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Vineyard Wind 1 Offshore Wind Energy Project
Final Environmental Impact Statement
Volume II

March 2021

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Author:

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Office of Renewable Energy Programs

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ENVIRONMENTAL IMPACT STATEMENT
FOR THE VINEYARD WIND 1 OFFSHORE WIND ENERGY PROJECT
DRAFT ( ) FINAL (X) DRAFT SUPPLEMENTAL ( )

Lead Agency: U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM), Office of Renewable Energy Programs

Cooperating Federal Agencies:
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service
U.S. Department of Defense, Army Corps of Engineers
U.S. Department of Homeland Security, Coast Guard
U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement
U.S. Environmental Protection Agency

Cooperating Tribal Nation: Narragansett Indian Tribe

Cooperating State Agencies:
Massachusetts Office of Coastal Zone Management
Rhode Island Coastal Resource Management Council
Rhode Island Department of Environmental Management

Contact Person:
Jennifer Bucatari
Environmental Protection Specialist
Office of Renewable Energy Programs, Environment Branch
Bureau of Ocean Energy Management
Office (703) 787-1742
Jennifer.Bucatari@boem.gov

Area: Lease Area OCS-A 0501

Abstract:

This Final Environmental Impact Statement (FEIS) assesses the potential environmental, social, economic, historic, and cultural impacts that could result from the construction, operation, maintenance, and decommissioning of an approximately 800-megawatt offshore wind energy facility located more than 14 miles (23.6 kilometers) southeast of Martha's Vineyard. This Vineyard Wind 1 Offshore Wind Energy Project (Project) is proposed by Vineyard Wind LLC and designed to serve demand for renewable energy in New England. The FEIS was prepared following the requirements of the National Environmental Policy Act (42 United States Code [U.S.C.] §§ 4321–4370f) and implementing regulations. This FEIS incorporates analyses in the Supplement to the Draft Environmental Impact Statement (SEIS) addressing reasonably foreseeable offshore wind activities and their effects, previously unavailable fishing data, a new transit lane alternative, and changes to the proposed Project made by Vineyard Wind LLC. The FEIS also addresses comments received during the Draft Environmental Impact Statement (DEIS) and SEIS comment periods. The FEIS will inform BOEM in deciding whether to approve, approve with modifications, or disapprove the proposed Project. Cooperating agencies may also rely on the FEIS to support decision making if they determine the analysis is adequate for that purpose. BOEM's action furthers U.S. policy to make the Outer Continental Shelf energy resources available for development in an expeditious and orderly manner, subject to environmental safeguards (43 U.S.C. § 1332(3)), including consideration of natural resources and existing ocean uses.

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APPENDIX A

Planned Action Offshore Wind Scenario and Assessment of Resources With Minor Impacts

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APPENDIX A. PLANNED ACTION OFFSHORE WIND SCENARIO AND ASSESSMENT OF RESOURCES WITH MINOR IMPACTS

This appendix describes offshore wind development activities that the Bureau of Ocean Energy Management (BOEM) considered reasonably foreseeable for the purpose of assessing planned action impacts in the Supplement to the Draft Environmental Impact Statement (SEIS) and in this Final Environmental Impact Statement (FEIS). In addition, to focus on the impacts of most concern in the main body of this FEIS, BOEM has included the analysis of resources with no greater than **minor** adverse impacts in this appendix (air quality, water quality, birds, and bats). Those resources with potential impact ratings greater than **minor** are included in FEIS Chapter 3.

Cumulative impacts are the incremental effects of the Proposed Action on the environment when added to other past, present, or reasonably foreseeable actions taking place within the region of the proposed Project, regardless of which agency or person undertakes the actions (40 Code of Federal Regulations [CFR] 1508.7). This FEIS discusses resource-specific impacts that could occur if impacts associated with the Proposed Action would contribute to or overlap spatially or temporally with impacts from other past, present, or planned actions taking place within the region of the proposed Project, regardless of which agency or person undertakes the actions. This appendix focuses on the expanded plan action scenario associated with planned offshore wind development activities described in Chapter 1. Unless otherwise specified in this FEIS, BOEM considers information related to past, present, and planned projects, including non-offshore wind-related activities, the same as presented in the Draft Environmental Impact Statement (DEIS).

As described in FEIS Section 1.7.1, BOEM conducted a thorough process to identify the possible extent of reasonably foreseeable offshore wind development on the Atlantic Outer Continental Shelf (OCS). As a result of this process, BOEM has assumed that approximately 22 gigawatts (GW) of Atlantic offshore wind development are reasonably foreseeable along the east coast. Reasonably foreseeable development includes 17 active wind energy lease areas (16 commercial and 1 research) (Figure A.1-1), which include named projects and assumed future development within the remainder of lease areas outside of named project boundaries, as described in this appendix and in FEIS Section 1.7.1. Levels of assumed future development are based on state commitments to renewable energy development, available turbine technology, and the size of potential development areas. These assumptions form the basis for analyzing potential resource-specific impacts (FEIS Chapter 3).

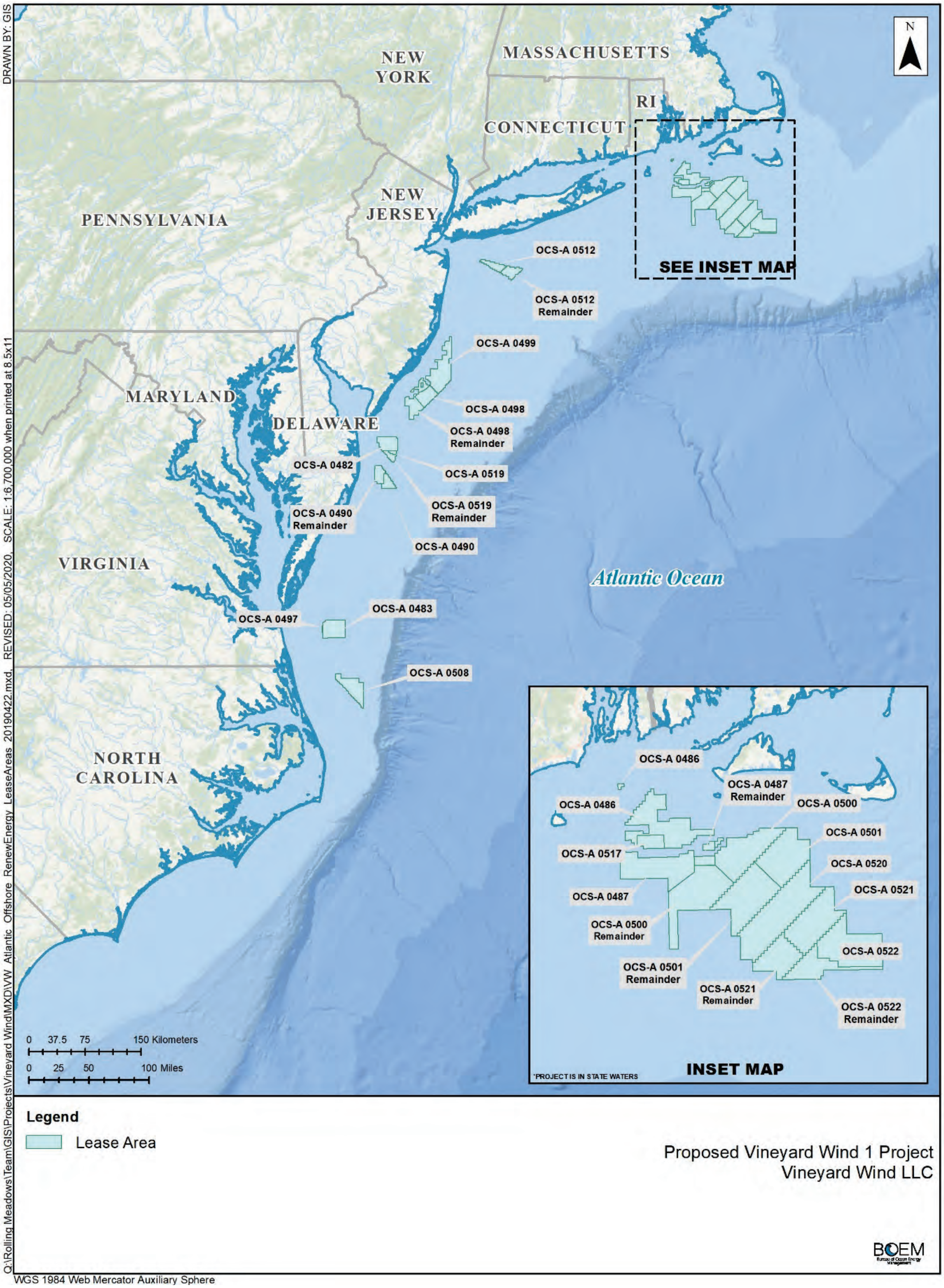

Figure A.1-1: Wind Lease Areas Considered in Planned Action Offshore Wind Scenario

Under the renewable energy regulations, the issuance of leases and subsequent approval of wind energy development on the OCS is a phased decision making process and occurs over several years. Starting with lease issuance, the process follows these general steps:

- Lease Issuance—BOEM issues a commercial wind energy lease that gives the lessee exclusive rights to seek BOEM approval for the development of the lease area. BOEM conducted National Environmental Policy Act (NEPA) analyses and assessed the potential impacts of site characterization surveys for offshore Rhode Island, Massachusetts, New York, and the Mid-Atlantic (76 Federal Register [Fed. Reg.] 169 [August 18, 2011], BOEM 2016b, and BOEM 2015a, respectively). Lessees may request to assign a portion of their lease to another qualified legal entity, which would lead to a new lease number within a previously defined lease area. A new lease would not impact the expanded planned action scenario because the collective acreage of lease area available for development would remain unchanged.
- Site Assessment Plan (SAP) Review/Approval[1]—Although a SAP is not required, BOEM assumes that every lessee will plan to install one meteorological (met) tower or one to two met buoys for site assessment. If the lessee is proposing to install site assessment facilities, the lessee has 1 year after lease execution to submit a SAP, which must contain a detailed proposal for the installation and, if applicable, construction of met towers or buoys. BOEM must approve the SAP before site assessment activities commence. After SAP approval, the lessee has up to 5 years to complete site characterization and site assessment activities to support a Construction and Operations Plan (COP). BOEM conducted NEPA analyses and assessed the potential impacts of site assessment activities for offshore Rhode Island, Massachusetts, New York, and the Mid-Atlantic (76 Fed. Reg. 169 [August 18, 2011], BOEM 2016b, and BOEM 2015a respectively).
- COP Review and Approval—Six months prior to the end of the 5-year assessment term, the lessee submits a COP that contains a detailed plan for the construction and operation of a wind energy project on the lease area. COP submittal triggers a project-specific NEPA analysis (for Vineyard Wind, this current NEPA process). After completion of the NEPA document, BOEM may approve, approve with modifications, or disapprove a lessee's COP. If approved, the lessee is allowed to construct and operate wind turbine generators and associated facilities for the operations term of the lease (typically 25 years) (BOEM 2016b).[2]

The following sections describe reasonably foreseeable activities associated with offshore wind development on the Atlantic OCS and identify the development status of proposed offshore wind projects. Reasonably foreseeable activities associated with offshore wind development include site characterization studies, site assessment activities, construction and operation of offshore wind facilities, port upgrades, and construction and maintenance of offshore export cables. These sections also identify assumptions used to evaluate potential impacts in the geographic analysis areas identified for resource-specific expanded planned action analysis contained within this FEIS.

[1] Note that BOEM may approve, approve with modifications, or disapprove a lessee's SAP.

[2] For analysis purposes, BOEM assumes in this FEIS that the proposed Project would have an operating period of 30 years. Vineyard Wind's lease with BOEM (Lease OCS-A 0501) has an operations period of 25 years that commences on the date of COP approval (https://www.boem.gov/Lease-OCS-A-0501/ at Addendum B; 30 CFR § 585.235(a)(3)). Vineyard Wind would need to request an extension of its operations period from BOEM in order to operate the proposed Project for 30 years. For purposes of the maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, however, this FEIS analyzes a 30-year operations period.

A.1. METHODOLOGY FOR ASSESSING PLANNED ACTION IMPACTS

A.1.1. Overview of the Scope for Offshore Wind Activities

BOEM analyzed the possible extent of future offshore wind development in the United States on the Atlantic OCS to determine reasonably foreseeable effects measured by installed power capacity, and the SEIS was published in June 2020 (BOEM 2020a). This is summarized in Chapter 1 Figure 1.7-1 and expands what offshore wind actions are considered reasonably foreseeable beyond those included in the DEIS to include approximately 22 GW of offshore wind power projects.

A.1.1.1. Reasonably Foreseeable Assumptions

- It is difficult to predict turbine capacity and spacing or other future engineering for planned but currently unscheduled offshore wind awards. For those projects with announced wind turbine generators (WTG) sizes, BOEM assumed an 8 or 12 MW WTG. BOEM understands that turbine capacity may exceed 12 megawatts (MW) in the future. However, for future procurements and projects under this planned action analysis, BOEM evaluates potential impacts assuming that 12 MW WTGs will be used—since it is the largest turbine now commercially available.
- The simultaneous construction of multiple projects within the U.S. Atlantic region would require a substantial number of specialized vessels and a robust supply chain. BOEM's analysis to develop a reasonably foreseeable build-out scenario assumes the challenges of vessel availability and supply chain will be overcome, and projects will advance at the schedule the states and developers have announced.
- BOEM assumes that all planned offshore wind procurements will be awarded, even for those states that have clauses requiring state boards or commissions to only approve offshore wind procurements if determined in the public interest or in the best interest of ratepayers. If any offshore wind agreements are not awarded, fewer projects will be developed than BOEM foresees.
- Some states might include technical, economic, or environmental stipulations in their offshore wind solicitations that are too burdensome for prospective developers, and this would reduce BOEM's build-out scenario.
- Infrastructure does not currently exist to handle interconnection points and transmission for 22 GW of Atlantic offshore wind energy. BOEM assumes these challenges will be solved and that 22 GW of Atlantic offshore wind can be built. This analysis does not address potential solutions, but independent transmission proposals dedicated to offshore wind energy could assist.
- BOEM assumes that each project would have its own submarine transmission line and that regional transmission ROW projects are not currently foreseeable. However, if shared submarine cable were developed in the future, environmental impacts would be reduced for most resources as compared to multiple cable corridors.
- Section A.1.1.2 details BOEM's technical assumptions regarding the design and placements of potential future project elements (e.g., WTGs, cables). This appendix also specifies BOEM's assumptions related to the anticipated timing of reasonably foreseeable offshore wind activities, including the number of foundations anticipated in a given year over the next 6 to 10 years, some of which would overlap in time. The assumptions outlined are used in evaluating potential planned action impacts on the resources analyzed in this document.

