar, that may be impacted by New England Wind-related activities. New England Wind will be developed in two Phases with a maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions located in all of Lease Area OCS-A 05134 and the southwest portion of Lease Area OCS-A 0501 (referred to as the Southern Wind Development Area [SWDA]).

While the Proponent intends to install all five New England Wind offshore export cables within the Offshore Export Cable Corridor (OECC) that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the option to install one or two Phase 2 cables[145] along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[146] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

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[145] It is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

[146] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

7.9.1 *Description of the Affected Environment*

For the purposes of this section, the Offshore Development Region and Onshore Development Region are the broader geographic regions offshore and onshore, respectively, that could be affected by New England Wind-related activities. These regions include Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the Massachusetts Wind Energy Area (MA WEA), the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), and waters surrounding potential vessel routes to the ports identified for use by New England Wind as well as the cities and towns surrounding the areas where New England Wind-related activities will occur. New England Wind activities will occur in the following areas:

- **SWDA:** Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501 in federal waters off the coast of Massachusetts.
- **OECC:** The corridor identified for routing the offshore export cables in Massachusetts state waters and federal waters. The Proponent is reserving the option to install one or two Phase 2 cables in the Western Muskeget Variant if technical, logistical, grid interconnection, or other unforeseen issues arise with installing all New England Wind offshore export cables within the OECC.
- **Port facilities:** Potential use of port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey.[147]

7.9.1.1 National Security

United States Navy

The United States (US) Navy has a significant presence along the US northeastern seaboard. Several naval facilities located outside of the Offshore Development Region may conduct training or operations within the Offshore Development Region, including within offshore waters or airspace in proximity to the SWDA and OECC (including the Western Muskeget Variant). These include Naval Station Newport in Newport, Rhode Island, which is home to 50 US Navy, US Marine Corps, US Coast Guard (USCG), and US Army Reserve commands and activities. Naval Station Newport is also home to the US Navy Supply Corps School, the Center for Service Support, the US Marine Corps Aviation Logistics School, and the Naval War College. Approximately 5,800 employees work at the various Naval Station Newport commands, and an additional 17,000 students annually pass through one of the many schools located on base. Naval Station Newport

[147] Although some components, materials, and vessels could come from Canadian and European ports (see Sections 3.2.2.5 and 4.2.2.5 of COP Volume I), impacts to other uses are only assessed for New England Wind activities within United States (US) waters.

also hosts the Naval Undersea Warfare Center, which is one of the corporate laboratories of the Naval Sea Systems Command. Additionally, New London and Groton, Connecticut host equipment and personnel at US Naval Submarine Base New London and the USCG Academy.

The US Navy maintains three range complexes located along the mid-Atlantic and northeastern seaboard of the US. A range complex is a designated set of specifically bounded geographic areas that encompass a water component (above and below the surface), airspace, and may encompass a land component. Range complexes are where training and testing of military platforms, tactics, munitions, explosives, and electronic warfare systems occur. They include established Operating Areas (OPAREAs) and special use airspace, which may be further divided to provide better control of an area and events being conducted for safety reasons.

The three range complexes—the Boston Range Complex, the Narragansett Bay Range Complex, and the Atlantic City Range Complex—are collectively referred to as the Northeast Range Complex and span the coast from Maine to New Jersey. Combined, these areas are the principal locations for some of the US Navy's major training and testing events and infrastructure in the Northeast. The Northeast Range Complex includes special use airspace with associated Warning Areas and surface and subsurface sea space of three OPAREAs: the Boston OPAREA, the Narragansett Bay OPAREA, and the Atlantic City OPAREA. The boundaries of the three OPAREAs largely correspond with the boundaries of the Boston, the Narragansett Bay, and the Atlantic City Range Complexes (see Figure 7.9-1).

The SWDA is located within the Narragansett Bay Range Complex and Narragansett Bay OPAREA (see Figure 7.9-1). This OPAREA is a surface and subsurface exercise/operating area, extending approximately 185 kilometers (km) (100 nautical miles [NM]) south and 407 km (220 NM) east of the coasts of Massachusetts, Rhode Island, and New York. OPAREA training exercises generally occur in deeper offshore waters, southeast of the SWDA (J. Casey, personal communication, November 30, 2017; SAMP 2010). US Navy vessels may, however, remain in shallower portions of the Narragansett Bay OPAREA in preparation for formal voyages (J. Casey, personal communication, November 30, 2017). Submarine Transit Lanes, which are transit corridors where submarines may navigate underwater, are also located within the Offshore Development Region.

United States Coast Guard

The USCG 1st District is headquartered in Boston, Massachusetts and is responsible for USCG activities in Northern New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, and Maine. The USCG 5th District, headquartered in Portsmouth, Virginia, maintains maritime safety and security of 404,038 square kilometers (km^2) (156,000 square miles [mi^2]) of navigable waterways in the Mid-Atlantic Region, from South Carolina to New Jersey (USCG 2020b). Each district is further divided into sectors.

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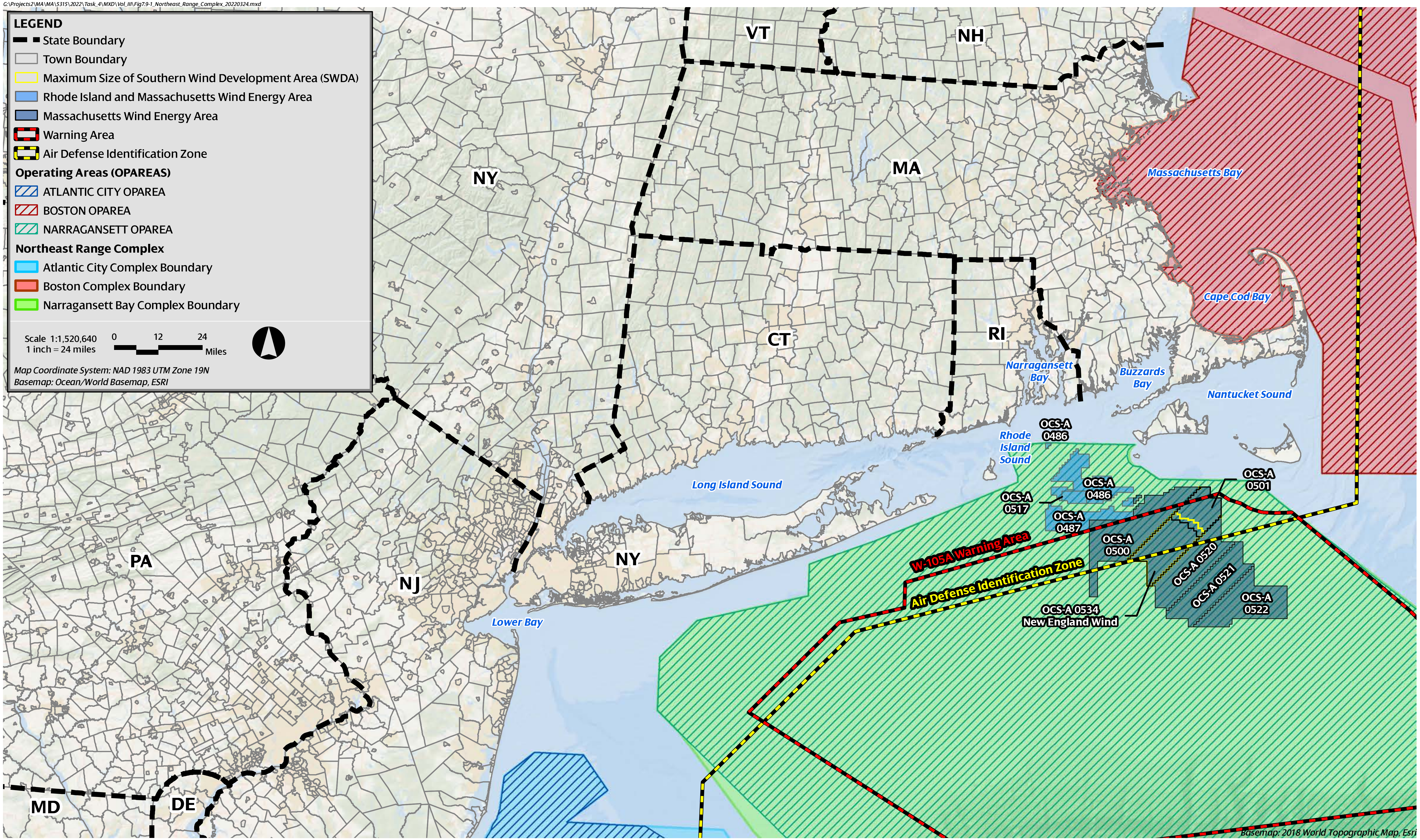

Figure 7.9-1
Military and Airspace Uses

- The SWDA is located within Sector Southeastern New England. Sector Southeastern New England, located in Woods Hole, Massachusetts, and its affiliated USCG stations cover over 777 km^2 (300 mi^2) of offshore waters and 1,930 km (1,200 mi) of coastline in Rhode Island and southeastern Massachusetts, including Cape Cod and the Islands (see Figure 7.9-2). Air Station Cape Cod, the only USCG Aviation Facility in the northeast, is located at Joint Base Cape Cod. Air Station Cape Cod provides search and rescue (SAR) operations, maritime law enforcement, international ice patrol, aids to navigation support, and marine environmental protection. USCG Base Cape Cod, also located at Joint Base Cape Cod, serves as the Deputy Commandant for Mission Support in support of USCG operations within the USCG 1st District.

Vessels transiting to and from potential ports in Connecticut, New York, and New Jersey may pass through Sector Long Island Sound, Sector New York, and Sector Delaware Bay, which are further described below:

- **Sector Long Island Sound (New Haven, Connecticut):** Sector Long Island Sound's area of responsibility runs from the New York/Connecticut border at Port Chester, New York; to the Connecticut/Rhode Island border at Watch Hill and along the northern coastline of Long Island across the "Race"[148] to Plum Island. The area of responsibility extends approximately 370 km (200 NM) out to sea. Sector Long Island Sound's area of responsibility comprises 61,100 km^2 (23,600 mi^2), including 724 km (450 mi) of coastline in Connecticut and the north and south shores of Long Island, New York (see Figure 7.9- 2).

- **Sector New York (Staten Island, New York):** New York is the largest USCG operational field command on the East Coast. Sector New York's area of operation extends from Sandy Hook, New Jersey, north through the Port of New York and New Jersey, up the Hudson River to south of Lake Champlain, and up the East River to the Long Island Sound/Connecticut border (USCG 2020c).

- **Sector Delaware (Philadelphia, Pennsylvania):** Sector Delaware's area of responsibility constitutes portions of New Jersey, Pennsylvania, and Delaware, and the commercial ports of Philadelphia and Wilmington, extending approximately 370 km (200 NM) from these states' coastlines (USCG 2020d).

[148] The Race is a deepwater channel which is the primary area of tidal exchange between the waters of Long Island Sound and Block Island Sound.