A.1.1.2. Detailed Scope for Future Offshore Wind Activities

Before deciding on the planned action scope described in Section A.1.1.1, BOEM evaluated several possible options. Each bar in Figure 1.7-1 represents possible offshore wind development based on the factors necessary for project development to occur (resource potential, area available, demand, and level of planning). From the top of the figure moving down, each bar narrows the level of potential development when compared to the bars above it. Each bar also represents a level of specific information available regarding the potential development, with increasing information as one goes down the inverted pyramid. To capture this information, BOEM began by reviewing the U.S. Department of Energy's (DOE) 2016 Offshore Wind Energy Resource Assessment for the United States (Musial et al. 2016) and the DOE's 2018 *Offshore Wind Technologies Market Report* (DOE 2019). Next, BOEM estimated the capacity of existing planning and lease areas, and reviewed state legislation, offshore wind commitments, and requests for proposals. BOEM also reached out to states when information was unclear or lacking, and compiled current and potential projects from submitted plans, discussions with lessees, and industry announcements.

A.1.1.2.1. Atlantic Offshore Wind Technical Resource Potential

DOE estimates the technical resource potential of state and federal waters offshore Maine to Georgia (water depths less than 3,280 feet [1,000 meters]) to be 1,236 GW (top bar on Figure 1.7-1), about the same as the nation's current total electricity use. BOEM did not assume that offshore wind turbines would occupy every square mile of these areas or that more energy would be produced than could be procured by Atlantic states (Musial et al. 2016) because it considers such scenarios unfeasible. Instead, BOEM's planned action analysis bases its estimate of wind technical resource potential on the potential of areas that are leased, excluding leased areas offshore North Carolina, which currently has no announced goals or stated demand for offshore wind energy.

A.1.1.2.2. Technical Resource Potential of Atlantic Call, Wind Energy, and Lease Areas

To determine developer interest in proposed areas, BOEM issues a Call. BOEM's Call Areas are typically reduced through the planning and leasing processes following engagement with stakeholders, tribes, and state and federal government agencies. There are currently two Call Areas on the Atlantic OCS: New York (approximately 1,735,154 acres [7,022 square kilometers (km^2)]) and South Carolina (approximately 853,957 acres [3,456 km^2]). See second bar on Figure 1.7-1.

Call Areas are then narrowed into Wind Energy Areas (WEAs), which are areas that appear to be most suitable for commercial wind energy development while presenting the fewest apparent environmental and user conflicts. BOEM does not consider development of Call Areas and WEAs reasonably foreseeable because leasing of these areas is highly uncertain. BOEM could decide not to offer a WEA for leasing, and there is no guarantee that all areas offered for lease will receive bids.

A.1.1.2.3. Technical Resource Potential of Existing Atlantic Leases

There are currently 17 active wind energy lease areas (16 commercial and 1 research) covering approximately 1,744,289 acres (7,059 km^2). BOEM estimates their total technical capacity to be about 25 GW (Figure 1.7-1, fourth bar).[3] This is greater than the capacity previously stated by BOEM and estimated by the National Renewable Energy Laboratory.[4] It would represent greater offtake than is presently planned by Atlantic states. Unsuitable geological conditions identified during site characterization surveys, potential use conflicts, habitat resource concerns, endangered species effects, and future navigation corridors identified by the U.S. Coast Guard (USCG) could exclude significant portions of the leases from development. Therefore, it is improbable that Atlantic active leases will be developed to their maximum technical capacity due to unsuitable conditions. This is consistent with BOEM's Oil and Gas Program, which does not assume all areas leased will be explored and developed.

A.1.1.2.4. State Capacity Commitment for Offshore Wind

As shown on Figure 1.7-1 (in Chapter 1) and Table 1.7-1 (in Appendix B), the state pledges for offshore wind capacity currently total about 29 GW (third bar on Figure 1.7-1). The offshore wind capacity associated with each

[3] Industry appears to anticipate continuing the trend of increasing available turbine size over the next several years of development. The recently developed Haliade-X 12 MW turbine has a rotor diameter of 722 feet (220 meters), making the optimal turbine spacing for this machine approximately 0.83 nautical mile. BOEM assumes an average spacing of 1 nautical mile with an average turbine size of 12 MW (12 MW per square nautical mile [MW/nm^2]) to calculate the total 25 GW active lease nameplate capacity.

[4] Existing wind energy leases in the Atlantic have been calculated by the National Renewable Energy Laboratory to have an approximate capacity of about 21 GW (all lease areas developed at 10.3 MW/nm^2 [DOE 2019]). The actual capacity of a particular lease may vary (higher or lower) due to turbine sizes, turbine field density, or navigation corridors. Average offshore wind turbine size in U.S. waters should average at least 12 MW and the largest turbines could exceed 15 MW before 2025. The build-out of Atlantic wind leases is likely to average more than 12 MW/nm^2 (if fully developed), assuming an average of 1 nautical mile spacing in all directions across wind leases (the widest spacing proposed by a developer for a project thus far).

state in Table 1.7-1 is divided among awarded, scheduled, and planned but unscheduled procurements. This total capacity is specific to offshore wind and does not include more general renewable or clean energy goals. Out of the three categories of commitments, offtake awards provide the greatest certainty for development, followed by announced, scheduled solicitations. State goals that are planned but do not have a scheduled award or procurement dates could occur as a series of procurements, or simply not be met if future cost reductions do not meet the states' award criteria. Some states have clauses requiring state boards or commissions to approve offshore wind procurements only if determined in the public interest or in the best interest of ratepayers. If offshore wind offtake is not awarded due to the cost of offshore wind subsidies or for other reasons, the planned state procurements would not be fully realized. Furthermore, state commitments for offshore wind development may not be met for lack of available lease area or technical capacity. BOEM considers only 22 GW of all state capacity commitments to be reasonably foreseeable, after accounting for such limitations on state commitments, particularly those that exceed what is technically achievable in existing lease areas within transmission range with existing technology (fifth bar on Figure 1.7-1).

BOEM estimates the years of planned capacity as shown in Table 1.7-1. The technology available to meet future procurements may be quite different in 10 or more years than what is available today.

A.1.1.2.5. Offshore Wind Offtake Awarded and Solicitations Announced

A total of 6.4 GW has been awarded to meet state offshore wind procurements. Announced solicitations are those that have not yet been awarded but that a state has scheduled to award. Combined awarded and announced offshore wind procurements total 13.8 GW (see awarded or announced procurements in Table 1.7-1). This does not include state commitments that have been planned but are unscheduled. Those commitments are captured in the planned category.

A.1.1.2.6. Projects Announced

Lessees have publicly announced plans for additional projects in addition to the ten COPs BOEM is currently processing. Table 1.7-2 in Appendix B describes the current approved, proposed, and contemplated projects across all Atlantic lease areas. The capacity listed for a project corresponds to either the design envelope in its submitted COP or the size of procurements that the developer has publicly announced it would bid on.

Some developers entered into offtake agreements before submitting a COP (e.g., Ocean Wind, Skipjack, and Sunrise), and some developers submitted COPs before securing an offtake agreement (e.g., Bay State Wind and Vineyard Wind 1). For purposes of this analysis, BOEM considers a project that has submitted a COP with no offtake agreement further along in development than a project with only an offtake agreement and no COP submitted, because the former provide information needed for regulatory review. The information associated with announced projects varies. For example, it might be a detailed submission to a procurement request for proposal, a company website with no specification beyond a general intention of development, or a general project area location and capacity.

If approved, the proposed Project is on track to be the nation's first large-scale offshore wind energy project. Comments received on the SEIS from companies in the offshore wind industry have noted that approval of the Project would encourage and support continued investment in other offshore wind projects and the creation of a domestic supply chain for the offshore wind industry in the eastern United States. This could accelerate the offshore wind industry and lead to additional future project announcements.

A.1.2. Resource Geographic Analysis Areas

Each resource has a geographic distribution and these differ in the areas that may be affected by the proposed Project (Table A-1). Figures A.7-1 through A.7-16 identify the resource-specific geographic analysis areas. Table A-4 lists reasonably foreseeable wind energy projects or activities in addition to the proposed Project. The table identifies whether these projects or activities are located within particular resource-specific analysis areas and thus are considered in the FEIS impacts analysis. BOEM has adjusted the geographic analysis areas for impacts for select resources since the DEIS as described in Table A-1.

Table A-1: Resource-Specific Geographic Analysis Areas for the Expanded Planned Action Analysis

Resource	Geographic Analysis Area
Terrestrial And Coastal Fauna	The geographic analysis area for terrestrial and coastal fauna is defined by a 0.5-mile (0.8-kilometer) buffer around all land areas that would be disturbed by the proposed Project. As described in FEIS Appendix A Section A.8.5.1, BOEM expects the terrestrial and coastal fauna in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges. Figure A.7-1 depicts the geographic analysis area for terrestrial and coastal fauna. The geographic analysis area for terrestrial and coastal fauna is similar to that considered in the DEIS, but has removed the New Hampshire Avenue landfall location and associated upland route as the route is no longer considered by Vineyard Wind. This discussion of terrestrial and coastal fauna does not include birds, which are discussed separately under Section A.8.3, or bats, which are discussed separately under Section A.8.4.
Coastal Habitats	The geographic analysis area for coastal habitats is defined as all lands and waters within the 3-nautical-mile seaward limit of Massachusetts' territorial sea to 100 feet (30.5 meters) landward of the first major land transportation route encountered (a road, highway, rail line, etc.) that is within a 1-mile (1.6-kilometer) buffer of the OECC. Figure A.7-2 depicts the geographic analysis area for coastal habitats. Although the plants and animals that build biogenic coastal habitats do not move appreciably except through reproduction, this buffer allows for the gradual progression of these organisms across the seascape. The geographic analysis area for coastal habitat is similar to that considered in the DEIS, but has removed the New Hampshire Avenue landfall location as the landfall is no longer considered by Vineyard Wind.
Benthic Resources	The geographic analysis area for benthic resources extends for a 10-mile (16.1-kilometer) radius around the WDA and the OECC proposed in the COP. This area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources. While sediment transport beyond this radius is possible, sediment transport related to the proposed activities is likely to remain within this area, according to the results of the model presented in COP Volume III, Appendix III-A (Epsilon 2020b). Highly mobile benthic animals and planktonic life stages of otherwise benthic organisms may be affected by activities outside of this area and are therefore considered among the resources discussed in Section 3.2. The following analysis includes any reasonably foreseeable offshore wind developments in lease areas with a more-than-nominal overlap with the geographic analysis area. Figure A.7-3 depicts the geographic analysis area. The geographic analysis area is identical to that considered in the DEIS.
Finfish, Invertebrates, and Essential Fish Habitat	The geographic analysis area for finfish, invertebrates, and EFH is the U.S. waters of the LME, which is likely to capture the majority of the movement range for most species in this group. The Northeast Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. Figure A.7-4 depicts the geographic analysis area for finfish, invertebrates, and EFH. The geographic analysis area for finfish, invertebrates, and EFH is similar to that considered in the DEIS, but its northern portion has been slightly reduced to include only U.S. waters.
Marine Mammals	The geographic analysis area for marine mammals includes the Scotian Shelf, Northeast Shelf, and Southeast Shelf LMEs, which are likely to capture the majority of the movement range for most species in this group. LMEs are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and NOAA uses them as the basis for ecosystem-based management. The Northeast Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. The Southeast Shelf LME extends from the Straits of Florida to Cape Hatteras, North Carolina. These LMEs extend from the coastline offshore to the shelf break (at approximately 328.1 to 656.2 feet [100 to 200 meters] depth). The geographic analysis area is identical to that considered in the DEIS. Figure A.7-5 depicts the geographic analysis area for marine mammals.
Sea Turtles	The geographic analysis area for sea turtles includes the Scotian Shelf, Northeast Shelf, and Southeast Shelf LMEs, which are likely to capture the majority of the movement range within U.S. waters for most species in this group. LMEs are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and NOAA uses them as the basis for ecosystem-based management. The Northeast Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. The Southeast Shelf LME extends from the Straits of Florida to Cape Hatteras, North Carolina. These LMEs extend from the coastline offshore to the shelf break (at a depth of approximately 328.1 to 656.2 feet [100 to 200 meters]). The geographic analysis area of nesting for all turtle species ranges from North