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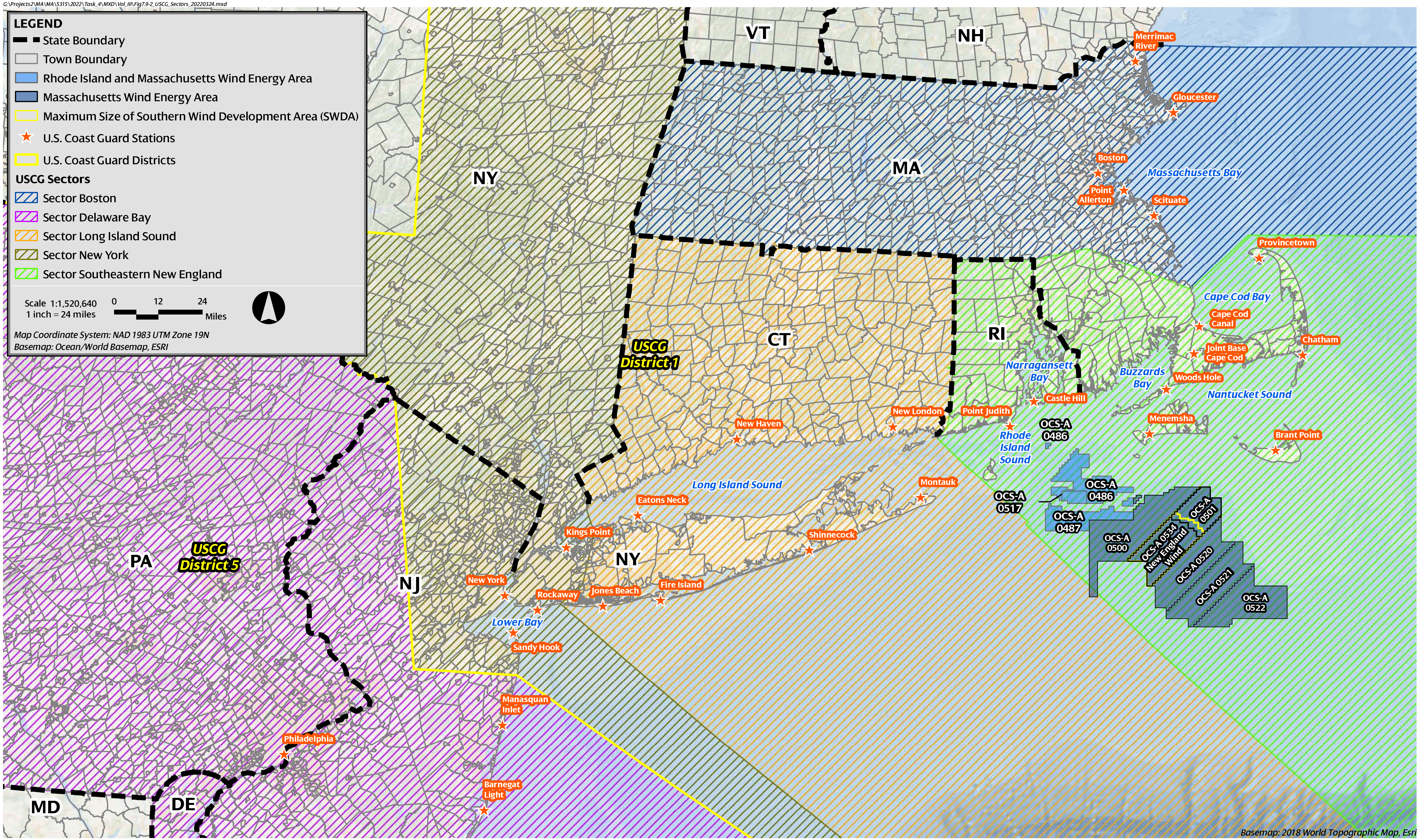

New England Wind
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Figure 7.9-2
USCG Sectors

7.9.1.2 Aviation and Air Traffic

Various segments of airspace overlie the Offshore Development Region and Onshore Development Region, including US territorial airspace, different levels of controlled airspace, and special-use airspace.

- **Territorial Airspace:** Territorial airspace is airspace over the US, its territories and possessions, and over US territorial waters out to 22 km (12 NM) from the coast. Although the SWDA is not located within territorial airspace, portions of the OECC, portions of the vessel routes between port facilities and the Offshore Development Area, and the port facilities themselves are within territorial airspace.

- **Controlled Airspace:** New England Wind-related activities may occur within three different controlled airspace classifications: Class E, East Coast Low Area, and the Atlantic Low Area. These airspace classifications define the volumes of airspace within which air traffic control services are provided. They also often dictate different operating requirements that are imposed upon pilots, including weather, communication, and equipment minimums.

- **Special-Use and Other Airspace:** The US Navy and, occasionally, other US Department of Defense (DoD) organizations use the airspace over and adjacent to the SWDA. The DoD uses domestic and international airspace for readiness training and exercises. To make "nonparticipating pilots" aware of military operations, the Federal Aviation Administration (FAA) designates sectors of airspace as Warning Areas and charts these areas on aeronautical charts with an identifying number. Within Warning Area airspace, limitations may be imposed on aircraft not participating in military operations. The SWDA, along with much of the Massachusetts Wind Energy Area (MA WEA), is within Warning Area W-105A, which is a block of airspace ranging from 0–15,240 meters (m) (0–50,000 feet [ft]) Above Mean Sea Level (AMSL). A portion of the SWDA is located within the limits of the Air Defense Identification Zone; all international flights entering this zone into US domestic airspace must provide the appropriate documentation. Being located in within these limits is not likely to have a physical impact on aviation operations.

Major airports in the region include Boston Logan International Airport (International Air Transport Association airport code BOS), which is located approximately 147 km (91 miles) from the SWDA, and T.F. Green Airport (International Air Transport Association airport code PVD), which is located approximately 101 km (63 miles) from the SWDA. The closest public airports to the SWDA are Katama Airpark and Martha's Vineyard (MVY) Airport on Martha's Vineyard and Nantucket Memorial Airport (ACK) on Nantucket.

Military, government, research, and other private aircraft may occasionally fly over the SWDA for training exercises, surveys, and SAR operations. Historical FAA air traffic data indicate relatively low use of the airspace above the SWDA at elevations that would be impacted by the presence of

New England Wind's WTGs. Further discussion of historical air traffic operations over the SWDA are provided in the Air Traffic Flow Analysis (ATFA) and the Obstruction Evaluation and Airspace Analysis (OE&AA) in Appendix III-J.

7.9.1.3 Offshore Energy

Energy Policy Act of 2005 amendments to the Outer Continental Shelf Lands Act grant the Secretary of the Interior authority to issue leases, easements, or rights-of-way on the Outer Continental Shelf (OCS) for the purpose of wind energy development (43 U.S.C. § 1337(p)(1)(C)). To that end, BOEM has identified the most appropriate areas for commercial wind energy leasing on the OCS off the Atlantic Coast. To date, BOEM has identified several wind energy areas (WEAs) on the OCS for commercial offshore wind energy development. These areas were selected after exhaustive public consultation processes with a goal of minimizing conflicts among existing uses and the environment.

New England Wind is located in the MA WEA, in proximity to the Rhode Island/Massachusetts (RI/MA) WEA. The development of additional offshore energy projects in lease areas within both the MA WEA and RI/MA WEA is expected. As of June 1, 2021, the following projects are planned for these WEAs:

- Vineyard Wind 1—An approximately 800 megawatt (MW) project in Lease Area OCS-A 0501 owned by Vineyard Wind 1 LLC. The project will deliver power to Massachusetts with operations expected to start in 2023.

- South Fork—A 132 MW project in Lease Area OCS-A 0517 owned by Eversource and Ørsted. The project will deliver power to New York with operations expected to start in 2023.

- Revolution Wind—An approximately 700 MW project in Lease Area OCS-A 0486 owned by Eversource and Ørsted. The project will deliver power to Connecticut and Massachusetts with operations expected to start in 2023.

- Bay State Wind—An 800 MW project in Lease Area OCS-A 0500 owned by Eversource and Ørsted with operations expected to start in 2027.

- Sunrise Wind—An approximately 880 MW project in Lease Areas OCS-A 0487 and OCS-A 0500 owned by Eversource and Ørsted. The project will deliver power to New York with operations expected to start in 2024.

- Mayflower Wind—An approximately 804 MW project located in Lease Area OCS-A 0521 being developed through a joint venture between Shell and EDP Renewables. The project will deliver power to Massachusetts with operations expected to start in the mid-2020s.

In addition to the projects listed above, several other lease areas in the region are expected to support production and transmission of offshore wind energy within the next decade. Currently, there are 17 active commercial leases for offshore wind development in federal waters off the East Coast. The Block Island Wind Farm, a 30 MW offshore wind farm located in Rhode Island state waters approximately 5 km (2.7 NM) southeast of Block Island and 56 km (30 NM) from the SWDA, is the only active renewable energy facility in the Offshore Development Region.

Additionally, a marine hydrokinetic facility being evaluated for the Muskeget Channel has been discontinued and the project is no longer pursuing deployment of tidal energy turbines within Muskeget Channel.

7.9.1.4 Sand and Marine Mineral Extraction

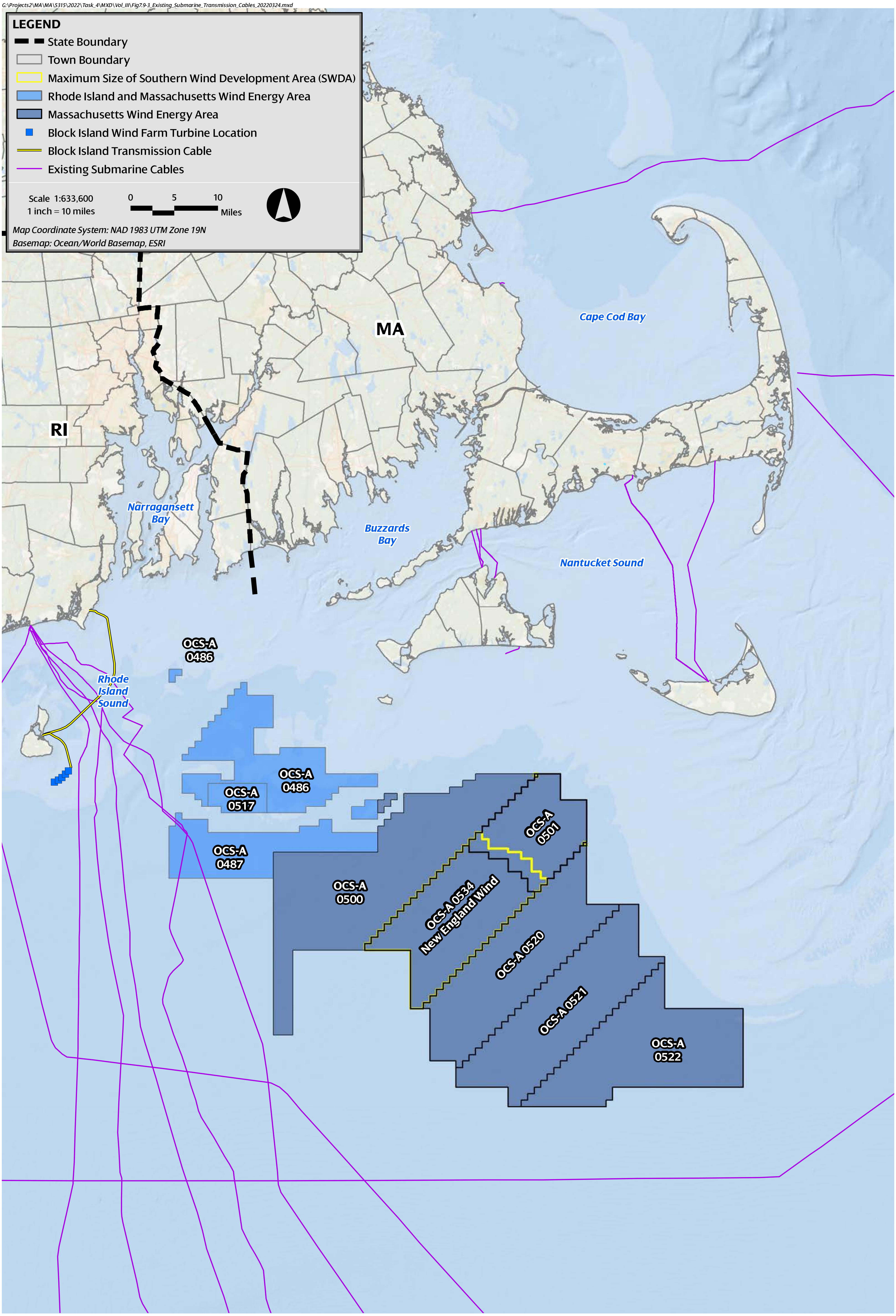
Chronic shoreline erosion, damage caused by coastal storms, and a growing awareness of the risks associated with climate change-induced sea level rise have increased the demand for sand resources suitable for beach and other nourishment efforts along the Atlantic coast. Sand resources on the OCS managed by BOEM may provide material to support costal resilience projects and plans designed with federal, state, and local partners. To help coastal communities recover from coastal storms and promote resilient coastal systems, BOEM funded offshore surveys in 2015–2017 as part of the Atlantic Sand Assessment Project to identify new sources of sand in federal waters 5.5–15 km (3–8 NM) offshore.

A review of BOEM's Marine Minerals Information Systems indicates that no sand resource areas were identified and characterized during governmental reconnaissance- and design-level studies conducted during the aforementioned offshore surveys. The Marine Minerals Information Systems also indicates that no federal OCS sand and mineral lease areas are located within the Offshore Development Region; the closest active lease is offshore New Jersey, approximately 274 km (170 mi) east of the MA WEA (BOEM MMIS 2020). Further, no significant sand resource blocks have been identified in the Offshore Development Region.

7.9.1.5 Offshore Cables and Pipelines

Currently, a total of five submarine transmission cable systems are located in Nantucket Sound, which are identified on National Oceanic and Atmospheric Administration's (NOAA) Raster Navigational Charts that service Nantucket and Martha's Vineyard (see Figure 7.9-3). Three of the five cables service Martha's Vineyard by interconnecting the Town of Falmouth on Cape Cod with Vineyard Haven and Tisbury through the easterly side of Vineyard Sound. The two remaining cables service Nantucket with cables from Dennis Port and Hyannis Port interconnecting through Nantucket Sound to a landfall at Jetties Beach. The Hyannis Port cable makes landfall at Kalmus Beach in Outer Lewis Bay.