Resource	Geographic Analysis Area
	Carolina southward. The geographic analysis area is identical to that considered in the DEIS. Figure A.7-6 depicts the geographic analysis area for sea turtles.
Demographics, Employment, and Economic Characteristics	The geographic analysis area for demographics, employment, and economic characteristics includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island). Figure A.7-7 depicts the geographic analysis area for demographics, employment, and economic characteristics. These counties are the most likely to experience beneficial or adverse economic impacts from the proposed Project. The geographic analysis area is smaller than the geographic analysis area considered in the DEIS. The DEIS included Fairfield and New London counties, Connecticut. These counties have been removed from the geographic analysis area because the Port of Bridgeport in Fairfield County and the Port of New London/Groton in New London County are no longer being considered as supporting facilities for the Vineyard Wind 1 Project offshore construction.
Environmental Justice	The geographic analysis area for environmental justice populations includes the counties where proposed onshore infrastructure and potential port cities are located, as well as counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island). Figure A.7-7 depicts the geographic analysis area for environmental justice populations. These counties, and environmental justice communities located within them, are the most likely to experience economic impacts from the Proposed Action. The geographic analysis area for environmental justice populations is smaller than the geographic analysis area considered in the DEIS. The DEIS included Fairfield and New London counties, Connecticut. These counties have been removed from the geographic analysis area because the Port of Bridgeport in Fairfield County and the Port of New London/Groton in New London County are no longer being considered for use supporting facilities for the Vineyard Wind 1 Project offshore construction.
Cultural Resources	The geographic analysis area for cultural resources consists of the areas of potential effect, as well as the locations of known or planned future offshore wind development off the coast of Cape Cod, Nantucket, and Martha's Vineyard. Figure A.7-8 depicts the geographic analysis area for cultural resources. For visually affected cultural resources, the geographic analysis area is limited to the viewshed area of intervisibility for the Proposed Action and the future offshore projects within the geographic analysis area for cultural resources. For all other cultural resources, the geographic analysis area is limited to the Proposed Action's terrestrial land and seafloor disturbance. As a result, the geographic analysis area for cultural resources is defined as follows: • The depth and breadth of the seabed potentially affected by any bottom-disturbing activities associated with the construction, including but not limited to the WTGs, offshore export cables, and support facilities, as well as areas that could be impacted by associated activities such as dredging, deploying and moving vessel anchors, and temporary or permanent construction or staging areas; • The depth and breadth of terrestrial areas potentially affected by ground-disturbing activities associated with construction of onshore infrastructure such as export cables, transmission lines, electrical substations, port expansions, and temporary or permanent construction or staging areas; and • The area of intervisibility between the viewshed from which structures from the Proposed Action would be visible and the viewshed from which structures would be visible from reasonably foreseeable offshore wind developments. The analysis of visual impacts is applied only to those historic properties that are adversely affected by the Proposed Action and that have a view of other reasonably foreseeable offshore wind developments. Although the description of the geographic analysis area has changed since the DEIS, the analysis area shown on Figure A.7-8 has not changed.
Recreation And Tourism	The geographic analysis area for recreation and tourism is the proposed RI and MA Lease Areas plus a 35.3-mile (56.8-kilometer) visual analysis area measured from the borders of the proposed Project WDA, as shown on Figure A.7-9. This radius is the area from which any portion of the proposed Project facilities would potentially be visible (based on a maximum rotor tip height of 837 feet [255 meters] above mean sea level, when considering only the obscuring effect of the curvature of the earth's surface). The geographic analysis area is the same as the area considered in the DEIS and includes marine areas, coastlines, and onshore areas where multiple projects could be visible simultaneously. The geographic analysis area includes many marinas and harbors on Martha's Vineyard, Nantucket, and Cape Cod that are important for recreational and sightseeing vessels. However, many of the recreational vessels that travel within and through the geographic analysis area originate outside the geographic

Resource	Geographic Analysis Area
	analysis area, including some that travel from Massachusetts and Rhode Island ports that would be used to support offshore wind development. The impacts of offshore wind development on ports are captured in other sections and is mentioned but not addressed in detail in this section.
Commercial Fisheries and For-Hire Recreational Fisheries	The geographic analysis area for commercial fisheries and for-hire recreational fishing is the boundaries of the management area of the New England Fishery Management Council and of the Mid-Atlantic Fishery Management Council for all federal fisheries within the U.S. Exclusive Economic Zone (from 3 to 200 nautical miles from the coastline) through Cape Hatteras, North Carolina, plus the state waters of the Commonwealth of Massachusetts (from 0 to 3 nautical miles from the coastline). For an analysis of private recreational fishing, see Section 3.9. Figure A.7-10 depicts the geographic analysis area for commercial fisheries and for-hire recreational fishing. The geographic analysis area is different from that considered in the DEIS, and now extends southward to Cape Hatteras, North Carolina, to include all reasonably foreseeable projects. The new geographic analysis area is the extent of fishing activities that overlap with the Vineyard Wind WDA and all reasonably foreseeable lease areas assigned to potential future power procurements in New England and the Mid-Atlantic.
Land Use and Coastal Infrastructure	The geographic analysis area for land use and coastal infrastructure includes the towns of Barnstable and Yarmouth and ports potentially used for the proposed Project's construction and installation, operations and maintenance, and decommissioning. These areas encompass locations where BOEM anticipates impacts associated with proposed onshore facilities and ports. Figure A.7-11 depicts the geographic analysis area for land use and coastal infrastructure. The geographic analysis area is smaller than the geographic analysis area considered in the DEIS. The DEIS included the ports of Bridgeport and New London/Groton in Connecticut; however, these are no longer being considered as supporting facilities for the Vineyard Wind 1 Project offshore construction.
Navigation and Vessel Traffic	The geographic analysis area for navigation and vessel traffic extends for a 10-mile (16.1-kilometer) radius around the WDA, the OECC, and vessel approach routes to the ports of New Bedford, Montauk, and Brayton Point in Bristol County, Massachusetts, ProvPort in Providence County, Rhode Island, and the Port of Davisville (Quonset Point) in Washington County, Rhode Island. Figure A.7-12 depicts the geographic analysis area for navigation and vessel traffic. These ports have been identified as suitable to support the offshore wind industry in Massachusetts and Rhode Island. The geographic analysis area has been modified since the DEIS. The DEIS included the ports of Bridgeport and the New London/Groton in Connecticut, which are no longer being considered for use as supporting facilities for Vineyard Wind 1 Project offshore construction. In addition, the geographic analysis area has been expanded to include all RI and MA Lease Areas for this expanded planned action analysis scenario due to presence of structures.
Other Uses	The geographic analysis area for marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys is described below and shown on Figure A.7-13. DEIS Section 3.4.8 analyzed potential effects of the Proposed Action on marine minerals extraction. BOEM is not analyzing the impacts of future offshore wind energy on marine minerals extraction because the Proposed Action would have no impacts on marine minerals extraction, and could not contribute to impacts on marine minerals extraction. In addition, BOEM assumes that export cables associated with future offshore wind projects—including Vineyard Wind 2, Mayflower Wind, South Fork Wind, and other potential projects within the RI and MA Lease Areas—would avoid identified borrow areas because BOEM would consult with the BOEM Marine Minerals Program and U.S. Army Corps of Engineers before approving offshore wind cable routes, avoiding impacts on known borrow areas. • **Military and National Security Uses:** The geographic analysis area includes airspace, surface, and submarine areas that are utilized by regional military entities in an area roughly bounded by Montauk, New York; Providence, Rhode Island; Provincetown, Massachusetts; and within a 10-mile (16-kilometer) buffer from the RI and MA Lease Areas. The geographic analysis area is the same as the geographic analysis area considered in the DEIS. • **Aviation and Air Traffic:** The geographic analysis area includes airspace and airports used by regional air traffic, generally an area roughly bounded by Montauk, New York; Providence, Rhode Island; Provincetown, Massachusetts; and within a 10-mile (16-kilometer) buffer from wind lease areas in the RI and MA Lease Areas. The geographic analysis area is the same as the geographic analysis area considered in the DEIS. • **Offshore Energy:** DEIS Section 3.4.8 analyzed potential impacts of the Proposed Action on other offshore energy projects. The geographic analysis area includes the seven active offshore RI and MA

Resource	Geographic Analysis Area
	Lease Areas that are not yet developed. No other reasonably foreseeable energy projects were identified in the geographic study area. BOEM is not analyzing the impacts of future offshore wind energy on offshore energy but is analyzing the impact of the Proposed Project on offshore energy. Therefore, the analysis of these impacts is limited to sections on Proposed Action and Action Alternatives. • **Cables and Pipelines:** The geographic analysis area includes areas within 1 mile (1.6 kilometers) of the OECC and WDA and the RI and MA Lease Areas that could affect future siting or operation of cables and pipelines. The geographic analysis area for cables and pipelines is similar to that considered in the DEIS, but has removed the New Hampshire Avenue landfall location as the landfall is no longer considered by Vineyard Wind. • **Radar Systems:** The geographic analysis area is the same as that identified for aviation and air traffic, and includes airspace and airports used by regional air traffic, generally an area roughly bounded by Montauk, New York; Providence, Rhode Island; Provincetown, Massachusetts; and within a 10-mile (16-kilometer) buffer from wind lease areas in the RI and MA Lease Areas. The geographic analysis area is the same as the geographic analysis area considered in the DEIS. • **Scientific Research and Surveys:** The geographic analysis area is the same as for finfish, invertebrates, and EFH (above) and includes the footprint of the Proposed Action and all reasonably foreseeable projects (as outlined in Figure A.7-4) between Maine and mid-North Carolina. The geographic analysis area is reduced from what was considered in the DEIS—which also included areas southwards to Florida—to better reflect the locations of scientific research and surveys similar to what is expected to occur within the WDA and OECC route.
Air Quality	The geographic analysis area for air quality includes the airshed within 15.5 miles (25 kilometers) of each area potentially impacted by the proposed Project, including the lease area, the on-land construction areas, and the mustering port(s). Given the generally low emissions of the sea vessels and equipment that would be used during proposed construction activities, any potential air quality impacts would likely be within a few miles of the source. BOEM selected the 15.5-mile (25-kilometer) distance to provide a reasonable buffer. Ozone is an exception. It is a significant regional pollutant, and this FEIS includes a detailed review of potential Project and collective impacts on regional ozone development. Figure A.7-14 depicts the geographic analysis area for air quality. The geographic analysis area for air quality is similar to that considered in the DEIS, however, it has had the following changes: removal of ports in Connecticut and removal of New Hampshire Avenue landfall location and associated upland route as the route is no longer considered by Vineyard Wind.
Water Quality	The offshore geographic analysis area for water quality extends for a 10-mile (16.1-kilometer) radius around the WDA, the OECC, and vessel approach routes to port facilities that would be used by the proposed Project. This area accounts for some transport of water masses due to ocean currents. Onshore, the water quality geographic analysis area includes the proposed Project footprint and surrounding areas. Figure A.7-15 depicts the geographic analysis area for water quality. The description of the geographic analysis area for water quality has been updated since the DEIS to include onshore components of the proposed Project. In addition, the offshore geographic area considered in this analysis is slightly reduced from the geographic analysis area considered in the DEIS because the Ports of Bridgeport and New London/Groton in Connecticut are no longer being considered for use as supporting facilities for the proposed Project as well as to account for the removal of New Hampshire Avenue landfall location and associated upland route as the route is no longer considered by Vineyard Wind.
Birds	The geographic analysis area for birds includes the U.S. East Coast from Maine to Florida to cover migratory species that may encounter the proposed Project and that utilize habitats along these states. The offshore limit is 100 miles (161 kilometers) from the Atlantic shore to capture the migratory movements of most species in this group. The onshore limit is 100 miles (161 kilometers) inland to cover onshore habitats used by the species that may be affected by offshore components of the proposed Project as well as to capture the movement range for species in this group. Figure A.7-16 depicts the geographic analysis area for birds.
Bats	While some historic, anecdotal observations of bats up to 1,212 miles (1,950 kilometers) offshore of North America exist, recent offshore observations of tree bats range from 10.5 to 26 miles (16.9 to 41.9 kilometers; Hatch et al. 2013). As such, the geographic analysis area for bats includes the U.S. East Coast, from Maine to Florida, to capture migratory species, and extends 100 miles (161 kilometers) offshore and 100 miles (161 kilometers) inland to capture the migratory movements of most species in this group. Northern long-eared bats (*Myotis septentrionalis)* and other cave bats do not typically occur

Resource	Geographic Analysis Area
	on the OCS. Tree bats are long-distance migrants whose ranges include the majority of the Atlantic coast from Florida to Maine. While these species have been documented traversing the open ocean and have the potential to encounter WTGs, use of offshore habitat is thought to be limited and generally restricted to spring and fall migration. The onshore limit of the geographic scope is intended to cover a majority of the onshore habitat use by those species that may encounter the proposed Project during the majority of their life cycle. Figure A.7-16 depicts the geographic analysis area for bats.

BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; DEIS = Draft Environmental Impact Statement; EFH = Essential Fish Habitat; FEIS = Final Environmental Impact Statement; LME = Large Marine Ecosystem; NEPA = National Environmental Policy Act; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; WDA = Wind Development Area; WTG = wind turbine generator

A.2. SITE CHARACTERIZATION STUDIES

A lessee is required to provide the results of site characterization activities (shallow hazard, geological, geotechnical, biological, and archaeological surveys) with its SAP or COP. A reasonably foreseeable consequence of issuing these leases is site characterization and site assessment (discussed in Section A.3). For the purposes of the planned action analysis, BOEM assumes site characterization surveys will occur on all existing leases during the life of a proposed project. BOEM makes the following assumptions for survey and sampling activities:

- Site characterization would likely take place in the first 3 years following execution of lease, based on the fact that a lessee would likely want to generate data for its COP at the earliest possible opportunity. Site assessment would likely take place starting within 1 to 2 years of lease execution, as preparation of a SAP (and subsequent BOEM review) takes time.
- Lessees would likely survey most or all of the proposed lease area during the 5-year site assessment term to collect required geophysical information for siting of a met tower and/or two buoys and commercial facilities (wind turbines). The surveys may be completed in phases, with the met tower and/or buoy areas likely to be surveyed first.
- Lessee would not use air guns, which are typically used for deep penetration two-dimensional or three-dimensional exploratory seismic surveys to determine the location, extent, and properties of oil and gas resources (BOEM 2016b).

Table A-2 describes the typical site characterization surveys, the types of equipment and/or method used, and which resources the survey information would inform.