As described in Section 2.4 of COP Volume I, unless technical, logistical, grid interconnection, or other unforeseen issues arise, all New England Wind offshore export cables will be installed within a shared OECC while maintaining a reasonable distance between each cable to facilitate



New England Wind
AVANGRID RENEWABLES

Figure 7.9-3
Existing Submarine Transmission Cables

installation as well as any future repairs that may be needed. The majority of the OECC will also be shared with Vineyard Wind 1's offshore export cables. As described further in Section 2.4 of COP Volume I, engineering evaluation has determined that it is feasible to install the New England Wind cables within substantially the same OECC used for Vineyard Wind 1. However, the Proponent is reserving the Western Muskeget Variant as a fallback option for the Phase 2 OECC.

As described in Section 7.9.1.3 above, several other offshore wind projects are currently planned for the MA WEA and RI/MA WEA. Mayflower Wind is the only other project with publicly-announced plans to install offshore cables within the vicinity of the OECC for New England Wind. Mayflower Wind currently plans to install its offshore export cables north from Lease Area OCS-A 0521 through Muskeget Channel and Nantucket Sound to a landfall site on Cape Cod's southern shore. The Proponent and Mayflower Wind would coordinate on any required cable crossings.

No offshore pipelines are located within the Offshore Development Region.

7.9.1.6 Radar Systems Other than Marine Navigation Radar

Commercial air traffic control radar systems, national defense radar systems, and weather radar systems operate in the Offshore Development Region and Onshore Development Region. A number of commercial air traffic control radar systems are deployed to service the Onshore and Offshore Development Region, as noted below. National defense radar systems operating within the Onshore and Offshore Development Region include the Precision Acquisition Vehicle Entry/Phased Array Warning System installation at Joint Base Cape Cod (also known as Cape Cod).

Air Force Station Early Warning Radar [AFS EWR]). The DoD uses the Cape Cod AFS EWR for ballistic missile defense and space surveillance. Radar systems for marine navigation are discussed in Section 7.8.

Weather radar systems (weather surveillance radar [WSR]) operating in the Onshore and Offshore Development Region include NEXRAD, which is also known as Next-Generation Radar. NEXRAD is a network of 160 high-resolution S-band Doppler weather radars operated by the National Weather Service (NWS) in a joint effort between the US Department of Commerce, US Department of Transportation, DoD, the US Air Force Weather Agency, and the FAA. The primary function of the NEXRAD system is to supply data to meteorologists for weather forecasting purposes. NEXRAD installations are located at the NWS Taunton, Massachusetts facility ("KBOX"), approximately 110 km (68 mi) to the north of the SWDA, and at the NWS Brookhaven, New York facility ("KOKX"), approximately 170 km (106 mi) west of the SWDA. KBOX, although located in Taunton, serves the Boston area and is sometimes referenced geographically as the "Boston" NEXRAD facility.

The FAA also operates a Terminal Doppler Weather Radar (TDWR) installation at the Boston Logan International Airport. TDWR systems are used primarily for the detection of hazardous wind shear conditions, precipitation, and winds aloft, on, and near major airports located in areas with great exposure to thunderstorms, such as Boston, Massachusetts. The TDWR system at the Boston Logan International Airport is located approximately 147 km (91 mi) north of the SWDA.

An initial review indicates that the following 10 primary surveillance radar sites are located within approximately 185 km (100 NM) of the SWDA (see Figure 7.9-4):

- Boston Airport Surveillance Radar (ASR) model-9 (ASR-9)
- Boston TDWR
- Cape Cod AFS EWR (Precision Acquisition Vehicle Entry/Phased Array Warning System)
- Falmouth Airport Surveillance Radar model-8 (ASR-8)
- Nantucket ASR-9
- North Truro Air Route Surveillance Radar (ARSR) model-4 (ARSR-4)
- Providence ASR-9
- Riverhead ARSR-4
- Boston (KBOX) WSR-88D
- Brookhaven (KOKX) WSR-88D

These radar sites provide radar data to multiple DoD, Department of Homeland Security, FAA, and NOAA facilities for conducting air traffic control, air defense, ballistic missile defense, homeland security, space surveillance, and weather operations.

Additionally, an initial review identified the following two navigational aid sites near the proposed wind turbines:

- Martha's Vineyard Very High Frequency Omnidirectional Range (VOR) and co-located Distance Measuring Equipment (VOR/DME)
- Nantucket VOR/DME

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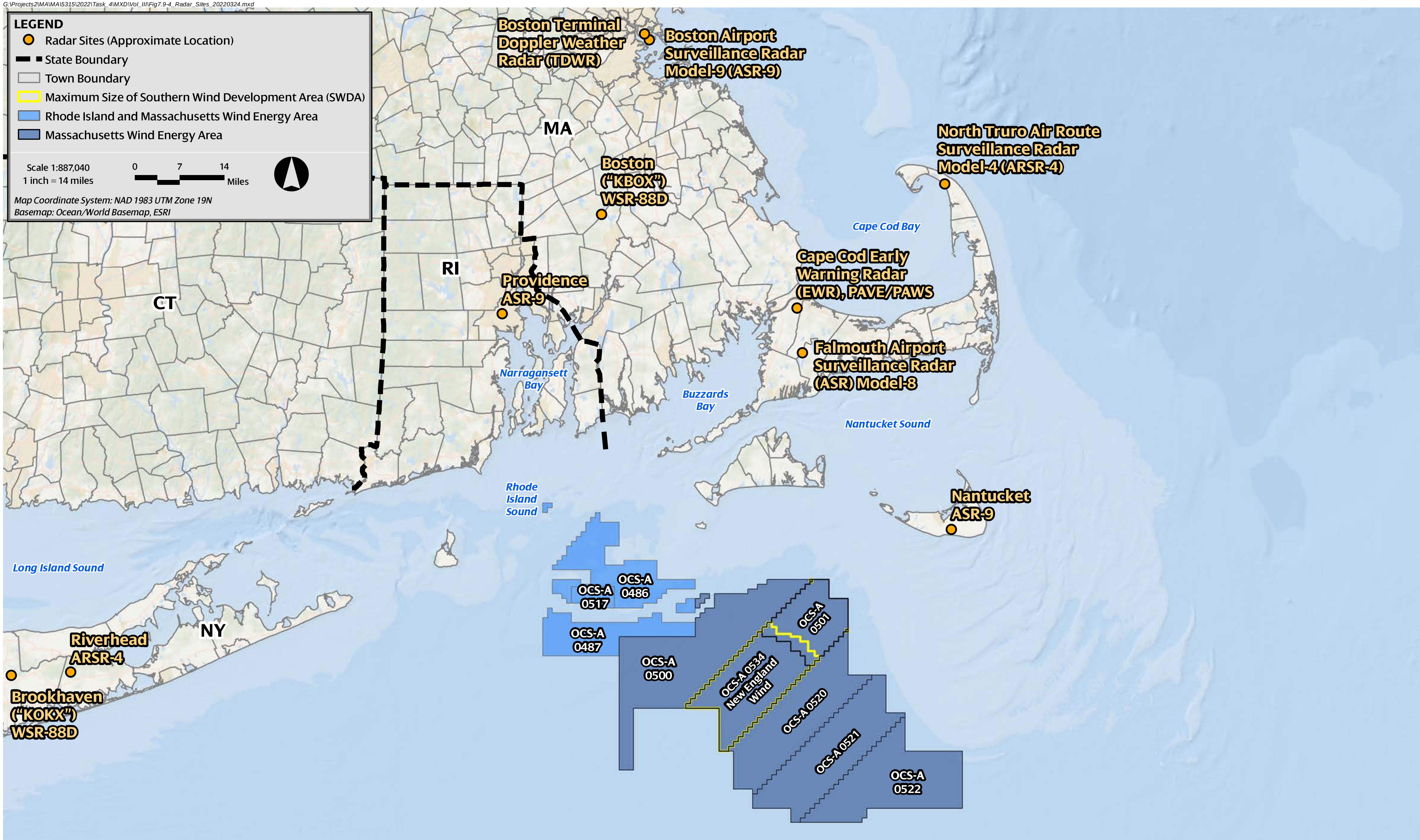

New England Wind
AVANGRID RENEWABLES

Figure 7.9-4
Radar Sites

- In addition to the above radar sites, an initial review identified 12 coastal high frequency (HF) radar sites in the vicinity of the SWDA:
- Amagansett HF radar
- Block Island Long Range HF radar
- Camp Varnum HF radar
- Horseneck Beach State Reservation HF radar
- Long Point Wildlife Refuge HF radar
- Martha's Vineyard HF radar
- Moriches HF radar
- Martha's Vineyard Coastal Observatory (MVCO) Meteorological Mast HF radar
- Nantucket HF radar
- Nantucket Island HF radar
- Nauset HF radar
- Squibnocket Farms HF radar

The Amagansett HF radar, Block Island Long Range HF radar, Martha's Vineyard HF radar, Moriches HF radar, and the Nantucket Island HF radar are operated by Rutgers University. The Camp Varnum HF radar, Horseneck Beach State Reservation HF radar, Long Point Wildlife Refuge HF radar, MVCO Meteorological Mast HF radar, Nantucket HF radar, and the Squibnocket Farms HF radar are operated by the Woods Hole Oceanographic Institution. The Nauset HF radar is operated by the University of Massachusetts Dartmouth. NOAA's Integrated Ocean Observing System (IOOS) Office and other federal agencies use the ocean surface current and wave data provided by these HF radar sites.

7.9.1.7 Scientific Research and Surveys

Several federal and state agencies, educational institutions, and environmental non-governmental organizations conduct aerial and ship-based oceanographic, biological, geophysical, and archaeological research in the vicinity of the Offshore Development Region.

The Ecosystems Surveys Branch of NOAA's Northeast Fisheries Science Center (NEFSC) collects fishery-independent data during standardized research vessel surveys (trawl surveys) in the spring (March–April) and fall (September–October). The surveys are conducted in the offshore Atlantic waters from Cape Hatteras to the Scotian shelf and provide oceanographic data for monitoring the health and status of marine resources and their habitat. The NEFSC trawl surveys gather data on abundance, distribution, feeding ecology, size, and age composition for stocks of economically and ecologically important species. Survey data are used to monitor trends in abundance, biomass, and recruitment; monitor the geographic distribution of species; monitor ecosystem changes; monitor trends in biological parameters (growth, mortality, and maturation rates) of the stocks; and collect environmental data.

Additionally, the Massachusetts Division of Marine Fisheries (MA DMF), as part of its responsibility to manage the Commonwealth of Massachusetts' living marine resources, has conducted spring and fall trawl surveys. MA DMF trawl survey data are intended to quantify the distribution, relative abundance, and size composition of finfish and select invertebrates within the territorial waters of Massachusetts, inclusive of Nantucket Sound. These surveys may occur in the same geographical area as the OECC (including the Western Muskeget Variant).

Other surveys currently occurring the in the Offshore Development Region, which may continue beyond the start of construction for either Phase of New England Wind, may include but are not limited to:

- Atlantic Marine Assessment Program for Protected Species surveys (Phase II occurred 2015–2019)
- New England Aquarium aerial surveys
- Surveys conducted by the Proponent and other offshore wind leaseholders, which would only occur within their respective lease areas or OECCs
- NEFSC Surf clam and Ocean Quahog Survey

7.9.2 Potential Impacts of New England Wind

For most of the other uses of the OCS considered in this section, potential impacts are related to New England Wind offshore development as a whole within the SWDA and along the OECC (including the Western Muskeget Variant). The assessment of potential impacts in this section therefore considers the full buildout of Phases 1 and 2 of New England Wind. Specific to the aviation and radar analyses, potential impacts are related to the specific height of the WTGs under consideration.[149] The impact producing factors for other uses are provided in Table 7.9-1.

[149] Prior to the April 2022 COP revision that updated the Phase 1 WTG dimensions to match the Phase 2 WTG dimensions, the aviation assessments were performed separately for the Phase 1 WTGs and the Phase 2 WTGs. Given that the Phase 1 and Phase 2 WTGs now have equivalent heights, the assessments performed for the SWDA using the Phase 2 WTG heights are now representative of both Phases.