Table A-2: Site Characterization Survey Assumptions

Survey Type	Survey Equipment and/or Method	Resource Surveyed or Information Used to Inform
High-resolution geophysical surveys	Side-scan sonar, sub-bottom profiler, magnetometer, multi-beam echosounder	Shallow hazards,[a] archaeological,[b] Bathymetric charting, benthic habitat
Geotechnical/sub-bottom sampling [c]	Vibracores, deep borings, cone penetration tests	Geological [d]
Biological [e]	Grab sampling, benthic sled, underwater imagery/ sediment profile imaging	Benthic habitat
	Aerial digital imaging; visual observation from boat or airplane	Avian
	Ultrasonic detectors installed on survey vessels used for other surveys	Bat
	Visual observation from boat or airplane	Marine fauna (marine mammals and sea turtles)

Survey Type	Survey Equipment and/or Method	Resource Surveyed or Information Used to Inform
	Direct sampling of fish and invertebrates	Fish

Source: BOEM 2016b

[a] 30 CFR § 585.610(b) and 30 CFR § 585.626(a)(1)
[b] 30 CFR § 585.610–585.611 and 30 CFR § 585.626(a)
[c] 30 CFR § 585.610(b)(1) and 30 CFR § 585.626(a)(4)
[d] 30 CFR § 585.610(b)(4) and 30 CFR § 585.626(a)(2)
[e] 30 CFR § 585.610(b)(5), 30 CFR § 585.611(b)(3-5), 30 CFR § 585.626(a)(3), and 30 CFR § 585.627(a)(3-5)

The following sections provide specific details by reference of these types of surveys as provided in the *Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York* (BOEM 2016b), as well as an overview of survey techniques such that potential impacts may be evaluated.

A.3. SITE ASSESSMENT ACTIVITIES

After SAP approval, a lessee can evaluate the met conditions, such as wind resources, with the approved installation of met towers, buoys, or moorings. For those lessees with submitted SAPs (Table A-3), site assessment activities are also considered in this expanded planned action analysis.

Table A-3: Expanded Planned Action Projects: Site Assessment Activities

Lease Number	State	Company Name	Initial Date SAP Received	Date SAP Approved	Date Deployed or to be Deployed	Facility Description
OCS-A 0482	Delaware	Garden State Offshore Energy I, LLC (Deepwater Wind & PSEG)	7/2018	12/6/2019	Deployed, 1/20/2020	One met buoy
OCS-A 0483	Virginia	Dominion Energy Services, Inc.	5/2014	10/12/2017	TBD	Two met buoys
OCS-A 0486	Rhode Island and Massachusetts	Deepwater Wind New England, LLC	4/1/2016	10/12/2017	1/17/2019	One met buoy
OCS-A 0490	Maryland	US Wind, Inc.	11/2015	3/22/2018	TBD	One met tower, seabed mountain sensors
OCS-A 0497	Virginia	Virginia Department of Mines, Minerals and Energy/ Dominion Energy Services, Inc.	12/2014 [a]	6/20/2019 [a]	March–October 2020	One wave/current buoy
OCS-A 0498	New Jersey	OceanWind LLC	9/15/2017	5/16/2018	8/20/2018	Two met buoys, one met/current buoy
OCS-A 0499	New Jersey	EDF Renewables Development, Inc.	12/9/2019	TBD	TBD	Two met buoys
OCS-A 0500	Massachusetts	Bay State Wind	12/20/2016	6/29/2017	7/10/2017	Two met buoys
OCS-A 0501	Massachusetts	Vineyard Wind LLC	3/31/2017	5/10/2018	5/22/2018	Two met buoys
OCS-A 0508	North Carolina	Avangrid Renewables, LLC	9/18/2019	4/3/2020	6/6/2020	Up to two buoys and up to two platforms
OCS-A 0512	New York	Equinor (Statoil), LLC	6/18/2018	11/21/2018	TBD	Two met buoys, one wave/met buoy, and one subsea Current Meter Mooring

Lease Number	State	Company Name	Initial Date SAP Received	Date SAP Approved	Date Deployed or to be Deployed	Facility Description
OCS-A 0521	Massachusetts	Mayflower Wind	7/29/2019	5/26/2020	TBD	One met buoy
OCS-A 0522	Massachusetts	Vineyard Wind LLC	3/6/2020	TBD	TBD	Two met buoys

met = meteorological; SAP = Site Assessment Plan; TBD = to be determined
[a] Included in modifications to Research Activities Plan rather than SAP

A.4. Construction and Operation of Offshore Wind Facilities

For purposes of this expanded planned action analysis, BOEM is classifying 22 GW of potential future offshore wind construction within the Atlantic OCS as reasonably foreseeable. The 22 GW of constructed capacity would include a combination of development within the 17 active wind energy lease areas (16 commercial and 1 research) (Figure A.1-1), which include named projects and assumed future development within the remainder of lease areas outside of named project boundaries. A detailed description of proposed activities associated with each named project and remnant lease areas is provided in Table A-4. Figures A.7-1 through A.7-16 show the geographic analysis area for each resource evaluated in this FEIS. The specific locations of WTGs, electrical service platforms (ESPs), offshore export cable routes, the principal ports to be used during construction, and the principal ports to be used during operations and maintenance are unknown for projects in the early stage of development. Some similar information is also unknown for areas of offshore wind development required to meet the energy demands described in Chapter 1 within existing lease areas but outside of specifically named project boundaries. Therefore, when predicting the potential impacts of possible future offshore wind activities, BOEM has made assumptions to determine whether and how much the future offshore wind activities could overlap each geographic analysis area, which are described below and listed in Table A-4.

BOEM assumes that all offshore wind developments offshore Massachusetts and Rhode Island would have 1 x 1 nautical mile spacing. This assumption was made based on the 2019 Rhode Island and Massachusetts Lease Area developers' agreement and does not preclude the selection of another alternative by the decision maker (Figure A.7-17). The USCG's Final Massachusetts and Rhode Island Port Access Route Study (MARIPARS), which evaluated the need for establishing vessel routing measures, was published on January 29, 2020 (85 Fed. Reg. 5222). The Final MARIPARS recommended all surface structures be aligned in a 1 x 1 nautical mile grid, such that vessels anywhere in the Rhode Island and Massachusetts Lease Areas (RI and MA Lease Areas) would pass one WTG on either side every 1 nautical mile when traveling north-south or east-west, and every 0.6 to 0.8 nautical mile when traveling northwest-southeast or northeast-southwest (USCG 2020). In response to concerns of increased navigational safety risks due to all transiting traffic being funneled into a navigational safety corridor, the USCG stated that "the standard and uniform [1-nautical-mile] grid pattern… should alleviate… concerns [with compression and funneling traffic through relatively narrow lanes] by providing vessels with sufficient spacing and multiple options to transit safely through the array. If the entire MA/RI WEA [Massachusetts/Rhode Island Wind Energy Area] is developed consistent with such a grid pattern, mariners could choose among the many resulting navigation safety corridors to safely navigate through the entire MA/RI WEA" (USCG 2020). The five Rhode Island and Massachusetts offshore wind leaseholders have proposed a collaborative regional layout for wind turbines (1 x 1 nautical mile apart in fixed east-to-west rows and north-to-south columns, with 0.7-nautical-mile theoretical transit lanes oriented northwest-southeast) across their respective BOEM leases (Geijerstam et al. 2019), which meets the layout rules set forth in the Final MARIPARS. Though the USCG attached to the MARIPARS Federal Register Docket the Responsible Offshore Development Alliance's (RODA) proposal (Hawkins and Johnston 2020) recommending additional transit corridors through the lease areas, the Final MARIPARS concluded that if the layout in the recommendations were implemented, the USCG would not pursue any additional routing measures. As cooperating agencies, BOEM and USCG will continue to consult over the course of the NEPA process for the proposed Project as it relates to navigational safety and other aspects. Wind development offshore other states is assumed to occur at the same density as 1 x 1 nautical mile spacing, but no particular layout orientation or foundation spacing is assumed as ocean users offshore different states may have different patterns of movement or considerations than projects in leases offshore Massachusetts and Rhode Island. A new alternative, Alternative F, had been incorporated into the SEIS and this FEIS to assess potential impacts of the RODA proposal.

The anticipated construction schedule of when projects in the different regions would foreseeably start construction is presented in Table A-4.

In addition to the assumptions identified under Table A-4, future offshore wind projects would be subject to evolving economic, environmental, and regulatory conditions. Lease areas may be split into multiple projects, expanded, or removed, and development within a particular lease area may occur in phases over long periods of time. Research currently being conducted[5] in combination with data gathered regarding physical, biological, socioeconomic, and cultural resources during development of initial offshore wind projects in the United States could affect the design and implementation of future projects, as could advancements in technology. For these reasons, it is not possible to accurately predict the nature, location, and scale of potential impacts on resources across all lease areas. At the time of this FEIS, 32 percent of the OCS Atlantic lease areas (1,744,289 acres [705,891 hectares] have submitted a COP to BOEM for review and consideration, which is comprised of only 10 locations out of the 17. BOEM has made the following qualitative assumptions about possible future impacts of offshore wind development across all leased areas that have been considered in the expanded planned action analysis, including:

- BOEM assumes proposed offshore wind projects will include the same or similar components as the proposed Project: wind turbines with fixed foundations, inter-array cable system, Offshore Export Cable Corridor (OECC), one or more ESPs, and onshore interconnection facilities. BOEM further assumes that other potential offshore wind projects will employ the same or similar construction, operation, and decommissioning activities as the proposed Project. Economies of scale could be realized in terms of port development and regional transmission support, as the onshore transmission systems could improve to support power incoming from multiple offshore wind projects. For purposes of this analysis, however, and as described below, BOEM assumes that each project will have its own cable (both onshore and offshore) and that future projects would not utilize regional transmission support.
- Where possible, future projects could potentially seek to collocate onshore facilities and offshore cabling systems to avoid creation of new impact areas.
- Public attitudes toward offshore wind facilities may change over time as initial projects become operational, potentially affecting potential impacts on recreation, visual resources, and socioeconomic resources, and affecting how future projects are designed.
- Adaptive management could be used for many resources, particularly regulated fisheries and wildlife resources (including birds, benthic resources, finfish, invertebrates, essential fish habitat, marine mammals, and sea turtles), which would be closely monitored for potential impacts. If data collected are sufficiently robust, BOEM or other resource agencies could use the information obtained to support potential regulation changes or new mitigation measures for future projects.
- Build-out of the U.S. offshore wind industry could displace non-renewable resources such as fossil fuel plants for power generation, resulting in a greater beneficial impact on air quality and potential reduction in regional and national greenhouse gas (GHG) emissions to address climate change.

For consideration of environmental impacts from future offshore wind projects, Table A-5 provides a list of best management practices (BMPs) that were considered in the impact analysis. The BMPs were adopted from the Record of Decision (MMS 2007b) on the 2007 *Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* (MMS 2007a).

[5] In addition to private and state-funded research, BOEM-funded research continues to contribute to the growing body of scientific knowledge on the marine environment and informs BOEM's decision-making regarding renewable energy planning, leasing, and development efforts. Ongoing and completed studies are listed on BOEM's website at https://www.boem.gov/Renewable-Energy-Environmental-Studies/.

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions (as of December 1, 2020)

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Estimated Offshore Construction Schedule[4]	Expected Turbine Size[5]	Generating Capacity (MW)						Offshore Export Cable Length (Statue Miles)[9]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-array Cable Length (Statue Miles)[10]	Hub Height (Feet)[11]						Rotor Diameter (Feet)[12]						Total Height of Turbine (Feet)[13]					
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses			Air[6]	Water[7]	Benthic[8]	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses				Air	Water/Navigation	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water/Navigation	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X			2022	6 MW				12																							
NE	Block Island (state waters)	Built				X			Built	6 MW				30			28	5	2				328						541						659		
	Total State Waters													42			28	5	2																		
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	2022-2024	up 14 MW	800	800	800	800	800	800	98	6.5	177	358	358	358	358	358	473	538	538	538	538	538	729	627	627	627	627	627	837
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X	2022-2023	8 or 12 MW		76		120	120	120	139	6.5	28		345		345	345	492		543		543	543	722		614		614	614	853
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	COP, PPA	X	X		X	X	X	2023-2024	8 or 12 MW	405	62		880	880	880	115	6.5	169	345	345		345	345	492	543	543		543	543	722	614	614		614	614	853
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	2023-2024	8 or 12 MW	56	665		700	700	700	40	6.5	136	345	345		345	345	492	543	543		543	543	722	614	614		614	614	853
MA/RI	Vineyard Wind South OCS-A 0501 remainder (includes Park City Wind)	COP, PPA	X	X	X	X	X	X	2024-2025	8 or 12 MW	804	539	539	804	804	804	138	6.5	155	492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	2024-2025	8 or 12 MW	804	201	201	804	804	804	60	6.5	155	492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X	By 2030, spread over 2025-2030	12 MW	5,337	2,841	2,641	7,304	7,304	7,304				492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW turbine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X		12 MW										492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X		12 MW										492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	OCS-A 0521 remainder		X			X	X	X		12 MW										492			492	492	492	722			722	722	722	853			853	853	853
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X		12 MW													492	492	492				722	722	722				853	853	853
MA/RI	OCS-A 0522 remainder					X	X	X		12 MW													492	492	492				722	722	722				853	853	853
	Remaining MA/RI Lease Area Total[2]	73%									3,870	2,060	1,915	5,296	5,296	5,296	720	6.5	659																		
	Total MA/RI Leases[2]									-	**6,739**	**4,402**	**3,455**	**9,404**	**9,404**	**9,404**	**1,310**		**1,480**																		
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X			2022-2023	12 MW				1,100			142	5	142				492						722						853		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X			2023-2024	12 MW				816			64	5	107				492						722						853		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X			By 2030, spread over 2024-2030	12 MW				3,996									492						722						853		
NY/NJ	Atlantic Shores OCS-A 0499					X				12 MW													492						722						853		
NY/NJ	OCS-A 0498 remainder					X				12 MW													492						722						853		
	Remaining NY/NJ Lease Area Total					X								3,996			480	5	499																		
	TOTAL NY/NJ LEASES													**5,912**			**686**		**748**																		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X			2022-2023	12 MW				120			40	10	21				492						722						853		
DE/MD	US Wind, part of OCS-A 0490	COP, PPA				X			2022-2023	12 MW				270			80	5	40				492						722						853		
DE/MD	GSOE I, OCS-A 0482	NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 678 MW (57 turbines). The remaining capacity may be utilized by demand from NJ (57 turbines).				X			By 2030, spread over 2023-2030	12 MW				1,908									492						722						853		
DE/MD	OCS-A 0519 remainder					X				12 MW							360						492						722						853		
	Remaining DE/MD Lease Area Total					X								1,908			360	5	242																		
	TOTAL DE/MD LEASES													**2,298**			**480**		**303**																		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X			Built	6 MW				12			27	3.3	9				364						506						620		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X			2023-2026	12 MW				2,640			200	5	332				492						722						853		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X			2030	12 MW				1,824			110	5	231				492						722						853		
	TOTAL VA/NC LEASES													**4,476**			**337**		**572**																		
	OCS Total[24, 25]:										**6,739**	**4,402**	**3,455**	**22,090**	**9,404**	**9,404**	**2,841**		**3,105**																		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions (as of December 1, 2020)

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Turbine Number						Estimated Foundation Number[15]						Foundation Footprint[16] (Acres)						Seabed Disturbance Based on Addition of Scour Protection (Foundation+Scour Protection) (Acres)[17]						Offshore Export Cable Seabed Disturbance (Acres)[18]					Offshore Export Cable Operating Seabed Footprint (Acres)				
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air[14]	Water[14]	Benthic[14]	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X						2						2																									
NE	Block Island (state waters)	Built				X						5						5						1						6										17		
	Total State Waters											7						7						1						6										17		
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	100	100	100	100	100	57	102	102	102	102	102	59	2	2	2	2	2	1	53	53	53	53	53	31	117	117	117	117	117	77	77	77	77	77
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X		9		15	15	10		10		16	16	11		0		1	1	0		8		14	14	9	166		166	166	166	110		110	110	110
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	COP, PPA	X	X		X	X	X	51	8		110	110	73	52	9		112	112	75	2	0		4	4	3	44	8		95	95	64	137		137	137	137	91		91	91	91
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	7	83		88	88	58	7	85		90	90	60	0	3		4	4	2	6	72		76	76	51	48		48	48	48	32		32	32	32
MA/RI	Vineyard Wind South OCS-A 0501 remainder (includes Park City Wind)	COP, PPA	X	X	X	X	X	X	101	67	67	101	101	67	103	69	69	103	103	69	4	3	3	4	4	3	87	58	58	87	87	59	164	164	164	164	164	109	109	109	109	109
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	101	25	25	101	101	67	103	26	26	103	103	69	4	1	1	4	4	3	87	22	22	87	87	59	72	72	72	72	72	47	47	47	47	47
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																																		
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW turbine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	445	237	220	609	609	610	454	242	225	621	621	622	18	10	9	25	25	25	386	206	191	528	528	529	428	428	856	856	856	284	284	567	567	567
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																																		
MA/RI	OCS-A 0521 remainder		X			X	X	X																																		
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																																		
MA/RI	OCS-A 0522 remainder					X	X	X																																		
	Remaining MA/RI Lease Area Total[2]	73%							322	172	160	441	441	442	329	175	163	450	450	451	13	7	7	18	18	18	280	149	139	383	383	383	428	428	856	856	856	284	284	567	567	567
	Total MA/RI Leases[2]								**681**	**464**	**352**	**955**	**955**	**775**	**695**	**475**	**359**	**975**	**975**	**794**	**26**	**17**	**12**	**37**	**37**	**31**	**557**	**370**	**272**	**795**	**795**	**413**	**1,132**	**781**	**1,560**	**1,560**	**1,560**	**749**	**517**	**1,032**	**1,032**	**1,032**
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X						92						94						4						80					169					86		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X						68						70						3						60					77					39		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																																				
NY/NJ	Atlantic Shores OCS-A 0499					X						333						340																								
NY/NJ	OCS-A 0498 remainder					X																																				
	Remaining NY/NJ Lease Area Total					X						333						340						14						289					571					291		
	TOTAL NY/NJ LEASES											**493**						**504**						**20**						**428**					**817**					**416**		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X						10						11						0.4						9					48					50		
DE/MD	US Wind, part of OCS-A 0490	COP, PPA				X						23						24						1						20					96					48		
DE/MD	GSOE I, OCS-A 0482	NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 678 MW (57 turbines). The remaining capacity may be utilized by demand from NJ (57 turbines).				X																																				
DE/MD	OCS-A 0519 remainder					X						159						163																								
	Remaining DE/MD Lease Area Total					X						159						163						7						139					428					218		
	TOTAL DE/MD LEASES											**192**						**198**						**8**						**168**					**572**					**317**		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X						2						2						0.08						2					33					11		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X						220						225						9						191					238					121		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X						152						155						6						132					131					67		
	TOTAL VA/NC LEASES											**374**						**382**						**15**						**325**					**402**					**199**		
	OCS Total[24, 25]:								**681**		**352**	**2,021**		**775**	**695**		**359**	**2,066**		**794**	**26**		**12**	**81**		**31**	**557**		**272**	**1,723**			**1,132**		**3,351**			**749**	**517**	**1,981**		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions (as of December 1, 2020)

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Offshore Export Cable Hard Protection (Acres)[19]					Anchoring Disturbance (Acres)[20]					Inter-array Construction Footprint/ Seabed Disruption (Acres)[21]					Inter-array Operating Footprint/ Seabed Disruption (Acres)[22]					Inter-array Cable Hard Protection (Acres)[23]				
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X																											
NE	Block Island (state waters)	Built				X															4					0.1					0.01		
	Total State Waters										0					0					4					0.1					0.01		
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	35	35	35	35	35	4	4	4	4	4	204	204	204	204	116	146	146	146	146	84	63	63	63	63	44
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X	50		50	50	50	14		14	14	14	23		36	36	24	14		23	23	16	14		12	12	8
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	COP, PPA	X	X		X	X	X	41		41	41	41	12		12	12	12	18		264	264	176	13		160	160	107	0		0	0	0
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	14		14	14	14	4		4	4	4	200		211	211	140	121		128	128	86	121		66	66	44
MA/RI	Vineyard Wind South OCS-A 0501 remainder (includes Park City Wind)	COP, PPA	X	X	X	X	X	X	49	49	49	49	49	14	14	14	14	14	162	162	241	241	161	98	98	147	147	99	98	51	76	76	51
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	21	21	21	21	21	6	6	6	6	6	60	60	241	241	161	37	37	147	147	99	0	0	0	0	0
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																									
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW turbine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	129	129	257	257	257	36	36	72	72	72	568	528	1,461	1,461	1,463	346	322	888	888	889	0	0	0	0	0
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																									
MA/RI	OCS-A 0521 remainder		X			X	X	X																									
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																									
MA/RI	OCS-A 0522 remainder					X	X	X																									
	Remaining MA/RI Lease Area Total[2]	73%							129	129	257	257	257	36	36	72	72	72	412	383	1,059	1,059	1,061	251	233	644	644	645	0	0	0	0	0
	Total MA/RI Leases[2]								**339**	**234**	**468**	**468**	**468**	**90**	**60**	**126**	**126**	**126**	**1,079**	**809**	**2,257**	**2,257**	**1,839**	**679**	**514**	**1,395**	**1,395**	**1,135**	**296**	**114**	**217**	**217**	**147**
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X					51					14					221					134					0		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X					23					6					163					100					0		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																											
NY/NJ	Atlantic Shores OCS-A 0499					X																											
NY/NJ	OCS-A 0498 remainder					X																											
	Remaining NY/NJ Lease Area Total					X					171					48					799					486					0		
	TOTAL NY/NJ LEASES										**245**					**69**					**1,183**					**721**					**0**		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X					14					4					24					16					0		
DE/MD	US Wind, part of OCS-A 0490	COP, PPA				X					29					8					55					34					0		
DE/MD	GSOE I, OCS-A 0482	NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 678 MW (57 turbines). The remaining capacity may be utilized by demand from NJ (57 turbines).				X																											
DE/MD	OCS-A 0519 remainder					X																											
	Remaining DE/MD Lease Area Total					X					129					36					382					233					0		
	TOTAL DE/MD LEASES										**171**					**48**					**461**					**283**					**0**		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X					10					3					5					3					0		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X					71					20					528					322					0		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X					39					11					365					222					0		
	TOTAL VA/NC LEASES										**120**					**34**					**898**					**546**					**0**		
	OCS Total[24, 25]:								**339**		**1,004**			**90**		**276**			**1,079**		**4,802**			**679**		**2,945**			**296**		**217**		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions (as of December 1, 2020)

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Total of Coolant fluids in WTGs (gallons)						Total Coolant fluids in ESP (gallons)						Total of Oils and Lubricants in WTGs (gallons)					
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X																				
NE	Block Island (state waters)	Built				X																				
	Total State Waters																									
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	42,300	42,300	42,300	42,300	42,300	24,111	46	46	46	46	46	46	383,000	383,000	383,000	383,000	383,000	218,310
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X		3,997		6,345	6,345	4,230		4		23	23	23		36,194		57,450	57,450	38,300
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	COP, PPA	X	X		X	X	X	21,404	3,257		46,530	46,530	31,020	23	27		51	51	38	193,798	29,491		421,300	421,300	280,867
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	2,961	35,162		37,224	37,224	24,675	3	38		40	40	38	26,810	318,369		337,040	337,040	223,417
MA/RI	Vineyard Wind South OCS-A 0501 remainder (includes Park City Wind)	COP, PPA	X	X	X	X	X	X	42,512	28,483	28,483	42,512	42,512	28,341	46	31	31	46	46	46	384,915	257,893	257,893	384,915	384,915	256,610
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	42,512	10,628	10,628	42,512	42,512	28,341	46	12	12	46	46	46	384,915	96,229	96,229	384,915	384,915	256,610
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																		
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW turbine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	188,128	100,150	93,113	257,466	257,466	257,889	213	120	112	284	284	284	1,703,383	906,799	843,078	2,331,193	2,331,193	2,335,023
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																		
MA/RI	OCS-A 0521 remainder		X			X	X	X																		
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																		
MA/RI	OCS-A 0522 remainder					X	X	X																		
	Remaining MA/RI Lease Area Total[2]	73%							136,408	72,617	67,514	186,684	186,684	186,991	154	87	81	206	206	206	1,235,092	657,504	611,301	1,690,307	1,690,307	1,693,084
	Total MA/RI Leases[2]								**288,096**	**196,444**	**148,925**	**404,106**	**404,106**	**327,709**	**319**	**245**	**170**	**458**	**458**	**443**	**2,608,530**	**1,778,679**	**1,348,423**	**3,658,927**	**3,658,927**	**2,967,197**
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X						38,916						46						352,360		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X						28,764						46						260,440		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																				
NY/NJ	Atlantic Shores OCS-A 0499					X																				
NY/NJ	OCS-A 0498 remainder					X																				
	Remaining NY/NJ Lease Area Total					X						140,859						161						1,275,390		
	TOTAL NY/NJ LEASES											**208,539**						**253**						**1,888,190**		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X						4,230						46						38,300		
DE/MD	US Wind, part of OCS-A 0490	COP, PPA				X						9,729						46						88,090		
DE/MD	GSOE I, OCS-A 0482	NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 678 MW (57 turbines). The remaining capacity may be utilized by demand from NJ (57 turbines).				X																				
DE/MD	OCS-A 0519 remainder					X																				
	Remaining DE/MD Lease Area Total					X						67,257						92						608,970		
	TOTAL DE/MD LEASES											**81,216**						**184**						**735,360**		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X						846						0						7,660		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X						93,060						115						842,600		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X						64,296						69						582,160		
	TOTAL VA/NC LEASES											**158,202**						**184**						**1,432,420**		
	OCS Total[24, 25]:											**852,063**						**1,079**						**7,714,897**		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions (as of December 1, 2020)

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Total Oils and Lubricants in ESP (gallons)						Total Diesel Fuel in WTGs (gallons)						Total Diesel Fuel in ESP (gallons)					
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X																				
NE	Block Island (state waters)	Built				X																				
	Total State Waters																									
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	123,559	123,559	123,559	123,559	123,559	123,559	79,300	79,300	79,300	79,300	79,300	45,201	5,696	5,696	5,696	5,696	5,696	5,696
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X		11,676		61,780	61,780	61,780		7,494		11,895	11,895	7,930		538		2,848	2,848	2,848
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	COP, PPA	X	X		X	X	X	62,521	71,294		135,915	135,915	102,966	40,126	6,106		87,230	87,230	58,153	2,882	3,287		6,266	6,266	4,747
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	8,649	102,708		108,732	108,732	102,966	5,551	65,918		69,784	69,784	46,258	399	4,735		5,012	5,012	4,747
MA/RI	Vineyard Wind South OCS-A 0501 remainder (includes Park City Wind)	COP, PPA	X	X	X	X	X	X	124,177	83,198	83,198	124,177	124,177	123,559	79,697	53,397	53,397	79,697	79,697	53,131	5,724	3,835	3,835	5,724	5,724	5,696
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	124,177	31,044	31,044	124,177	124,177	123,559	79,697	19,924	19,924	79,697	79,697	53,131	5,724	1,431	1,431	5,724	5,724	5,696
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																		
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW turbine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	571,618	323,591	301,186	761,947	761,947	761,947	352,685	187,752	174,559	482,673	482,673	483,466	26,351	14,917	13,885	35,125	35,125	35,125
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																		
MA/RI	OCS-A 0521 remainder		X			X	X	X																		
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																		
MA/RI	OCS-A 0522 remainder					X	X	X																		
	Remaining MA/RI Lease Area Total[2]	73%							414,470	234,630	218,385	552,474	552,474	552,474	255,725	136,136	126,570	349,977	349,977	350,552	19,107	10,816	10,067	25,469	25,469	25,469
	Total MA/RI Leases[2]								**857,553**	**658,110**	**456,186**	**1,230,813**	**1,230,813**	**1,190,862**	**540,095**	**368,275**	**279,190**	**757,579**	**757,579**	**614,357**	**39,533**	**30,338**	**21,030**	**56,740**	**56,740**	**54,898**
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X						123,559						72,956						5,696		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X						123,559						53,924						5,696		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																				
NY/NJ	Atlantic Shores OCS-A 0499					X																				
NY/NJ	OCS-A 0498 remainder					X																				
	Remaining NY/NJ Lease Area Total					X						432,457						264,069						19,936		
	TOTAL NY/NJ LEASES											**679,575**						**390,949**						**31,328**		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X						61,780						7,930						2,848		
DE/MD	US Wind, part of OCS-A 0490	COP, PPA				X						61,780						18,239						2,848		
DE/MD	GSOE I, OCS-A 0482	NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 678 MW (57 turbines). The remaining capacity may be utilized by demand from NJ (57 turbines).				X																				
DE/MD	OCS-A 0519 remainder					X																				
	Remaining DE/MD Lease Area Total					X						247,118						126,087						11,392		
	TOTAL DE/MD LEASES											**370,677**						**152,256**						**17,088**		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X						0						1,586						0		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X						308,898						174,460						14,240		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X						185,339						120,536						8,544		
	TOTAL VA/NC LEASES											**494,236**						**296,582**						**22,784**		
	OCS Total[24, 25]:											**2,775,301**						**1,597,366**						**127,940**		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions (as of December 1, 2020)