Table 7.9-1 Impact Producing Factors for Other Uses

Impact Producing Factors	Southern Wind Development Area	Offshore Export Cable Corridor	Onshore Development Areas	Construction and Installation	Operations and Maintenance	Decommissioning
Vessel traffic	•	•		•	•	•
Presence of towers	•			•	•	•
Presence of construction equipment	•	•	•	•	•	•
Cable installation		•		•		•
Port utilization	•	•		•		•
Helicopter use	•				•	

7.9.2.1 Construction and Installation

The New England Wind components that will be installed in the Offshore Development Area include WTGs, up to five electrical service platforms (ESPs), and offshore export, inter-array, and inter-link cables. At various points during construction of either Phase 1 or 2, large vessels with limited maneuverability will deliver WTGs, ESPs, foundations, and associated equipment to the SWDA, either from one or more port facilities or directly to the site. Likewise, cable laying and other support vessels will deliver and install offshore export, inter-array, and inter-link cables to the OECC and SWDA. During construction and installation activities, these vessels will be on-station in the SWDA or OECC with limited mobility. Temporary safety buffer zones may be established around work areas during construction and installation. The temporary safety buffer zones are expected to improve safety in the vicinity of active work areas and would not affect the entire SWDA or OECC (including the Western Muskeget Variant) at any given time.

The Proponent has identified several port facilities and construction staging areas in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for major Phase 1 or Phase 2 construction staging activities. A complete list of the ports that may be used for Phases 1 or 2 can be found in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.

7.9.2.1.1 National Security (Phases 1 and 2)

New England Wind construction activities may result in temporary impacts to navigation and have the potential to affect US Navy or USCG operations. Since OPAREA training exercises generally occur in deeper offshore waters southeast of the SWDA, the Proponent does not anticipate that construction activities will result in significant interference with either US Navy or USCG operations. Potential impacts from New England Wind on DoD operations within W-105A are described further in Section 7.9.2.1.2. Potential impacts to North American Aerospace Defense Command (NORAD) homeland defense radar are described in Section 7.9.2.2.2.

The Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the USCG to provide Notices to Mariners that describe New England Wind-related activities that may be of interest to national security interests, including US Navy personnel operating within the Offshore Development Region. In accordance with the stipulations in Lease OCS-A 0534, the Proponent will temporarily suspend operations and evacuate the SWDA if required for national security or defense purposes.

7.9.2.1.2 Aviation and Air Traffic (Phases 1 and 2)

The following addresses the potential airspace impacts associated with offshore structures in the SWDA, activities at the onshore ports and construction staging areas, and the movement of vessels between ports and the Offshore Development Area. DoD Warning Areas are also discussed. Proposed aviation marking and lighting of the WTGs is discussed in Section 3.2.1.1 and 4.2.1.1 of COP Volume I. Appendix III-J contains two aviation impact analyses for Phases 1 and 2: the OE&AA and ATFA.[149]

The FAA has jurisdiction to review "structures interfering with air commerce" (49 U.S.C. § 44718) within US territorial waters which extend 22 km (12 NM). The FAA also has jurisdiction to review certain structures used at construction staging areas and transported on vessels within territorial waters. Finally, the FAA reviews any modifications to minimum vectoring altitudes (MVAs), and these reviews are not limited to US territorial waters.

Under FAA regulations, any party that proposes to build certain structures within FAA jurisdiction, including those more than 61 m (200 ft) above ground level (AGL), must notify the FAA. The FAA then evaluates the proposed structure(s) to determine if it would constitute an obstruction to air navigation that may affect the safe and efficient use of navigable airspace or the operation of planned or existing air navigation and communication facilities. Whether a proposed structure is an "obstruction" is determined by its height and location. If the FAA concludes a proposed structure is an obstruction or would have a substantial adverse physical or electromagnetic effect on the operation of air navigation facilities—or if the FAA determines it is otherwise necessary—the FAA will conduct an aeronautical study to assess the extent of any adverse impact on the safe and efficient use of the airspace, facilities, or equipment.

BOEM has jurisdiction to review impacts to aviation from structures that are located beyond US territorial waters. BOEM is likely to follow the FAA's policies and guidance when evaluating impacts to aviation from structures within its jurisdiction.

At various points during construction of New England Wind, three geographic areas will contain WTGs, EPSs, cranes, and equipment that may affect flight operations. These areas are: (1) the SWDA which will be the final, as-built location of the WTGs and ESPs (2) the onshore ports and construction staging areas, and (3) vessel routes used to transport New England Wind components from port facilities and construction staging areas to the SWDA or OECC (including the Western Muskeget Variant). The FAA's jurisdiction over these three geographic areas of New England Wind is discussed below.

Offshore Development Area

As previously stated, the FAA has jurisdiction to review "structures interfering with air commerce" within US territorial waters up to 22 km (12 NM) offshore. None of the WTGs or ESPs in the SWDA will be located within US territorial waters and are therefore not subject to FAA jurisdiction, other than for review of potential changes to MVAs.

Appendix III-J contains two aviation impact analyses of the SWDA (OE&AA and ATFA). In addition, recent "determination of no hazard to air navigation" precedents in the MA WEA were reviewed. The purpose of these analyses and the precedents review was to identify aviation impacts resulting from the construction of WTGs within the SWDA. The analyses reviewed the potential impacts of WTGs with blade tip heights of up to 357 m (1,171 ft). Impacts to aviation and air traffic during installation and construction are anticipated to be similar to those described in Section 7.9.2.2.2.

Overall, construction of New England Wind may cause some aircraft (particularly those conducting training exercises, surveys, and SAR operations) to alter their flight paths to avoid WTGs in the SWDA; however, based on the volume of other airspace available and the low percentage of aircraft using the airspace above the Offshore Development Area, impacts to aviation are not expected.

Onshore Development Areas

As described in Sections 3.2.2.5 and 4.2.2.5 of COP Volume I, the Proponent has identified several port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for major construction staging activities for Phases 1 or 2. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction of both Phases depending upon final construction logistics planning. For each port being evaluated for use by either Phase 1 or 2, it is anticipated that WTG components may potentially be delivered from ship to shore and stored in laydown areas without impacting aviation operations in the area. While at the construction staging area, the WTGs may exceed 61 m (200 ft) AGL or may otherwise require notice to the FAA.[150] In addition, during the construction and installation of New England Wind, onshore cranes will be utilized for assembly of WTG towers (or, for bottom-frame foundations, assembly of towers and foundations) and loading and unloading ships. Many of the ports under consideration for construction and installation, or related activities, already have cranes and other equipment necessary to handle WTG components. Cranes and other equipment used in both the assembly process and the unloading and loading of New England Wind components may also exceed 61 m (200 ft) AGL/AMSL in height and similarly require notice to the FAA. When construction logistics for each Phase of New

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[150] Transition pieces may also be stored and undergo final assembly at port facilities and construction staging areas. However, with a maximum height of 40 m (131 ft) for Phases 1 and 2, the transition pieces are not expected to require notice to the FAA.

England Wind are further defined, the Proponent expects to coordinate with the FAA on defining the boundary of the construction staging areas. FAA Form 7460-1 Notice of Proposed Construction or Alteration will be submitted for each structure requiring notice to the FAA via the FAA's Obstruction Evaluation/Airport Airspace Analysis online portal.

Once onshore construction staging areas have been selected, the Proponent will assess the potential for these areas to impact visual flight rules operations and instrument flight rules procedures. The FAA uses level and sloping imagery surfaces to determine if a proposed structure is an obstruction to navigation. Additionally, onshore construction cranes at construction staging areas may exceed public-use airport imaginary surfaces defined in 14 CFR Part §77. If so, such cranes are likely to be subject to marking and lighting in accordance with FAA Advisory Circular 70/7460-1M.

Marine Vessel Transportation of New England Wind Components

New England Wind components will be transported into and out of port facilities and construction staging areas to the Offshore Development Area. Depending on the final anticipated heights of the New England Wind components being transported by vessels, in particular the potential heights of partially or fully constructed WTGs, it may be necessary for the FAA to conduct aeronautical studies of WTGs and equipment located within territorial waters that meet the obstruction criteria (i.e. a height of more than 61 m [200 ft] AGL/AMSL).

Airports and heliports located along the shore in the vicinity of the vessel routes could be affected by vessels carrying WTG towers or other components. Through coordination with the FAA, certain actions may be necessary to protect air traffic operations on a temporary basis during vessel operations. These actions could include the publication of Notices to Airmen for each vessel movement above a specified height and Temporary Flight Restriction, which would restrict specific low altitude aircraft movements. Temporary low/medium intensity obstruction lighting may also be required on the highest point of the structure during transit.

Department of Defense Warning Areas

DoD uses domestic and international airspace for readiness training and exercises. To make pilots aware of military operations, the FAA designates sectors of airspace as Warning Areas and charts these areas on aeronautical charts with an identifying number. The US Navy and, occasionally, other DoD organizations use the airspace over and adjacent to the SWDA. As noted above, this airspace has been designated as W-105A (see Figure 7.9-1).

The scheduling of W-105A is managed by Fleet Area Control and Surveillance Facility, Virginia Capes (an organizational element of the US Navy located in Virginia Beach, Virginia). The vertical limits of W-105A begin at the surface of the water and extend to 15,240 m (50,000 ft) AMSL. Publicly available information for this Warning Area indicates that it is used for flight testing by the US Navy. Adjacent sections of W-105A are used for surface-to-air gunnery exercises using conventional ordnance and antisubmarine warfare exercises.

This Warning Area was identified in BOEM's Revised Environmental Assessment for the Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts (BOEM 2014), and BOEM has coordinated with DoD on the final MA WEA. Due to the low altitude associated with W-105A, offshore wind development could have an impact on training operations within W-105A. The Proponent is consulting with the Military Aviation and Installation Assurance Siting Clearinghouse (Clearinghouse) regarding the potential impacts of New England Wind through the Clearinghouse's informal review process. In their October 27, 2020 letter, the Clearinghouse identified that New England Wind may impact supersonic, chaff, and flare operations conducted by the Air National Guard 104th Fighter Wing. To de-conflict potential impacts on W-105A, the Proponent expects that it will need to acknowledge that New England Wind's offshore facilities can withstand the daily sonic overpressures (sonic booms) and potential falling debris from dispensing chaff and flare as well as confirm that the US Air Force will not be held liable for any damage to property or personnel. The Proponent will comply with the Hold and Save Harmless stipulation in its Lease Agreement, which prevents the Proponent from holding the US Government liable for loss, damage, or injury in connection with specific military options in the Lease Area.

7.9.2.1.3 Offshore Energy (Phases 1 and 2)

Several offshore wind projects are planned for the MA WEA and RI/MA WEA with construction targeted to begin between the early and mid-2020s (see Section 7.9.1.3). Although offshore wind developers can only install offshore wind energy generation facilities within their own lease areas, the cable routes and interconnection points for New England Wind may impact the siting of other offshore wind projects (see Section 7.9.2.1.3). New England Wind's construction activities could also affect other offshore wind projects' access to port facilities, vessels, construction equipment, and personnel. However, based on the current timeline for Phase 1 construction activities and coordination with other offshore wind developers, spatial and temporal conflicts with other offshore wind energy projects are not anticipated. While the timeline for Phase 2 is not yet known, the Proponent anticipates coordinating with other developers to avoid or minimize the potential for conflicts. Further, the Proponent has defined a range of port options in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used to support construction of Phases 1 and 2, thereby providing flexibility in the event a given port is in use by another offshore energy project.

In conformance with the Section 7(a) of the Proponent's Commercial Lease of Submerged Lands for Renewable Energy Development on the OCS, New England Wind does not propose activities that will unreasonably interfere with or endanger activities or operations carried out under any lease or grant issued or maintained pursuant to the Outer Continental Shelf Lands Act.

7.9.2.1.4 Sand and Mineral Extraction (Phases 1 and 2)

As described in Section 7.9.1.4, no federal OCS sand and mineral lease areas or identified significant sand resource blocks are located within the Offshore Development Region. Further, it is not anticipated that any sand or mineral extraction would occur within the areas designated by

BOEM for offshore wind energy use (i.e. the RI/MA WEA or MA WEA). Construction and installation activities for Phases 1 and 2 are not anticipated to affect sand and mineral extraction that may occur within the Offshore Development Region, other than potential, temporary vessel restrictions in areas of active offshore cable installation.

7.9.2.1.5 Offshore Cables and Pipelines (Phases 1 and 2)

The OECC for Phases 1 and 2 (including the Western Muskeget Variant) does not cross any existing offshore cables or pipelines. As described in Section 2.4 of COP Volume I, New England Wind will have substantially the same OECC as Vineyard Wind 1. The five offshore export cables for New England Wind will not cross Vineyard Wind 1's cables.

7.9.2.1.6 Radar Systems other than Marine Navigation Radar (Phases 1 and 2)

Impacts to radar systems during construction are anticipated to be similar to those described in Section 7.9.2.2.6.

7.9.2.1.7 Scientific Research and Surveys (Phases 1 and 2)

During construction of Phases 1 and 2, research and survey vessels in the SWDA and along the OECC (including the Western Muskeget Variant) may need to temporarily alter transit routes to avoid installation activities. Low altitude aerial surveys may also need to alter routes to avoid WTGs. Because each year's trawl survey stations are randomly selected, it may be possible to eliminate a station location or adjust a trawl direction or duration based on the locations of anticipated New England Wind-related activities. The Proponent will keep the relevant parties informed throughout the construction and installation phase of New England Wind. The Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the USCG to provide Notices to Mariners that describe New England Wind-related activities.

7.9.2.1.8 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

The SWDA is located in the MA WEA, which was selected by BOEM, in part, because it avoids and/or minimizes conflicts with the other uses described in this section.

Measures to avoid, minimize, and/or mitigate impacts to other uses of the Offshore Development Region and Onshore Development Region are summarized below:

- **National Security:** The Proponent will coordinate closely with the DoD, US Navy, and USCG to minimize potential conflicts in the Offshore Development Area during construction activities. The Proponent will issue Offshore Wind Mariner Update Bulletins and work with the USCG to provide Notices to Mariners that describe New England Wind-related activities within the Offshore Development Area. Further, the Proponent employs a Marine Operations Liaison Officer, who is responsible for ensuring safe marine operations by the Proponent.

- **Aviation and Air Traffic:** All temporary and permanent structures, including vessels and their appurtenances, located within territorial airspace that exceed an overall height of 61 m (200 ft) AGL/AMSL or any obstruction standard contained in 14 CFR Part 77 will be marked and/or lighted in accordance with FAA Advisory Circular (AC) 70/7460-1M (unless current guidance is modified by the FAA by the time Phase 2 proceeds). For WTGs located outside territorial airspace in the SWDA, mitigation measures are detailed in Section 7.9.2.2.8.

- **Offshore Energy:** The Proponent will continue to collaborate with other offshore wind developers to minimize potential impacts to other offshore wind energy projects. The Proponent has also defined a range of ports that may be used for New England Wind construction activities to provide flexibility.

- **Sand and Mineral Extraction:** Since there are no federal OCS sand and mineral lease areas or identified significant sand resource blocks within the Offshore Development Region, New England Wind avoids impacts to sand and mineral extraction activities.

- **Offshore Cables and Pipelines:** The OECC for Phases 1 and 2 (including the Western Muskeget Variant) does not cross any existing offshore cables or pipelines.

- **Radar Systems other than Marine Navigation Radar:** As described in Section 7.9.2.2.6, NEXRAD impacts associated with the WTGs that would require the implementation of mitigation measures are not anticipated.

- **Scientific Research and Surveys:** The Proponent will keep the relevant parties informed throughout the construction and installation phase of New England Wind and plans to issue Offshore Wind Mariner Update Bulletins. The Proponent will also coordinate with the USCG to provide Notices to Mariners that describe New England Wind-related activities.

7.9.2.2 Operations and Maintenance

The Proponent expects to use one or more facilities in support of operations and maintenance (O&M) activities for Phases 1 and 2. As described further in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I, New England Wind's O&M facilities may include management and administrative team offices, a control room, office and training space for technicians and engineers, and/or warehouse space for parts and tools. The O&M facilities are also expected to include pier space for crew transfer vessels (CTVs) and/or other larger support vessels, such as service operation vessels (SOVs). For Phases 1 and 2, O&M activities may occur at any of the ports identified for potential use during construction and installation, though it is expected that Phase 1 and Phase 2 O&M activities will be primarily staged from port facilities located in Bridgeport, Connecticut, Vineyard Haven, Massachusetts and/or New Bedford Harbor, Massachusetts.

Limited increases in vessel traffic are expected to support O&M activities. While the WTGs are designed to operate without attendance by any operators, and monitoring will be conducted from a remote location, some maintenance activity at the SWDA or along the OECC may occur. During preventive or corrective maintenance events, a crew will be dispatched to the identified location to complete maintenance requirements or repairs and restore normal operations. As described in Sections 3.3.2.6 and 4.3.2.6 of COP Volume I, for daily O&M, it is anticipated that the Proponent will use an SOV, which is typically is 80–90 m (~260–300 ft) in length. The Proponent may also use several CTVs, which are typically about 23 m (75 ft) in length, to transport crew to the SWDA. In addition to the SOV, CTVs, and/or daughter craft, other larger support vessels (e.g. jack-up vessels) may be used on an infrequent basis to perform some routine maintenance activities, periodic corrective maintenance, and significant repairs (if needed). These vessels are similar to the vessels used during construction.

7.9.2.2.1 National Security (Phases 1 and 2)

The proposed layout for each Phase of New England Wind is expected to facilitate navigation within the SWDA during O&M. Within the SWDA, the WTGs and ESPs will be oriented in fixed east-to-west rows and north-to-south columns with one nautical mile (1.85 km) spacing between WTG/ESP positions. This grid layout provides 1.85 km (1 NM) wide corridors in the east-west and north-south directions as well as 1.3 km (0.7 NM) wide corridors in the northwest-southeast and northeast-southwest directions.

The proposed layout is consistent with the expected regional wind turbine layout throughout the RI/MA WEA and MA WEA, which is also recommended by the USCG. The USCG undertook a Massachusetts and Rhode Island Port Access Route Study to evaluate the need for vessel routing measures within the RI/MA WEA and MA WEA (USCG-2019-0131). 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" (USCG 2020). The New England Wind layout is consistent with the USCG's recommendations and is therefore not expected to cause significant interference with US Navy or USCG operations.

The use of vessels during O&M of New England Wind is not anticipated to substantially increase vessel traffic in the Offshore Development Region or interfere with US Navy or USCG operations. Potential impacts from New England Wind on NORAD homeland defense radar and DoD operations within W-105A are described in Sections 7.9.2.2.2 and 7.9.2.1.2, respectively.

The Proponent will issue Offshore Wind Mariner Update Bulletins and coordinate with the USCG to provide Notices to Mariners that describe New England Wind-related activities that may be of interest to national security interests, including US Navy personnel operating within the Offshore

Development Region. In accordance with the stipulations in Lease OCS-A 0534, the Proponent will temporarily suspend operations and evacuate the SWDA if required for national security or defense purposes.

7.9.2.2.2 Aviation and Air Traffic (Phases 1 and 2)

The following section addresses the potential airspace impacts associated with O&M of the New England Wind offshore structures in the SWDA. DoD Warning Areas are discussed above in Section 7.9.2.1.2. Proposed marking and lighting of the WTGs is discussed in Sections 3.2.1.1 and 4.2.1.1 of COP Volume I. Appendix III-J contains two aviation impact analyses of the SWDA (OE&AA and ATFA). These two studies contain an assessment of potential impacts to aviation and radar systems resulting from the construction of WTGs with a maximum height of 357 m (1,171 ft).[149]

During O&M, it is not anticipated that components exceeding 61 m (200 ft) AGL will either be assembled at a port facility used by New England Wind or delivered to and from the SWDA. If a major corrective maintenance activity occurs that requires port usage and/or vessel transport in excess of this height, coordination with the FAA will occur as described in Section 7.9.2.1.2.

As previously stated, the FAA has jurisdiction to review "structures interfering with air commerce" within US territorial waters which extend 22 km (12 NM) offshore. None of the WTGs or ESP(s) in the SWDA will be located within US territorial waters and are therefore not subject to FAA jurisdiction, other than for review of changes to MVAs.

At a maximum height of 357 m (1,171 ft) for the WTGs, the WTGs may necessitate changes to MVAs for several sectors in Boston Consolidated (A90) Terminal Radar Approach Control (TRACON) and Providence (PVD) TRACON (see OE&AA in Appendix III-J). However, because most existing air traffic over the SWDA occurred at altitudes that would not be impacted by the presence of WTGs (i.e. between 457 and 1,524 m [1,500 and 5,000 ft] AMSL), it is unlikely that any potential impacts would affect a significant volume of flight operations (see ATFA in Appendix III-J).

The Preliminary Screening Tool (PST) on the FAA Obstruction Evaluation/Airport Airspace Analysis website provides a cursory indication whether WTGs may be visible, that is, within radar line-of-sight (RLOS) to one or more radar sites, and likely to affect radar performance.[151] The PST Long Range Radar (LRR) analysis accounts for ARSR sites and a few select ASR sites used for air defense

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[151] See http://oeaaa.faa.gov.

and homeland security.[152] The PST LRR analysis does not account for all DoD, DHS, and/or FAA radar sites, including EWR sites. Further, the PST NEXRAD analysis accounts for WSR-88D radar sites but does not account for FAA TDWR radar sites.[153]

The PST is helpful for identifying potential impacts to LRR and NEXRAD; however, the results are preliminary, as suggested by the title of the PST, and do not provide an official decision as to whether impacts are acceptable to operations.

The PST LRR results show four air traffic control, air defense, and homeland security radar sites – Falmouth ASR-8, Nantucket ASR-9, North ARSR-4, and Providence ASR-9 – in proximity to the SWDA. The PST analysis results for LRR show that the SWDA falls within yellow and green areas, and no red areas (see Figure 7.9-5). Red indicates that impacts are highly likely, as indicated by a 37 km (20 NM) area around all LRR sites, yellow indicates that impacts are likely, and green indicates no anticipated impacts to air defense and homeland security radar. While the PST indicates that impacts are likely, based on the fact that there are multiple radar sites within approximately 185 km (100 NM) of the SWDA, overlapping coverage in addition to existing efforts by the operator(s) to optimize radar systems are expected to mitigate any potential effects of the WTGs in the SWDA.

In addition to the results from the PST above, a basic RLOS analysis was conducted for seven radar sites (three of which were also considered in the PST):

- Cape Cod AFS EWR;
- Boston ASR-9;
- Falmouth ASR-8;
- Nantucket ASR-9;
- Providence ASR-9
- North Truro ARSR-4; and
- Riverhead ARSR-4.