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Construction Emissions NOx (tons)	Construction Emissions VOC (tons)	Construction Emissions CO (tons)	Construction Emissions PM10 (tons)	Construction Emissions PM2.5 (tons)	Construction Emissions SO2 (tons)	Construction Emissions CO2 (tons)	Operation Emissions NOx (tpy)	Operation Emissions VOC (tpy)	Operation Emissions CO (tpy)	Operation Emissions PM10 (tpy)	Operation Emissions PM2.5 (tpy)	Operation Emissions SO2 (tpy)	Operation Emissions CO2 (tpy)
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
NE	Aquaventis (state waters)	State Project				X																
NE	Block Island (state waters)	Built				X																
	Total State Waters																					
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	4,961	122	1,116	172	166	38	318,660	71	2	18	2	2	0.3	5,487
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X														
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	COP, PPA	X	X		X	X	X	2,510	61	565	87	84	19	161,242	36	1	9	1	1	0	2,776
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	347	9	78	12	12	3	22,306	5	0	1	0	0	0	384
MA/RI	Vineyard Wind South OCS-A 0501 remainder (includes Park City Wind)	COP, PPA	X	X	X	X	X	X	4,986	122	1,121	173	167	38	320,253	71	2	18	2	2	0	5,514
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	4,986	122	1,121	173	167	38	320,253	71	2	18	2	2	0	5,514
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X														
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW turbine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X														
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X														
MA/RI	OCS-A 0521 remainder		X			X	X	X														
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X														
MA/RI	OCS-A 0522 remainder					X	X	X														
	Remaining MA/RI Lease Area Total[2]	73%							16,011	392	3,601	556	535	124	1,028,420	228	6	58	8	7	1	17,708
	Total MA/RI Leases[2]								**33,801**	**828**	**7,602**	**1,175**	**1,129**	**261**	**2,171,135**	**482**	**14**	**123**	**16**	**16**	**2**	**37,385**
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X																
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X																
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																
NY/NJ	Atlantic Shores OCS-A 0499					X																
NY/NJ	OCS-A 0498 remainder					X																
	Remaining NY/NJ Lease Area Total					X																
	TOTAL NY/NJ LEASES																					
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X																
DE/MD	US Wind, part of OCS-A 0490	COP, PPA				X																
DE/MD	GSOE I, OCS-A 0482	NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 678 MW (57 turbines). The remaining capacity may be utilized by demand from NJ (57 turbines).				X																
DE/MD	OCS-A 0519 remainder					X																
	Remaining DE/MD Lease Area Total					X																
	TOTAL DE/MD LEASES																					
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X																
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X																
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X																
	TOTAL VA/NC LEASES																					
	OCS Total[24, 25]:																					

Notes: BOEM = Bureau of Ocean Energy Management; CO = carbon dioxide; CO_2 = carbon dioxide; COP = Construction and Operations Plan; CT = Connecticut: CVOW = Coastal Virginia Offshore Wind; DE = Delaware; EFH = Essential Fish Habitat; ESP = electrical service platform; FDR = Facility Design Report; FIR = Fabrication and Installation Report; MA = Massachusetts; MD = Maryland; MW = megawatt; NC = North Carolina; NE = New England; NJ = New Jersey; NO_x = nitrogen oxides; NY = New York; OCS = Outer Continental Shelf; $PM_{2.5}$ = particulate matter with diameters 2.5 microns and smaller; PM_{10} = particulate matter with diameters 10 microns and smaller; PPA = Power Purchase Agreement; RAP = Research Activities Plan; RI = Rhode Island; SO_2 = sulfur dioxide; tpy = tons per year; VOC = volatile organic compound; VA = Virginia; WTG = wind turbine generator

1. The spacing/layout for projects/regions are as follows: NE State water projects include a single strand of WTGs and no ESPs; for projects in the RI and MA Lease Areas, the analysis for the Vineyard Wind 1 Project assumes the spacing/layout is specific to the Proposed Action or action alternatives presented in FEIS Chapter 2; however, Vineyard Wind has stated they would utilize a 1 nautical mile x 1 nautical mile grid spacing. A 1 nautical mile x 1 nautical mile grid spacing is assumed for all other projects in the RI and MA Lease Areas; for the projects in the New Jersey/New York and the DE/MD Lease Areas, BOEM assumes that a 1 nautical mile x 1 nautical mile grid spacing also would be utilized; for the Coastal Virginia Offshore Wind Project, the spacing is 0.7 nautical mile; and the Dominion commercial lease area off the coast of Virginia would utilize 0.5 nautical mile average spacing, which is less than the 1 x 1 nautical mile spacing due to the need to attain the state's goals.
2. Because development could occur anywhere within the RI and MA Lease Areas and assumes a continuous 1 x 1 nautical mile grid, the actual development for these projects is expected to be approximately 73 percent of the collective technical capacity. Under the expanded planned action scenario described in Chapter 1, the total area in the RI and MA Lease Areas is greater than the area needed to meet state demand. Therefore, if a project is not constructed, BOEM assumes that another future project would be constructed to fulfill the unmet demand.
3. This column identifies lease areas that are applicable to each resource based on the geographic analysis areas shown on Figures A.7-1 through A.7-16. Except for known locations of special value or sensitivity with regard to a resource, BOEM assumes all locations within a geographic analysis area exhibit similar levels of sensitivity to potential impacts. Accordingly, a location at the periphery of a geographic analysis area is equally sensitive to potential impacts of other future offshore wind activities as is a location within Vineyard Wind's proposed Project footprint.
4. The estimated offshore construction schedule is based on information known at the time of this analysis and could be different when an applicant submits a COP. Furthermore, for this expanded planned action analysis, BOEM assumes that construction all the foundations would be installed during year 1 of construction and the balance of the work would be completed in year 2.
5. It is difficult to accurately predict future technology for planned but currently unscheduled offshore wind awards, including turbine spacing and capacity. For those projects with announced WTG sizes, BOEM used the assumption of an 8 or 12 MW WTG based on maximum-case scenario for the resource. BOEM understands that it is feasible that in the future, turbine capacity could be greater than 12 MW. For future procurements and projects under this expanded planned action analysis, BOEM assumes the largest turbine that is presently commercially available, a 12 MW WTG, to evaluate potential impacts.
6. The generating capacity for the lease areas within the air quality geographic analysis area without a known project size has been assumed to be a percentage of the technical capacity (7,304 MW). The percentage (73 percent) has been calculated based on the amount of lease area acreage for the specific lease areas (359,146 acres [1,453 km^2]) divided by the remaining "RI and MA Lease Areas" total (491,515 acres [1,989 km^2]). The air quality geographic analysis area includes 100 percent of the following leases: Bay State Wind Project, part of OCS-A 0500; OCS-A 0500 and OCS-A 0487 remainder; OCS-A 0520 (Equinor Massachusetts); and OCS-A 0521 remainder.
7. The generating capacity for the lease areas within the water quality geographic analysis area without a known project size has been assumed to be a percentage of the technical capacity (7,304 MW). The percentage (63%) has been calculated based on the amount of lease area acreage for the specific lease areas (310,041 acres [1,255 km^2]) divided by the remaining "RI and MA Lease Areas" total (491,515 acres [1,989 km^2]). The water quality geographic analysis area includes the following leases: 100 percent of Bay State Wind Project, part of OCS-A 0500; 22 percent of OCS-A 0500 and OCS-A 0487 remainder; and 63 percent of OCS-A 0520 (Equinor Massachusetts).
8. The generating capacity for the lease areas within the benthic resources geographic analysis area without a known project size has been assumed to be a percentage of the technical capacity (7,304 MW). The percentage (63 percent) has been calculated based on the amount of lease area acreage for the specific lease areas (310,041 acres [1,255 km^2]) divided by the "MA/RI Lease Area" total (491,515 acres [1,989 km^2]). The benthic resources geographic analysis areas includes the following leases: 100 percent of the Bay State Wind Project, part of OCS-A 0500; 9 percent of OCS-A 0500 and OCS-A 0487 remainder; and 63 percent of OCS-A 0520 (Equinor Massachusetts).
9. BOEM assumes that each offshore wind development would have its own cable (both onshore and offshore), and that future projects would not utilize a regional transmission line. The length of offshore export cable for those lease areas without a known project size has been assumed to include two offshore cables totaling 120 miles (193 kilometers). The offshore export cable would be buried a minimum of 6 feet (1.8 meters) but not more than 10 feet (3.1 meters).
10. The length of inter-array cabling has been assumed for all lease areas, except Vineyard Wind 1 Project, to be the average amount per foundation based on the COPs submitted to date, which is 1.48 miles (2.4 kilometers). In addition, for those lease areas that require more than one ESP, it has been assumed that an additional 6.2 miles (9.9 kilometers) of inter-link cable would be required to link the two ESPs. Inter-array cable is assumed to be buried between 4 and 6 feet.
11. The hub height for lease areas is based on maximum-case scenario for the resource area.
12. The rotor diameter for lease areas is based on maximum-case scenario for the resource area.
13. The total height of the turbine for lease areas is based on maximum-case scenario for the resource area.
14. The number of turbines for those lease areas without a known project size has been calculated based on the generating capacity and a 12 MW turbine.
15. The estimated number of foundations is the total number of turbines plus ESPs, and it has been assumed that for every 50 turbines there would be one ESP installed. There are some exceptions to this assumption where additional relevant information is available in publically available COPs for future projects.
16. The foundation footprint has been assumed to be 0.04 acre (161 square meters), which is based on the largest monopile reported (12 MW) for all lease areas other than Vineyard Wind 1 Project, which is 0.02 acre (81 square meters) as calculated from FEIS Appendix G.
17. The seabed disturbance with the addition of scour protection was calculated based on scour protection expected in submitted COPs. The Vineyard Wind 1 Project is based off the amount calculated from the COP and FEIS Appendix G. It is assumed that for all other lease areas that a 12 MW foundation with addition of scour protection would be 0.85 acre (3,440 square meters) per foundation.
18. Offshore export cable seabed bottom disturbance is assumed to be due to installation of the export cable, the use of jack-up vessels, and the need to perform dredging.
19. The offshore export cable hard protection is assumed to be similar to Vineyard Wind 1 Project, which is 0.357 acre (1,445 square meters) per mile of offshore export cable. It is assumed that 10 percent of the offshore export cable would require protection.
20. Anchoring disturbance has been assumed to be a rate equal to 0.10 acre (405 square meters) per mile of offshore export cable for all lease areas with the exception of Vineyard Wind 1 Project, which is 0.044 acre per mile of offshore export cable as calculated per FEIS Appendix G. Vineyard Wind has stated dynamic positioning vessels would be used and anchoring would occur only along the offshore export cable route.
21. Inter-array construction seabed disturbance has been assumed to be a rate equal to the average area per foundation, 2.4 acres (9,712 square meters) per foundation, for all lease areas with the exception of Vineyard Wind 1 Project, which is 2.04 acres (8,256 square meters) per foundation as calculated from the COP and FEIS Appendix G.
22. The inter-array operating footprint is assumed to be a rate equal to the average amount per foundation of 1.43 acres (5,787 square meters) per foundation for all lease areas.
23. Inter-array cable hard protection is assumed to be zero for all lease areas with the exception of Vineyard Wind 1 Project, Vineyard Wind South OCS-A-5001, South Fork, part of OCS-A 0486 and Revolution Wind, part of OCS-A 0486.
24. BOEM recognizes that the estimates presented within this expanded planned action analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential expanded planned action impacts and errs on the side of maximum impacts.
25. New York's demand is not double-counted; this total comes from looking at New York's state demand, not adding up the potential of the areas because that would double-count New York.