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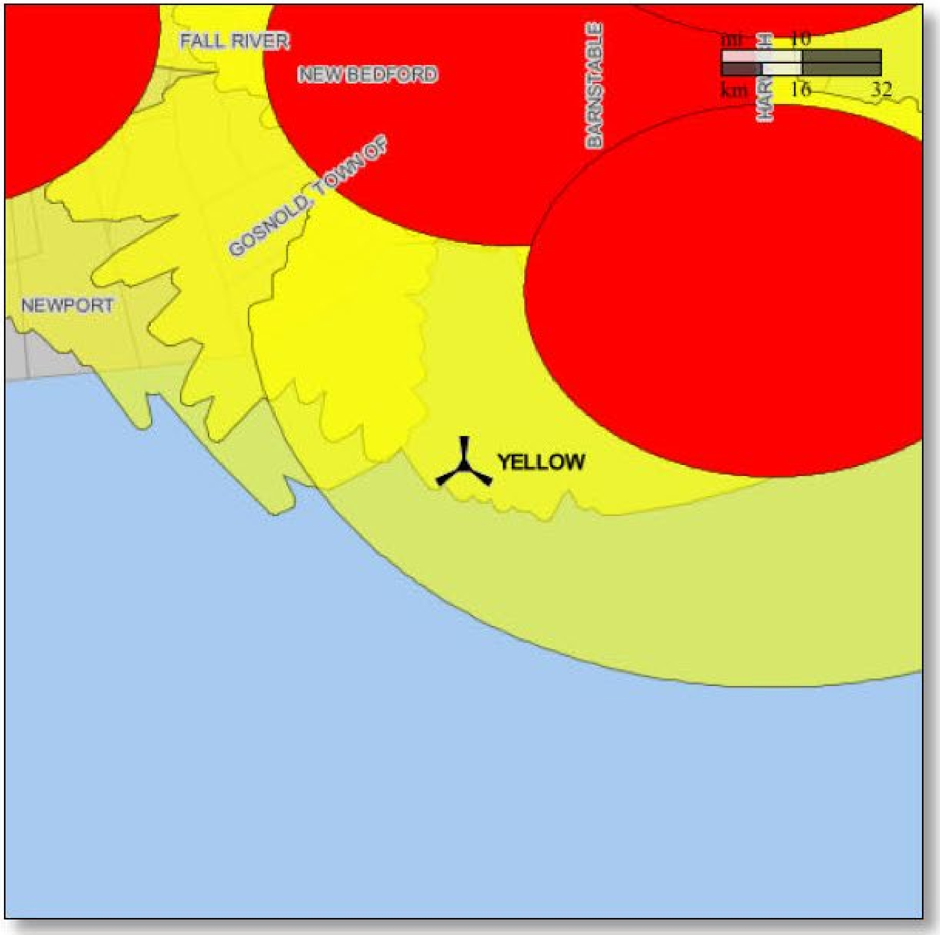
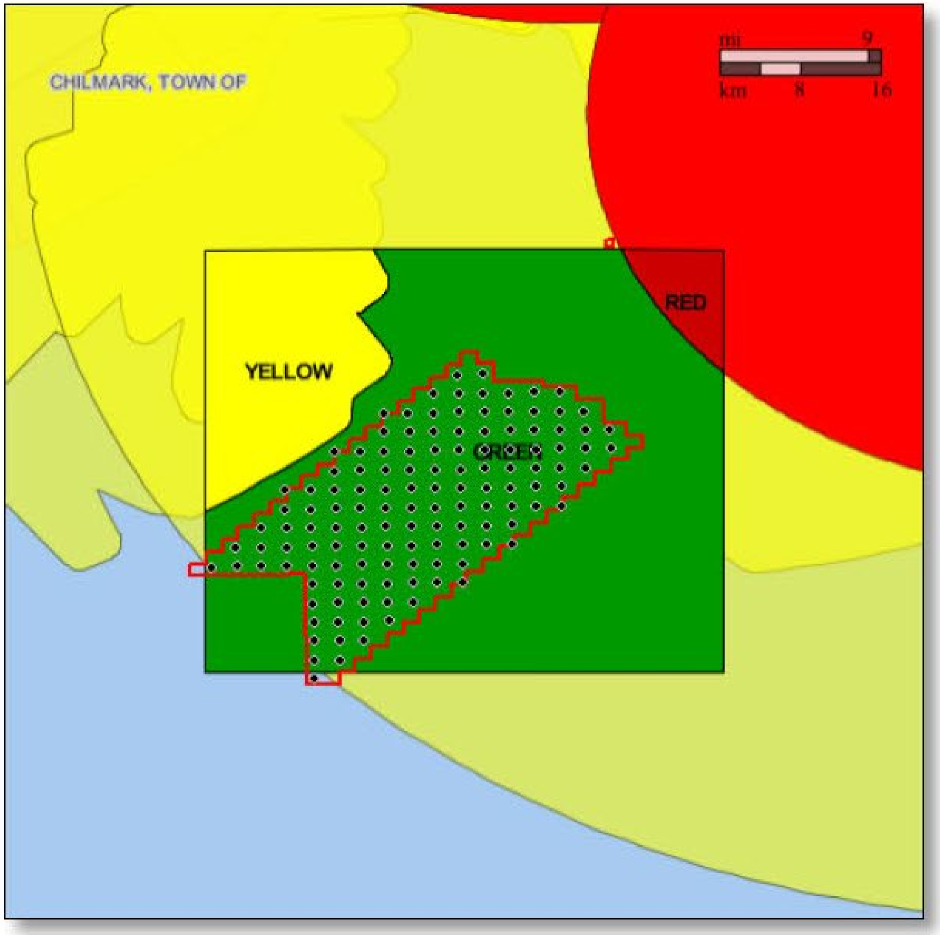
[152] For LRR, the PST uses a buffered RLOS analysis at a blade-tip height of 229 m (750 feet) AGL.

[153] For NEXRAD, the PST uses a blade-tip height of 160 m (525 ft) AGL. It should be noted that the PST NEXRAD analysis does not reflect the wind farm impact zone scheme updated in 2018 by the NOAA WSR-88D Radar Operations Center. The updated scheme expands the red area, or "No Build Zone," from 3 to 4 km (1.9 to 2.5 mi) and to areas where wind turbines penetrate the third elevation angle scanned by a WSR-88D.





Please note that blue and grey areas also represent green areas. In the image on the right, it should also be noted that yellow areas underlie the green areas.

Similar to the PST, the RLOS analyses identified that the Phase 1 and Phase 2 WTGs would be visible to and may affect the Falmouth ASR-8 and Nantucket ASR-9 radar sites. (The analysis indicated that the Phase 1 and Phase 2 WTGs are not expected to affect the secondary surveillance radar co-located with the Falmouth ASR-8 or the Nantucket ASR-9.) As noted previously for the PST analysis, based on the fact that there are multiple radar sites within approximately 185 km (100 NM) of New England Wind, overlapping coverage in addition to existing efforts by the operator(s) to optimize radar systems are expected to mitigate any potential effects of New England Wind. The RLOS analyses also identified that the Phase 1 and Phase 2 WTGs would be visible to and could impact the Cape Cod AFS EWR, so early consultation with the DoD Siting Clearinghouse is ongoing (see Section 7.9.2.1.2 for additional details). The Proponent expects to enter into an agreement with DoD to mitigate any potential conflicts or impacts to NORAD radar systems.

The RLOS analyses identified that Phase 1 and Phase 2 WTGs will not be visible to or interfere with the North Truro ARSR-4 and Riverhead ARSR-4 radar sites. Finally, the SWDA is beyond the instrumented range of the Boston ASR-9, Boston TDWR, and the Providence ASR-9 radar sites. As such, no impacts are expected.

Additionally, a VOR screening analysis was conducted for the Martha's Vineyard VOR/DME and the Nantucket VOR/DME. The proposed WTGs are greater than 14.8 km (8 NM) from the Martha's Vineyard VOR/DME and the Nantucket VOR/DME. As such, no additional analysis was considered necessary for these navigational aid sites.

The Proponent researched "determination of no hazard to air navigation" precedents for nearby projects that will install WTGs in the MA WEA. The Bay State Wind project is proximate (located immediately west of the SWDA) with similar WTG tip heights (1,049 ft AGL/AMSL). The Bay State wind project received a "determination of no hazard to air navigation," issued by the FAA on August 8, 2019 (Aeronautical Study No. 2019-WTE-122-OE). In that determination the following finding was made:

> "Aeronautical study disclosed that the proposed structures would not have a substantial adverse effect on any existing or proposed arrival, departure, or en route IFR [Instrument Flight Rules] operations or procedures. The MOCA [Minimum Obstacle Clearance Altitude] in this area is not routinely assigned by ATC [Air Traffic Control] and is therefore not considered a significant impact. MVAs are solely used by Air Traffic and are not published nor are they circulated for public comment. Increasing the MVAs in the area of the turbines will not impact a significant number of operations. An MSA [Minimum Safe Altitude] is the minimum obstacle clearance altitude for emergency use within a specified distance from the navigation facility upon which a procedure is predicated. The MSA altitudes are designed for emergency use only and are not routinely used by pilots or by air traffic control. Consequently, they are not considered a factor in determining the extent of adverse effect."

In addition to the above finding, the Bay State Wind determination found that there would be no substantial adverse effect to operations when considering RLOS implications. Given the analyses conducted by the Proponent (OE&AA and ATFA), the PST and RLOS analyses, and the Bay State Wind precedent, it is unlikely that any adverse impacts to aviation will ensue from the presence of the WTGs in the SWDA.

Inspection and monitoring of the SWDA may be conducted by helicopters, as needed (see Sections 3.3.1.12.1 and 4.3.1.12.1 of COP Volume I). Any helicopters used to support O&M activities would ideally be based at a general aviation airport in reasonable proximity to the O&M facilities. Any such flights will adhere to FAA and other requirements and are not anticipated to affect aviation and air traffic in the Offshore Development Region or Onshore Development Region.

7.9.2.2.3 Offshore Energy (Phases 1 and 2)

Offshore wind energy developers, including the Proponent, can only install offshore wind energy generation facilities within their own lease areas; therefore, the presence of the WTGs and ESPs within the SWDA will not preclude the installation of WTGs and ESPs in other lease areas within the MA WEA and RI/MA WEA. Mayflower Wind is currently the only other project with publicly-announced plans to install offshore cables within the vicinity of the OECC for New England Wind. The Proponent and Mayflower Wind would coordinate on any required cable crossings.

While final offshore export cable routes for other projects that may be built within the MA WEA and RI/MA WEA are not known, it is expected that any future-installed cables would be able to cross the New England Wind offshore export cables using standard cable crossing techniques. The Proponent anticipates that it would likewise coordinate with other offshore wind developers as necessary regarding any required crossing for New England Wind's cables.

The Proponent does not anticipate that O&M activities will interfere with any of the offshore wind energy projects proposed within the MA WEA and RI/MA WEA. It is expected that Phase 1 and Phase 2 O&M activities will be primarily staged from port facilities located in Bridgeport, Connecticut, Vineyard Haven, Massachusetts, and/or New Bedford Harbor, Massachusetts (see Sections 3.2.2.6 and 4.2.2.6 of COP Volume I). It is likewise anticipated that other developers will establish their own O&M facilities. If the Proponent uses any of the other port facilities listed in Sections 3.2.2.6 and 4.2.2.6 of COP Volume I for major repair events during O&M of New England Wind, it is expected that the Proponent's use of such port facilities would not be exclusive and that other projects would be able to use the same port.

7.9.2.2.4 Sand and Mineral Extraction (Phases 1 and 2)

For the reasons described in Section 7.9.1.2.1.4, O&M of New England Wind is not anticipated to impact any proposed future sand and mineral extraction.

7.9.2.2.5 Offshore Cables and Pipelines (Phases 1 and 2)

While the OECC for Phases 1 and 2 (including the Western Muskeget Variant) does not cross any existing offshore cables or pipelines, the installation and alignment of the offshore export cables may impact the siting of future submarine cables. However, it is expected that any future-installed cables would be able to cross New England Wind's offshore export cables using standard cable crossing techniques.

7.9.2.2.6 Radar Systems Other than Marine Navigation Radar (Phases 1 and 2)

Impacts to radar systems used in aviation are described in Section 7.9.2.2.2. For NEXRAD radar systems, experience with WTGs located in NEXRAD line of sight has shown that WTGs can impact radar reflectivity, internal algorithms that generate alerts and derive weather products, and other attributes. In general, the severity of impacts is related to the separation distance between the WTGs and the NEXRAD facility. Impacts increase as distance decreases, especially for WTGs located within 17.7 km (11 mi) of the NEXRAD facility (Vogt et al n.d.).

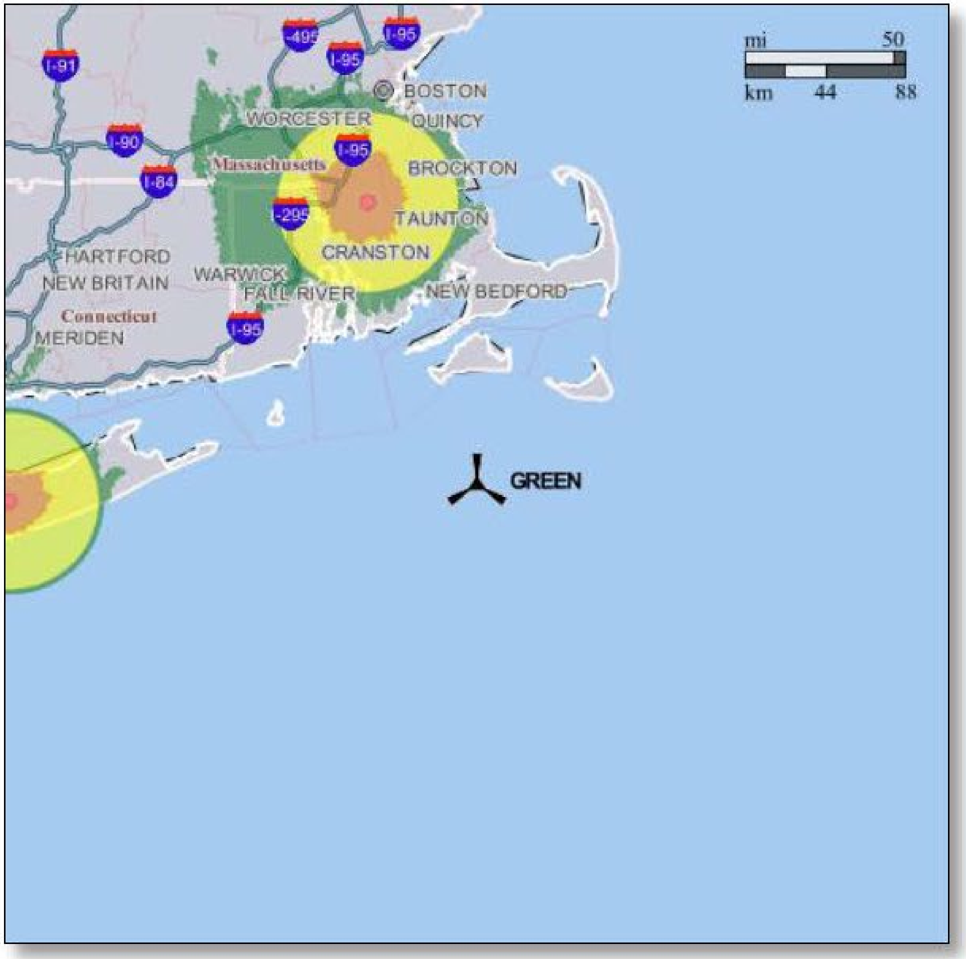
Because the closest NEXRAD facility to the SWDA (KBOX) is located approximately 110 km (68 mi) away, there are no anticipated impacts associated with the WTGs that would require the implementation of mitigation measures.

A PST analysis for NEXRAD shows that the SWDA falls within a green area, or "No Impact Zone," which indicates that impacts are not likely to WSR-88D operations (see Figure 7.9-6). Specifically, no impacts to the Boston (KBOX) WSR-88D or Brookhaven (KOKX) WSR-88D radar systems are expected, due to the distances involved.

Of the 12 coastal HF radar systems reviewed, the SWDA is outside the radar line-of-sight for three HF radar systems: the Amagansett HF radar, Moriches HF radar, and the Nauset HF radar, although radar effects are still possible beyond line-of-sight due to the propagation of HF electromagnetic waves over the ocean surface. Some or all of the WTGs within the SWDA are within the radar line-of-sight for the remaining nine HF radar systems: Block Island Long Range HF radar, Martha's Vineyard HF radar, Nantucket Island HF radar, Camp Varnum HF radar, Horseneck Beach State Reservation HF radar, Long Point Wildlife Refuge HF radar, MVCO Meteorological Mast HF radar, Nantucket HF radar, and the Squibnocket Farms HF radar.

7.9.2.2.7 Scientific Research and Surveys (Phases 1 and 2)

Potential offshore wind energy development in any of the lease areas within the RI/MA WEA and MA WEA may impact NEFSC surveys. This potential impact is a consideration for all offshore wind projects within these WEAs and is not limited to New England Wind. BOEM and NOAA have also acknowledged that some of the current NOAA survey methodologies may need to change due to future construction of offshore wind farms.



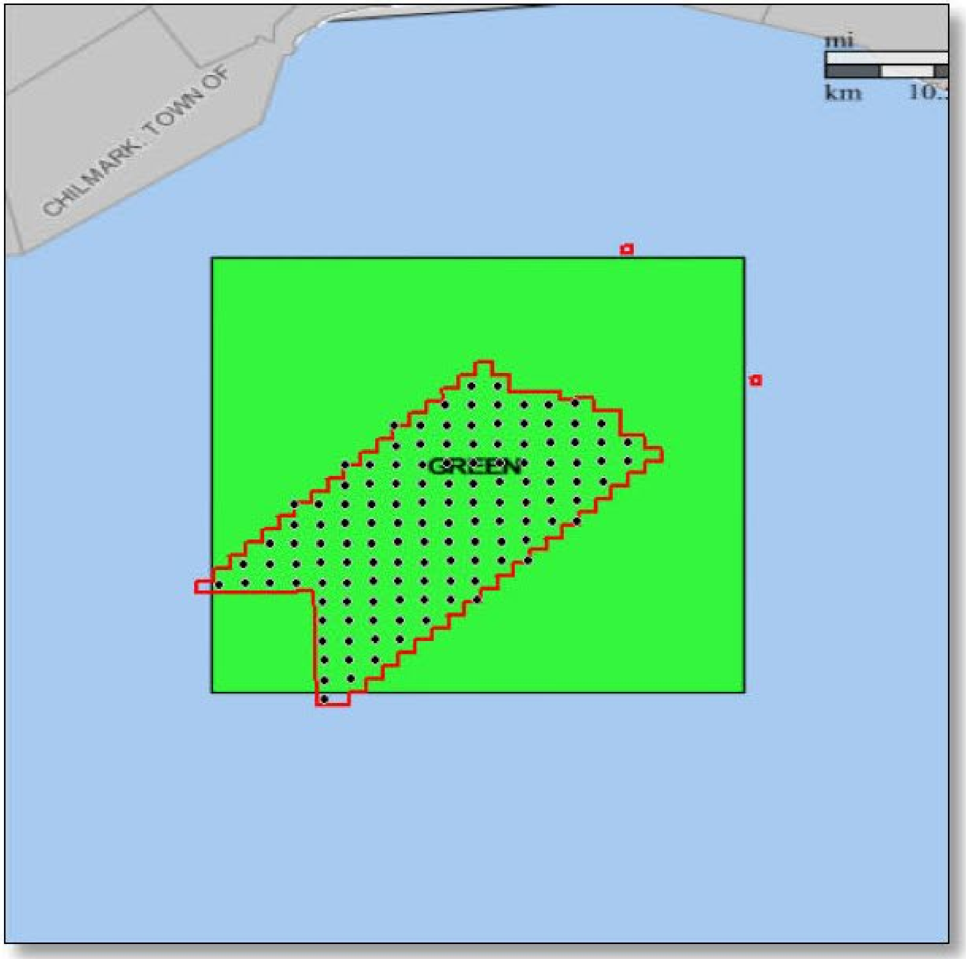


Figure 7.9-6

Preliminary Screening Tool NEXRAD Results for the Single Point (left) and for the Polygon (right)

Within the SWDA, the WTGs and ESPs will be oriented in fixed east-to-west rows and north-to-south columns with one nautical mile (1.85 km) spacing between WTG/ESP positions. This grid layout provides 1.85 km (1 NM) wide corridors in the east-west and north-south directions as well as 1.3 km (0.7 NM) wide corridors in the northwest-southeast and northeast-southwest directions. It is anticipated that a uniform, east-west 1 x 1 NM layout (1.85 x 1.85 km) will be adopted throughout the RI/MA WEA and MA WEA. The use of the 1 x 1 NM layout can accommodate smaller survey vessels access through New England Wind.

BOEM and NOAA have indicated they are working collaboratively to design appropriate surveys, or changes in survey methodologies, that can generate comparable information to the historic dataset. BOEM has contributed $650,000 to NOAA Fisheries to begin the process of adapting NOAA Fisheries sampling techniques for the bottom trawl survey to offshore wind facilities. BOEM and NOAA Fisheries have committed to implement NOAA Fisheries' Federal Survey Mitigation Program, which will be implemented within two years of the Vineyard Wind 1 COP approval and will address impacts from offshore wind development on NOAA Fisheries' surveys. One aspect of the collaboration between BOEM and NOAA may include having individual offshore wind leaseholders use survey methods that align with NOAA or other established survey methods with long-term datasets in order to facilitate data integration between offshore wind specific surveys and existing long-term datasets, what some refer to as a "nested and modular" survey design. Another advantage of this "nested and modular" approach is that it also allows integration of short-term surveys (such as pre-and post-construction studies) with longer-term regional surveys and datasets. It is expected that the ongoing collaboration between BOEM and NOAA, and adoption of solutions such as those described above, will allow NOAA to make informed management decisions.

In recognition of the regional nature of fisheries science, the Proponent expects to continue to work with BOEM, federal and state agencies such as NOAA Fisheries and MA DMF, fisheries stakeholders, academic institutions, and other stakeholders to develop appropriate fisheries studies. The Proponent is already engaging in collaboration with other offshore wind developers, fishing industry representatives, and federal and state agencies through its participation in the Responsible Offshore Science Alliance (ROSA) and a Regional Wildlife Science Entity (RWSE).

It is also worth noting that the Proponent may also provide increased opportunities for scientific research and surveys in the Offshore Development Region that are focused on the impacts of offshore wind farms on marine resources.

7.9.2.2.8 Avoidance, Minimization, and Mitigation Measures (Phases 1 and 2)

National Security: The Proponent will coordinate closely with the DoD, US Navy, and USCG to minimize potential conflicts in the Offshore Development Area during O&M activities. The Proponent will issue Offshore Wind Mariner Update Bulletins and work with the USCG to provide Notices to Mariners that describe New England Wind-related activities within the Offshore Development Area. Further, the Proponent employs a Marine Operations Liaison Officer, who serves as the strategic maritime liaison between the Proponent's internal parties and all external maritime partners and stakeholders, including USCG, US Navy, port authorities, state and local law enforcement, marine patrol, and commercial operators (e.g. ferry, tourist, fishing boat operators, and other offshore wind leaseholders). The Marine Operations Liaison Officer ensures compliance with permit requirements and applicable laws relating to the Proponent's vessel activities. Potential impacts to USCG SAR aircraft operating in the SWDA and measures to mitigate those impacts are described in Section 7.8.2.2.5 of COP Volume III and Appendix III-I.

Aviation and Air Traffic: The WTGs and ESPs are sited well offshore beyond US territorial airspace, which substantially minimizes impacts to aviation. To further minimize impacts to aviation, all temporary and permanent structures, including vessels and their appurtenances, located within territorial airspace that exceed an overall height of 61 m (200 ft) AGL/AMSL or any obstruction standard contained in 14 CFR Part 77 will be marked and/or lighted in accordance with FAA Advisory Circular (AC) 70/7460-1M (unless current guidance is modified by the FAA by the time Phase 2 proceeds). New England Wind structures located beyond 22 km (12 NM) are expected to be marked and/or lighted in accordance with BOEM's 2019 *Draft Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development* or subsequent updates to that guidance, which is generally consistent with AC 70/7460-1M. Aviation obstruction lighting for the WTGs and ESPs is described in Sections 3.2.1.1, 3.2.1.3, 4.2.1.1, and 4.2.1.3 of COP Volume I. For Phase 1, the Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent would expect to use the same or similar approaches to reduce lighting used for Phase 1, including the use of an ADLS. Use of an ADLS or a similar system would reduce the potential impacts of nighttime light on migratory birds and minimize potential visual impacts. The Proponent expects to enter into an agreement with DoD to mitigate any potential conflicts or impacts to NORAD radar systems.

Offshore Energy: The Proponent will continue to collaborate with other offshore wind developers to minimize impacts to other offshore wind energy projects.

Sand and Mineral Extraction: Since there are no federal OCS sand and mineral lease areas or identified significant sand resource blocks within the Offshore Development Region, New England Wind avoids impacts to sand and mineral extraction activities.

Offshore Cables and Pipelines: The OECC for Phases 1 and 2 (including the Western Muskeget Variant) does not cross any existing offshore cables or pipelines. If a future crossing of the Proponent's offshore export cables is proposed by another offshore wind developer and cannot be avoided, the Proponent will work with the developer to ensure that the planned cable crossing maintains the integrity of the cables while minimizing impacts to other stakeholders (e.g. commercial fishermen).

Radar Systems other than Marine Navigation Radar: As described in Section 7.9.2.2.6, there are no anticipated NEXRAD impacts associated with the WTGs that would require the implementation of mitigation measures. For coastal HF radar systems, the Proponent will consult with the radar operators and NOAA's (IOOS) Office to evaluate whether the proposed WTGs are expected to cause radar interference to the extent that such interference affects radar performance.

Scientific Research and Surveys: The Proponent will support the continuation of research in the Offshore Development Region and is participating in regional science efforts with a specific focus on fish, avian, and marine mammal species. The Proponent is already engaging in collaboration with other developers, fishing industry representatives, and state and federal agencies through its participation in ROSA and an RWSE.

Furthermore, the Proponent has already conducted numerous surveys to characterize the Offshore Development Area including, but not limited to, boat-based offshore avian surveys, fisheries surveys, and benthic habitat surveys. The Proponent's pre-, during, and post-construction surveys and monitoring will generate a substantial body of environmental, fisheries, and other data, further augmenting scientific understanding of the Offshore Development Area. The Proponent has collaborated and will continue to collaborate with federal and state agencies to design surveys that align with established survey methods so that the data generated can be compared to previous data and ongoing regional studies to support a regional, longer-term study program to monitor the regional impacts of offshore wind development. Additionally, BOEM and NOAA Fisheries committed to implement NOAA Fisheries' Federal Survey Mitigation Program, which will address impacts from offshore wind development on NOAA Fisheries' surveys.

Environmental and fisheries data collected by the Proponent will be available in the public domain in a manner consistent with other academic research. Much of the data will be publicly available through the federal and state permitting process, as well as reports or academic publications that may come out of the survey or monitoring work. The Proponent also plans to make all fisheries monitoring data publicly available on its website. For other environmental and fisheries data, the Proponent will explore cost-effective and appropriate ways to store and make data publicly available and easy to access. Through ROSA and an RWSE, the Proponent will work with stakeholders and neighboring developers to find ways to streamline and standardize available data across all offshore efforts.