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Table A-5: Best Management Practices for Future Offshore Wind Activities

Preconstruction Planning
Lessees and grantees shall minimize the area disturbed by preconstruction site monitoring and testing activities and installations.
Lessees and grantees shall contact and consult with the appropriate affected federal, state, and local agencies early in the planning process.
Lessees and grantees shall consolidate necessary infrastructure requirements between projects whenever practicable.
Lessees and grantees shall develop a monitoring program to ensure that environmental conditions are monitored during construction, operation, and decommissioning phases. The monitoring program requirements, including adaptive management strategies, shall be established at the project level to ensure that potential adverse impacts are mitigated.
Seafloor Habitats
Lessees and grantees shall 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.
Lessees and grantees shall conduct appropriate pre-siting surveys to identify and characterize potentially sensitive seafloor habitats and topographic features.
Lessees and grantees shall avoid locating facilities near known sensitive seafloor habitats, such as coral reefs, hard-bottom areas, and chemosynthetic communities.
Lessees and grantees shall avoid anchoring on sensitive seafloor habitats.
Lessees and grantees shall minimize seafloor disturbance during construction and installation of the facility and associated infrastructure.
Lessees and grantees shall employ appropriate shielding for underwater cables to control the intensity of electromagnetic fields.
Lessees and grantees shall 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.
Lessees and grantees shall take all reasonable actions to minimize seabed disturbance and sediment dispersion during cable installation.
Marine Mammals
Lessees and grantees shall 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.
Vessels related to project planning, construction, and operation shall travel at reduced speeds when assemblages of cetaceans are observed and maintain a reasonable distance from whales, small cetaceans, and sea turtles as determined during site-specific consultations.
Lessees and grantees shall minimize potential vessel impacts on marine mammals and sea turtles by requiring project-related vessels to follow the NMFS and BOEM requirements while in transit. Operators shall be required to undergo training on applicable vessel requirements.
Lessees and grantees shall take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.
Lessees and grantees shall avoid and minimize impacts on marine species and habitat in the project area by posting a qualified observer approved by BOEM and NMFS on-site during construction activities.
Fish Resources and Essential Fish Habitat
Lessees and grantees shall conduct pre-siting surveys (may use existing data) to identify important, sensitive, and unique marine habitats in the vicinity of the project and design the project to avoid, minimize, or otherwise mitigate adverse impacts on these habitats.
Lessees and grantees shall minimize construction activities in areas containing anadromous fish during migration periods.
Lessees and grantees shall minimize seafloor disturbance during construction and installation of the facility and associated infrastructure.
Sea Turtles
Lessees and grantees shall minimize potential vessel impacts on marine mammals and sea turtles by requiring project-related vessels to follow the NMFS Regional Viewing Guidelines while in transit. Operators shall be required to undergo training on applicable vessel guidelines.
Lessees and grantees shall take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.
Lessees and grantees shall locate cable landfalls and onshore facilities so as to avoid impacts on known nesting beaches.

Avian Resources
Lessees shall evaluate avian use of 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-by-project basis.
Lessees and grantees shall take measures to reduce perching opportunities.
Lessees and grantees shall locate cable landfalls and onshore facilities so as to avoid impacts on known nesting beaches.
Lessees and grantees shall comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimizes impacts on avian species.
Acoustic Environment
Lessees and grantees should plan site characterization surveys by using the lowest sound levels necessary to obtain the information needed.
Lessees and grantees shall take efforts to minimize disruption and disturbance to marine life from sound emissions such as pile driving during construction activities.
Lessees and grantees shall employ, to the extent practicable, state-of-the- art, low-noise turbines or other technologies to minimize operational sound impacts.
Fisheries
Lessees and grantees shall work cooperatively with commercial/recreational fishing entities and interests to ensure that the construction and operation of a project will minimize potential conflicts with commercial and recreational fishing interests.
Lessees and grantees shall review planned activities with potentially affected fishing organizations and port authorities to prevent unreasonable fishing gear conflicts. Lessees and grantees shall minimize conflict with commercial fishing activity and gear by notifying registered fishermen of the location and time frame of project construction activities well in advance of mobilization with updates throughout the construction period.
Lessees and grantees shall use practices and operating procedures that reduce the likelihood of vessel accidents and fuel spills.
Lessees and grantees shall avoid or minimize impacts on the commercial fishing industry by marking applicable structures (e.g., wind turbines, wave generation structures) with USCG approved measures (such as lighting) to ensure safe vessel operation.
Lessees and grantees shall avoid or minimize impacts on the commercial fishing industry by burying cables, where practicable, to avoid conflict with fishing vessels and gear operation. If cables are buried, lessees and grantees shall inspect cable burial depth periodically during project operation to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity.
Coastal Habitats
Lessees and grantees shall avoid hard-bottom habitats, including seagrass communities and kelp beds, where practicable, and restore any damage to these communities.
Lessees and grantees shall implement turbidity reduction measures to minimize impacts on hard-bottom habitats, including seagrass communities and kelp beds, from construction activities.
Lessees and grantees shall minimize impacts on seagrass and kelp beds by restricting vessel traffic to established traffic routes.
Lessees and grantees shall minimize impacts on wetlands by maintaining buffers around wetlands, implementing BMPs for erosion and sediment control, and maintaining natural surface drainage patterns.
Electromagnetic Fields
Lessees and grantees shall use submarine cables that have proper electrical shielding and bury the cables in the seafloor where practicable.
Transportation and Vessel Traffic
Lessees and grantees shall site alternative energy facilities to avoid unreasonable interference with major ports and USCG-designated Traffic Separation Schemes.
Lessees and grantees shall meet FAA guidelines for siting and lighting of facilities.
Lessees and grantees shall place proper lighting and signage on applicable alternative energy structures to aid navigation per USCG circular NVIC 01-19 (USCG 2020) and comply with any other applicable USCG requirements.
Lessees and grantees shall 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, including identification of possible solutions.

Visual Resources
Lessees and grantees for wind projects shall address key design elements including visual uniformity, use of tubular towers, and proportion and color of turbines.
Lessees and grantees for wind projects shall 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.
Lessees and grantees shall comply with FAA and USCG requirements for lighting while minimizing the impacts through appropriate application.
Lessees and grantees shall seek public input in evaluating the visual site design elements of proposed wind energy facilities.
Lessees and grantees, within FAA guidelines, shall use directional aviation lights that minimize visibility from shore.
Cultural Resources
Lessees and grantees shall conduct magnetometer tows using 100-foot (30-meter) line spacing in areas where there is a high potential for shipwrecks.

Source: Adopted from MMS 2007a

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; FAA = Federal Aviation Administration; NMFS = National Marine Fisheries Service; USCG = U.S. Coast Guard

Table A-6: Anticipated Construction Schedule in Number of Foundations (as of December 1, 2020) [a]

Project/Region	Before 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 & Beyond
Maine Aqua Ventus (state waters)			2 [b]								
Block Island Wind Farm (state waters)	5 [b]										
Massachusetts/Rhode Island Region											
Vineyard Wind 1 (Proposed Action) part of OCS-A 0501				102							
South Fork, part of OCS-A 0517			16								
Revolution, part of OCS-A 0486				90							
Sunrise, parts of OCS-A 0500 and OCS-A 0487				112							
Mayflower (North), part of OCS-A 0521					103						
Vineyard Wind South OCS-A 0501 remainder (Park City Wind)					103						
Future Project(s) in Massachusetts/Rhode Island Region						139					
Future Project(s) in Massachusetts/Rhode Island Region							139				
Future Project(s) in Massachusetts/Rhode Island Region							171				
Estimated Annual Massachusetts/Rhode Island Construction:	*0*	*0*	*16*	*304*	*206*	*139*	*310*	*0*	*0*	*0*	*0*
Estimated Operations and Maintenance Total:	*0*	*0*	*0*	*16*	*320*	*526*	*665*	*975*	*975*	*975*	*975*
New York/New Jersey Region											
Ocean Wind, part of OCS-A 0498			94								
Empire Wind, part of OCS-A 0512				70							
Empire Wind Phase 2, part of OCS-A 0512					70						
Empire Wind Phase 3, part of OCS-A 0512						70					
Future Project(s) in New York/New Jersey Region							131				
New Jersey-Delaware/Maryland											69
Estimated Annual New York/New Jersey Construction:	*0*	*0*	*94*	*70*	*70*	*70*	*131*	*0*	*0*	*0*	*69*
Estimated Operations and Maintenance Total:	*0*	*0*	*0*	*94*	*164*	*234*	*304*	*435*	*435*	*435*	*504*
Delaware/Maryland Region											
Skipjack, part of OCS-A 0519			11								
US Wind, part of OCS-A 0490			24								
Future Project(s) in Delaware/Maryland Region				55							
Future Project(s) in Delaware/Maryland Region					54						
Future Project(s) in Delaware/Maryland Region						54					
Estimated Annual Delaware/Maryland Construction:	*0*	*0*	*35*	*55*	*54*	*54*	*0*	*0*	*0*	*0*	*0*
Estimated Operations and Maintenance Total:	*0*	*0*	*0*	*35*	*90*	*144*	*198*	*198*	*198*	*198*	*198*
Virginia Region											
Coastal Virginia Offshore Wind, OCS-A 0497	2										
Dominion Commercial lease, OCS-A 0483				75							
Dominion Commercial lease, OCS-A 0483					75						
Dominion Commercial lease, OCS-A 0483						75					

Project/Region	Before 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 & Beyond
Avangrid Renewables, OCS-A 0508											155
Estimated Annual Virginia Construction:	*2*	*0*	*0*	*75*	*75*	*75*	*0*	*0*	*0*	*0*	*155*
Estimated Operations and Maintenance Total:	*2*	*0*	*2*	*2*	*77*	*152*	*227*	*227*	*227*	*227*	*382*
Estimated Annual Total Construction:	**7**	**0**	**147**	**504**	**405**	**338**	**441**	**0**	**0**	**0**	**224**
Estimated Operations and Maintenance Total:	**7**	**2**	**6**	**154**	**658**	**1,063**	**1,401**	**1,842**	**1,842**	**1,842**	**2,066**

[a] Construction schedule for projects are assumed to occur over a 2-year period; for this expanded planned action analysis, it has been assumed that pile driving would occur during year 1 of construction and that all other construction activities would occur in year 2.
[b] The foundations are located in state waters.
Assumptions: All announced projects would begin construction on schedule and adequate vessels and components would be available for all projects. Construction of a project is assumed to occur over 2 calendar years, unless explicitly planned otherwise. Projects with more than 50 foundations are assumed to potentially utilize two pile hammers, and development without an associated project is assumed to have a pile hammer for every 50 foundations. Future Massachusetts procurements are assumed to occur in approximately 800 megawatt (MW) increments. The remaining Connecticut demand is assumed to be procured in a single 1,200 MW procurement, but could just as likely occur in two (approximately 800 MW and 400 MW) procurements and thus the timing of the associated development be staggered. Empire Wind has submitted two possible construction schedules: one depicted above was chosen due to it having the longer extent of the two proposed schedules and potentially overlapping with more projects. Empire Wind also may use gravity foundations; however, for the purposes of analyzing the maximum impact scenario it has been assumed that the foundations would be pile driven (monopile). For future development with either no associated COP or broad project envelopes, 12 MW turbine sizes were assumed for the purposes of estimating the number foundations. This is a high estimate based on the largest commercially available turbine at this time, as it is likely that the total number of foundations for projects developed in 2024 and beyond would be less as larger sized turbines become available. The development considered here does not include approximately 3,200 MW of New Jersey's goals and 6,674 MW of New York’s goals for which there is seemingly not capacity for in existing leases in the New York/New Jersey and Delaware/Maryland areas given the assumptions of 12 MW turbines spaced 1 nautical mile apart. BOEM has assumed for this FEIS expanded planned action analysis that either Phase 2 or 3 of Empire Wind will be “Boardwalk Wind” serving New Jersey, with the remaining phase going to either New York or New Jersey. Precisely which state gets what in terms of Empire Wind phases or development in the New Jersey leases is not consequential, as state demand will exceed space available even when including the remaining lease area around the Ocean Wind lease, the Atlantic Shores project, and full development of the remaining Delaware/Maryland lease areas being applied to New Jersey. BOEM notes that it is possible New York may continue to procure from the RI and MA Lease Areas.

A.5. PORT UPGRADES

Ports in Connecticut, Rhode Island, Massachusetts, and New York may require upgrades to support the offshore wind industry developing in the northeastern United States.[6] Upgrades may include onshore developments or underwater improvements (such as dredging). The following summarizes reasonably foreseeable activities at regional ports that are planned to support the proposed Project and other past, present, and reasonably foreseeable offshore wind project activities at ports near the RI and MA Lease Areas:

- The Connecticut Port Authority announced a $93 million public-private partnership to upgrade the Connecticut State Pier in New London to support the offshore wind industry (Sheridan 2019). According to the Connecticut Maritime Strategy 2018 (Connecticut Port Authority 2018), New London is the only major port between New York and Maine that does not have vertical obstruction and offshore barriers, two factors that are critical for offshore wind turbine assembly. The document includes strategic objectives to manage and redevelop the Connecticut State Pier partially to support the offshore wind industry, which could create a dramatic increase in demand for the Connecticut State Pier and regional job growth. The development partnership, announced in May 2019, includes a 3-year plan to upgrade infrastructure to meet heavy-lift requirements of Ørsted and Eversource offshore wind components (Cooper 2019). Redevelopment of the Connecticut State Pier is considered a reasonably foreseeable activity.
- In Rhode Island, Deepwater Wind has committed to investing approximately $40 million in improvements at the Port of Providence, the Port of Davisville at Quonset Point, and possibly other Rhode Island ports for the Revolution Wind Project (Kuffner 2018). This investment will position Rhode Island ports to participate in construction and operation of future offshore wind projects in the region (Rhode Island Governor's Office 2018). The Port of Davisville has added a 150-megaton mobile harbor crane, which will enable the port to handle wind turbines and heavy equipment, and enables the Port of Davisville to participate in regional offshore wind projects (Port of Davisville 2017). Further improvements at Rhode Island ports to support the offshore wind industry are considered reasonably foreseeable.
- The Massachusetts Clean Energy Center (MassCEC) has identified 18 waterfront sites in Massachusetts that may be available and suitable for use by the offshore wind industry. Potential activities at these sites include manufacturing of offshore wind transmission cables, manufacture and assembly of turbine components, substation manufacturing and assembly, operations and maintenance bases, and storage of turbine components. The 18 sites include two identified by Vineyard Wind as potential construction or operations and maintenance ports: the Brayton Point Power Plant site and the Montaup Power Plant site.
  - The former Brayton Point Power Plant is currently being redeveloped as the Brayton Point Commerce Center, a "world-class logistical port and support center built for offshore wind…capable of component manufacturing, staging, operations, and maintenance for offshore wind and other related sectors" (Brayton Point Commerce Center 2019). The site redevelopment includes the proposed Anbaric Renewable Energy Center, which will include development of a 1,200 MW high-voltage direct current converter and 400 MW of battery storage on the site (Anbaric 2019a). Development of the Brayton Point Commerce Center and the Anbaric Renewable Energy Center are considered reasonably foreseeable, as the projects are currently active.
  - The Montaup Power Plant site is a former power plant site located in Somerset, Massachusetts, that was also identified by the MassCEC as having potential to support construction of turbine components, as well as operations and maintenance activities (MassCEC 2017). No plan for redevelopment of the Montaup Power Plant has been released (MassCEC 2017); therefore, improvements at this site are not considered reasonably foreseeable.
- The MassCEC manages the New Bedford Marine Commerce Terminal (MCT) in New Bedford, Massachusetts. The 29-acre facility was completed in 2015 and is the first in North America designed specifically to support the construction, assembly, and deployment of offshore wind projects (MassCEC

[6] BOEM 2016d includes an assessment of port capacity, potential environmental and socioeconomic consequences of port modifications to support offshore wind development, and the effectiveness of potential mitigation measures to reduce said consequences of port modifications.