7.9.2.3 Decommissioning

As currently envisioned, decommissioning of New England Wind is largely the reverse of the construction and installation process (see Sections 3.3.3 and 4.3.3 of COP Volume I). No aspects of New England Wind are anticipated to affect national security, including US Navy and USCG interests. The Proponent will continue to work cooperatively with US Navy and USCG personnel to address any navigation, operations, or other concerns with decommissioning activities.

Impacts to aviation and air traffic, offshore energy, radar systems (other than marine radar), and sand and mineral extraction during decommissioning are anticipated to be similar to those during construction, as described in Section 7.9.2.1. The New England Wind offshore cables could be retired in place or removed, subject to discussions with the appropriate regulatory agencies on the preferred approach to minimize environmental impacts. If the cables are retired in place, pipelines or cables installed in the future would be able to cross the offshore export cables using standard cable crossing techniques.

Impacts to scientific research and survey activities associated with decommissioning are similar to those during construction (see Section 7.9.2.1.7), where temporary shifts in survey techniques or locations may be required to accommodate vessel traffic and activities associated with decommissioning. Removal of New England Wind components may increase the area that can be surveyed, and decommissioning would also provide the opportunity for scientific research and surveys in the Offshore Development Region focused on the impacts of decommissioning on marine resources.

Avoidance, minimization, and mitigation measures associated with decommissioning are similar to those described in Section 7.9.2.1.8 for construction.

8.0 NON-ROUTINE AND LOW PROBABILITY EVENTS

The following sections discuss low probability events that could occur during construction, operation, and/or decommissioning of New England Wind. The low probability events include collisions between vessels or between vessels and marine life, allisions between vessels and a wind turbine generator (WTG) or electrical service platform (ESP), severe weather and natural events, corrective maintenance or significant infrastructure failure, cable displacement or damage, spills resulting from refueling, maintenance, or catastrophic events, and other accidental releases.

8.1 Collisions and Allisions

Collisions generally concern vessels colliding with other vessels or with marine life. Allisions generally involve vessels collisions with fixed objects such as WTGs or ESP(s). As described further in the Navigation Safety Risk Assessment provided as Appendix III-I, collisions and allisions are considered low probability events.

All such events could result in spills (as described below), damage to infrastructure or vessels, human injuries, or fatalities, or, in the case of a collision with marine life, injury or fatalities of marine life. In general, the risk of vessel collisions is low due to mariner adherence to international regulations, such as the International Regulations for Preventing Collisions at Sea, and various mitigating factors including: (1) United States Coast Guard (USCG)-required lighting on vessels, (2) the fact that areas of higher vessel traffic were excluded from the Massachusetts Wind Energy Area (WEA) (BOEM 2014), and (3) the National Oceanic and Atmospheric Administration's vessel strike avoidance guidance to reduce ship strikes with North Atlantic right whales (*Eubalaena glacialis*) (see Section 6.7.4).

The risk of an allision with a WTG, or ESP, is low due to mitigating factors, such as the distance of the Southern Wind Development Area (SWDA) from typical vessel routes. The SWDA is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501, as shown in Figure 1.1-1 of COP Volume I. The SWDA (excluding the two separate aliquots that are closer to shore) is just over 32 kilometers (km) (20 miles [mi]) from the southwest corner of Martha's Vineyard and approximately 38 km (24 mi) from Nantucket.[154] At this time, the Proponent does not intend to develop the aliquots located northeast and northwest of Lease Area OCS-A 0501 as part of New England Wind.

Additional mitigating factors that reduce the likelihood of collisions or allisions include the spacing between WTGs/ESP(s) and the marine navigation lighting and marking scheme that will be in place. New England Wind will adopt the 1 x 1 nautical mile (1.85 x 1.85 km) WTG/ESP layout (with the WTGs and ESP(s) oriented in an east-west, north-south grid pattern) in accordance with the

[154] Within the SWDA, the closest WTG is approximately 34 km (21 mi) from Martha's Vineyard and 40 km (25 mi) from Nantucket.

USCG's recommendations contained in the May 27, 2020 final Massachusetts and Rhode Island Port Access Route Study (MARIPARS). The MARIPARS evaluated the need for vessel routing measures within the seven adjacent lease areas located in the Rhode Island/Massachusetts and Massachusetts WEAs (USCG 2020). The MARIPARS 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." Accordingly, the risk of vessel collision or allision with a WTG or ESP is decreased due to the proposed WTG/ESP spacing. The risk of allision is expected to be further reduced due to the likely inclusion of Mariner Radio Activated Sound Signals and Automatic Identification System transponders in the design of New England Wind's offshore facilities to enhance marine navigation safety. Furthermore, the specific location of New England Wind's offshore facilities (e.g. WTGs and ESP[s]) will be provided to USCG and the National Oceanic and Atmospheric Administration for inclusion on nautical charts.

8.2 Severe Weather and Natural Events

As described in the Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment (BOEM 2014), severe weather events have the potential to cause structural damage and injury to personnel. While major storms, winter nor'easters, and, to a lesser extent, hurricanes pass through the SWDA regularly, New England Wind's offshore facilities are designed to withstand such severe weather events. As described in COP Volume I, the WTGs and ESPs are designed to site-specific conditions in accordance with international and United States (US) standards and the designs will be reviewed by a third-party Certified Verification Agent (CVA) that certifies the design conforms to all applicable standards.

The Phase 1 and Phase 2 WTG design will be verified for the specific site conditions during the CVA review process (see Section 3.2.3.2), where the design will be able to withstand wind speeds and gusts anticipated at the SWDA (see Appendix I-E). The WTGs will be designed to automatically stop power production 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. The structures will be designed for the extreme environmental conditions (including wind speed and wave height) verified by the CVA.

New England Wind is sited in an area with very little seismic activity; therefore, the potential for catastrophic damage to the offshore facilities from an earthquake is extremely low.

While catastrophic damage to the onshore transition vaults or buried concrete duct bank system is extremely unlikely, it could occur as a result of a natural disaster, such as earthquakes or major hurricane/coastal storm that causes severe flooding and/or coastal erosion. Regardless of the cause, any damage to or breakage of the duct bank system or transition vaults would require excavation to uncover and repair the damaged section. Such work would result in temporary impacts similar to those related to the initial duct bank and transition vault installation. New England Wind's use of solid-state transmission and inter-array cables minimize any impact from cable damage. Any required repair work that results in temporary impacts to coastal habitat will incorporate mitigation for construction and installation as described in Section 6.4.

8.3 Corrective Maintenance Activities or Significant Infrastructure Failure

The Proponent will ensure that the New England Wind preventive maintenance strategy aligns with best industry practice. This preventive maintenance strategy will be regularly reviewed to ensure maintenance objectives are met and continuously improved. Ultimately, preventive maintenance aims to reduce or eliminate the need for corrective maintenance. In addition to the physical preventive maintenance, proactive inspections will be undertaken on a routine basis.

Although highly improbable, as with any major infrastructure, is it possible that a component of New England Wind could fail. Examples of infrastructure failure include blade failures (e.g. blade damages, cracks, breakups, and bends), electrical control failures, yaw system failures, gearbox failures, hydraulic failures, nacelle fires, tower collapse, and cable displacement or damage by anchors or fishing gear (Lau, Ma, and Pecht 2012). The Proponent will work to maintain in-house knowledge of component failure rates, maintenance requirements for such failures, repair periods, and spare part requirements. If a New England Wind component requires significant repairs, repairs would be made as soon as practicable, which may include deploying vessels similar to those used during construction. Impacts of a major repair would be temporary and contained to the immediate area requiring repair.

To minimize the possibility of component failure, New England Wind will undergo an extensive and well-vetted structural design process based on site-specific conditions. As described in Sections 3.2.3.1 and 4.2.3.1 of COP Volume I, New England Wind's components are designed to international and US standards, which are identified in New England Wind's Hierarchy of Standards (see Appendix I-E). The Proponent will develop a Facility Design Report (FDR) containing the specific details of New England Wind's design and a Fabrication and Installation Report that describes how New England Wind's components will be manufactured and installed in accordance with the design criteria in the FDR. Both the FDR and Fabrication and Installation Report will be reviewed by a CVA, the Bureau of Ocean Energy Management, and the Bureau of Safety and Environmental Enforcement.

8.4 Cable Displacement or Damage

Displacement or damage of offshore export, inter-array, or inter-link cables by anchors or fishing gear may potentially occur but is not expected. In the unlikely event such damage or displacement occurs, this may result in safety concerns for marine users and vessel operators, and repair of the cables would be required. Such an event is not expected, however, because the target burial depth for New England Wind cables is 1.5-2.5 m (5-8 ft), which is based on a cable burial risk assessment (see Appendix III-P). The cable burial risk assessment demonstrates that the target burial depth is more than twice the burial depth required to protect the cables from fishing activities. Likewise, the target burial depth considers anchor strikes and is set to provide a negligible risk (i.e. a probability of anchor strike of one in 100,000 years). In the event sufficient cable burial is not achieved, cable protection will be used as described in Sections 3.2.1.5 and 4.2.1.5 of COP Volume I. The cables will also be monitored as described in Sections 3.3.2 and 4.3.2 of COP Volume I. Accordingly, cable displacement or damage is not expected.

8.5 Offshore Spills and Accidental Releases

Offshore spills include inadvertent releases resulting from vessel refueling during construction or operation, spills potentially resulting from routine maintenance activities required during operation of New England Wind, inadvertent releases due to equipment malfunction or breakage, and more significant spills that could result from a catastrophic event occurring at or in proximity to New England Wind. Vessel fuel spills are not expected, and, if one occurred, it is likely to be small. According to the Bureau of Transportation Statistics (2020), between 2000 and 2019, the average oil spill size for vessels other than tank ships and tank barges in all US waters was 443 liters (117 gallons). Because a diesel fuel or similar fuel spill of this size is expected to dissipate rapidly and evaporate within days, impacts to any affected resources would be short-term and localized to the vicinity of the spill. The risk of spills will be further minimized because vessels will be expected to comply with USCG regulations at 33 CFR § 151 relating to the prevention and control of oil spills. Additionally, the Oil Spill Response Plan for New England Wind, a draft of which is provided as Appendix I-A, will provide for rapid spill response, clean-up, and other measures intended to minimize resource impacts from spills and accidental releases that might occur, including spills resulting from catastrophic events.

Inadvertent release of grout is also considered a low probability event. Grout release management procedures, as detailed in Sections 3.3.4.5 and 4.3.4.5 of COP Volume I, are designed to reduce the potential for a grout release and, in the event of a release, minimize impacts.

8.6 Coastal and Onshore Spills and Accidental Releases

Impacts to terrestrial and coastal fauna and other coastal habitats and resources could potentially result from the unlikely event of an accidental release of fuel, lubricating oils, or hydraulic oils from construction equipment operating in or adjacent (landside) to the landfall site. Refueling and lubrication of stationary equipment will be conducted in a manner that protects coastal habitats from accidental spills. Where practicable, 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. The fuel transfer operation will be performed by well-trained personnel knowledgeable about the equipment, the location, and with the use of the work zone spill kit (see Appendix I-B for a description of the Safety Management System). Proper spill containment gear and absorption materials will be maintained for immediate use in the event of inadvertent spills or leaks thereby minimizing the risk of potential impacts from any spill or leak.

Temporary impacts to coastal habitats could also occur during horizontal directional drilling (HDD) activities at the landfall sites. As is standard practice, the HDD operations will use bentonite or other naturally-occurring, inert, non-hazardous drilling mud to drill a "tunnel" beneath the coastal and nearshore habitats that are seaward of the HDD entry point. HDD crews are trained to closely monitor the position of the drill head and drill mud pressure to reduce the risk of inadvertent releases of pressurized drilling mud to the surface. While it is not anticipated, in the unlikely event of an inadvertent release, there could be minor impact in the form of turbidity. However, because drilling mud is a natural and inert and the amount of fluid is typically low, the released material is expected to result in only minor and temporary impacts.

Damage to the onshore buried concrete duct bank system is a low probability event since the duct bank will be buried with a minimum cover depth of 0.9 meters (3 feet). Once installed, underground duct banks generally require no maintenance for the life of the project they serve. There is a remote chance the duct bank could be damaged at some point by an unrelated construction project. However, since the cables are solid-state cables that contain no liquid and the duct bank is composed of concrete, duct bank damage would not result in any spills or accidental release.

8.7 Terrorist Attacks

Although highly unlikely, New England Wind could be a target for terrorism. Impacts associated with a terrorist attack would depend on the magnitude and location of the attack. Potential impacts from this type of event would be similar to the potential outcomes listed above. Measures described above to contain offshore spills and releases are also expected to minimize the environmental impacts from a terrorist attack.

9.0 REFERENCES

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Section 6.3

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