2018). The New Bedford Port Authority Strategic Plan 2018–2023 contains goals related to expanding the MCT to improve and expand services to the offshore wind industry, including development of North Terminal with the capacity to handle two separate offshore wind installation projects in the future (Port of New Bedford 2018). Vineyard Wind signed an 18-month lease with the MCT in October 2018 (Port of New Bedford 2020) and has supported the New Bedford Port Authority with grants to develop publicly owned facilities to support shore-based operations for offshore wind facilities (Vineyard Wind 2019).

- Vineyard Wind would use Vineyard Haven Harbor in Tisbury as the location of the proposed Project's Operations and Maintenance Facility. Vineyard Haven Harbor is the island's year-round working port and is home to most of the Martha's Vineyard boatyards. Small coastal tankers and ferries regularly use Vineyard Haven Harbor to transport freight, vehicles, and passengers. The areas of Tisbury near the Vineyard Haven Harbor are a mix of marine-related, commercial, and residential uses. Vineyard Wind has stated that upgrades to the port are not a direct result of the proposed Project; therefore, any impacts from potential upgrades to this port would not be a result of the proposed Project.

Potential impacts related to port upgrades could include, but are not limited to, the following:

- Increased seafloor disturbance, turbidity, and benthic habitat alterations;
- Risk of direct physical impacts, displacement, or disturbance to wildlife, including threatened/endangered species;
- Increased vessel traffic and associated effluent discharges, air emissions, and noise;
- Visual impacts on onshore and offshore observers within the daytime and nighttime visibility zones;
- Economic impacts, including beneficial impacts on tax revenues, employment, and economic activity associated with operating the wind energy facility, maintaining the wind energy facility, tourism, and other ocean economy sectors;
- Displacement or reduction in fishing opportunities (commercial and recreational), marine mineral extraction, and other ocean economy sectors;
- Displacement of recreational opportunities or change in value of recreational opportunities;
- Disturbance of cultural resources or impacts on cultural values; and
- Introduction of navigational obstructions to aviation and marine vessels (submarine and surface vessels).

A.6. Offshore Export Cables Construction and Maintenance

Offshore cable routes have been identified for the Coastal Virginia Offshore Wind Project (Dominion Energy 2018) and the ten COPS that have been submitted. Cable routes have not yet been announced for the remainder of the projects.

In addition, Anbaric Development Partners, LLC has submitted unsolicited proposals to BOEM for development of two open access offshore transmission systems designed to support offshore wind in the northeastern United States; however, neither is considered reasonably foreseeable projects for this analysis.

- The proposed New York/New Jersey Ocean Grid Project would consist of approximately 185 nautical miles (213 statute miles) of subsea transmission cables, and up to nine offshore collector platforms. The transmission network would collect and distribute power from wind lease areas offshore New York and New Jersey to up to six onshore landing locations from Long Island to Cardiff, New Jersey (Anbaric 2018).
- The proposed Southern New England OceanGrid Project would consist of 337 nautical miles (388 statute miles) of subsea transmission cables and up to eight offshore collector platforms around the RI and MA Lease Areas. The transmission network would collect and distribute power generated from RI and MA Lease Areas offshore wind farms to landings between Long Island Sound and Massachusetts (Anbaric 2019b).

The transmission systems would be "open access" and allow multiple offshore wind farms to connect to a single transmission line, potentially consolidating cabling systems, landing areas, and onshore infrastructure. Utilizing a transmission network may reduce total miles of cables required to connect offshore wind farms, environmental impacts associated with subsea cabling and onshore interconnections, and costs of development and operation.

BOEM issued a Request for Competitive Interest for the New York/New Jersey Ocean Grid Project in June 2019. These projects are currently under review with BOEM and are not considered reasonably foreseeable due to the current lack concrete development plans. Even if BOEM did consider these projects reasonably foreseeable, they would not be considered in the maximum-case scenario because implementation of these networks would serve to reduce impacts associated with the transmission system. The maximum-case scenario for offshore cables associated with offshore wind development is defined as each lease having separate offshore cables, landing sites, and onshore interconnection facilities.

Reasonably foreseeable impacts of new transmission system projects associated with individual offshore wind projects could include (BOEM 2016b):

- Increased vessel traffic and associated effluent discharges, air emissions, and noise during construction and decommissioning;
- Increases of accidental releases of trash and marine debris during construction and decommissioning;
- Intermittent underwater noise associated with construction, including noise from ESP construction activities;
- Temporary disturbance of benthic habitat from installation, and long-term impacts from habitat conversion;
- Increased potential for oil spills during construction and decommissioning;
- Potential interaction with existing telecommunication cables; and
- Temporary sediment disturbance during installation or maintenance.

A.7. GEOGRAPHIC ANALYSIS AREA MAPS

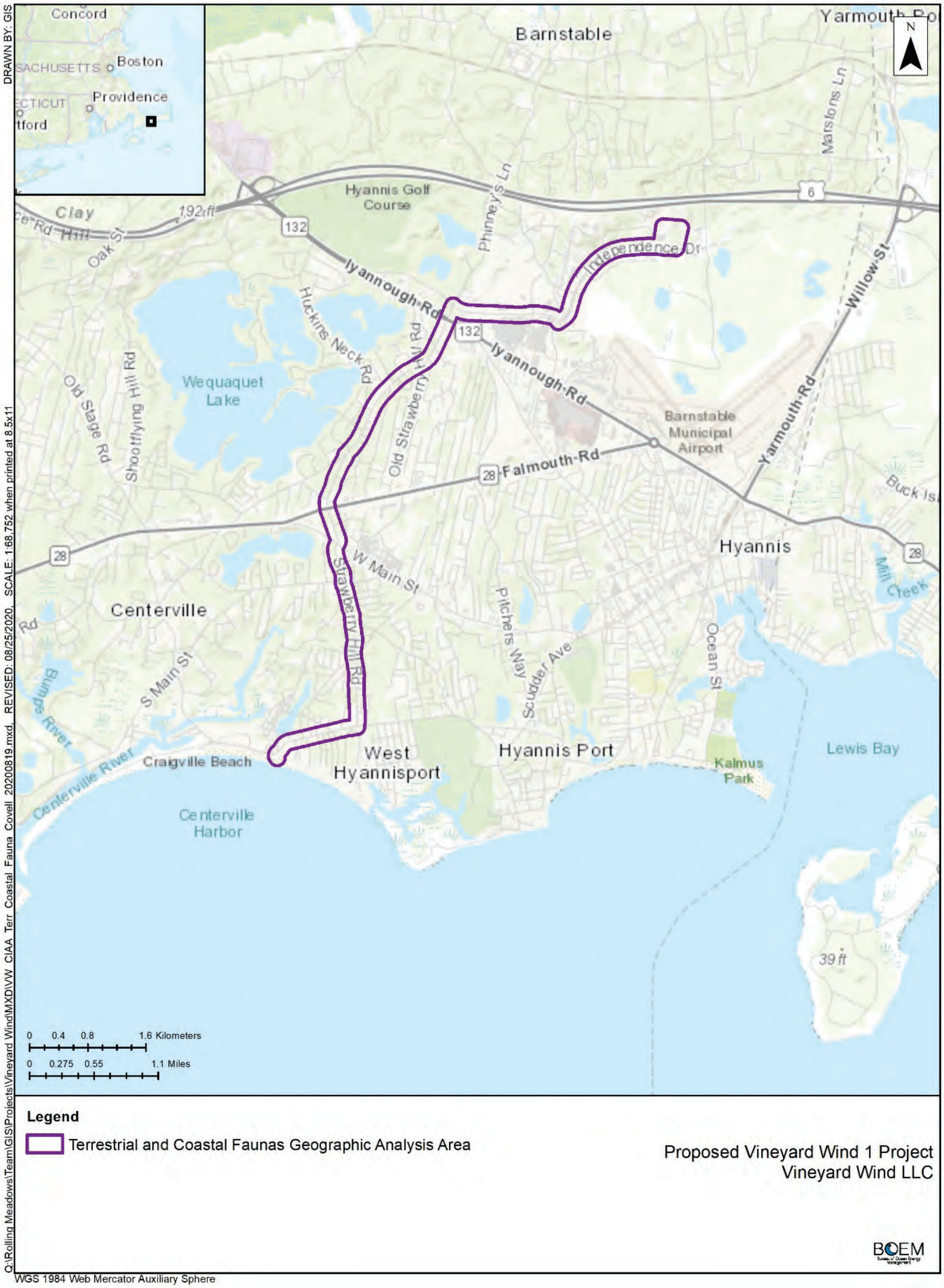


Figure A.7-1: Terrestrial and Coastal Fauna Geographic Analysis Area

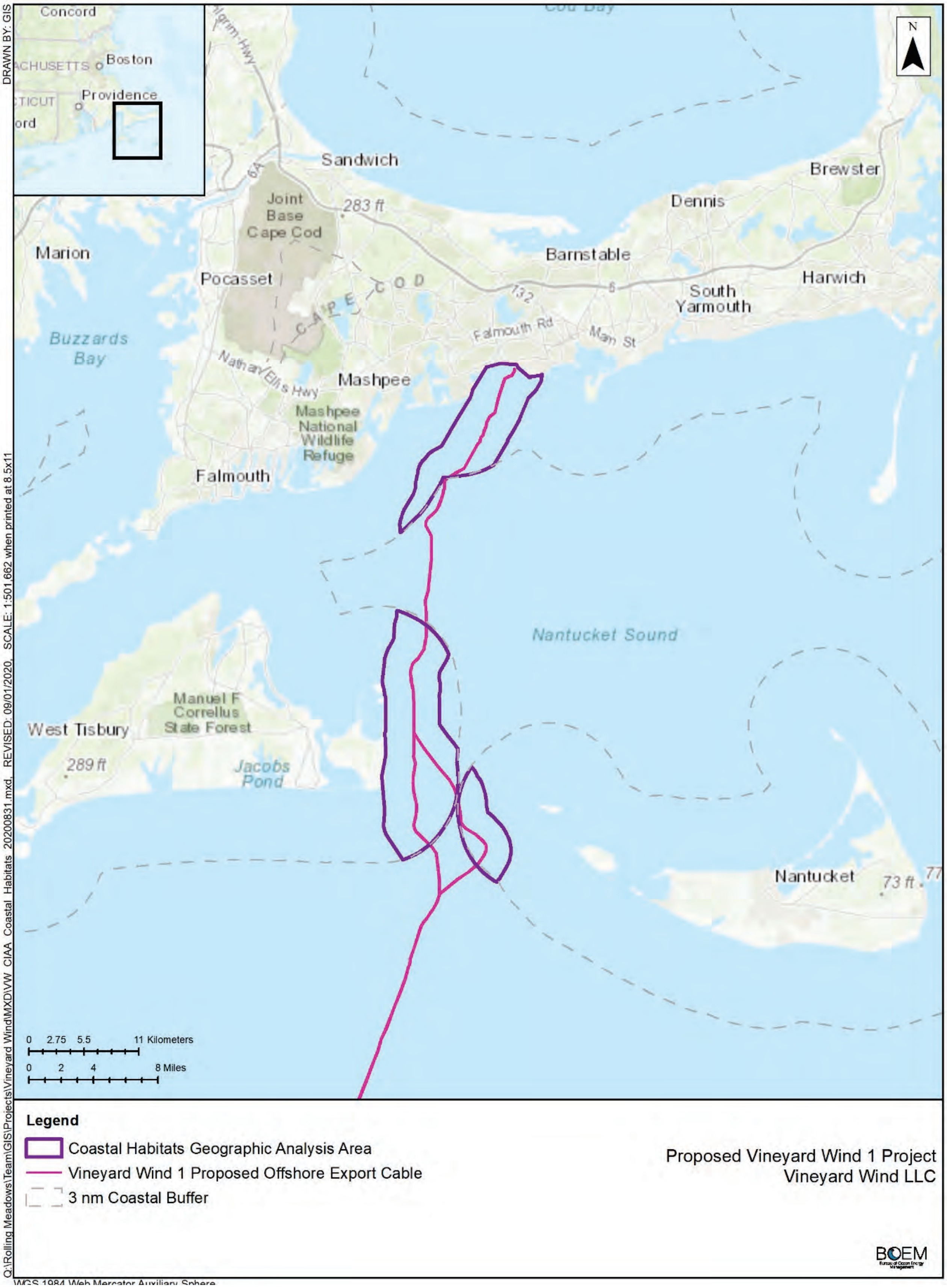


Figure A.7-2: Coastal Habitats Geographic Analysis Area

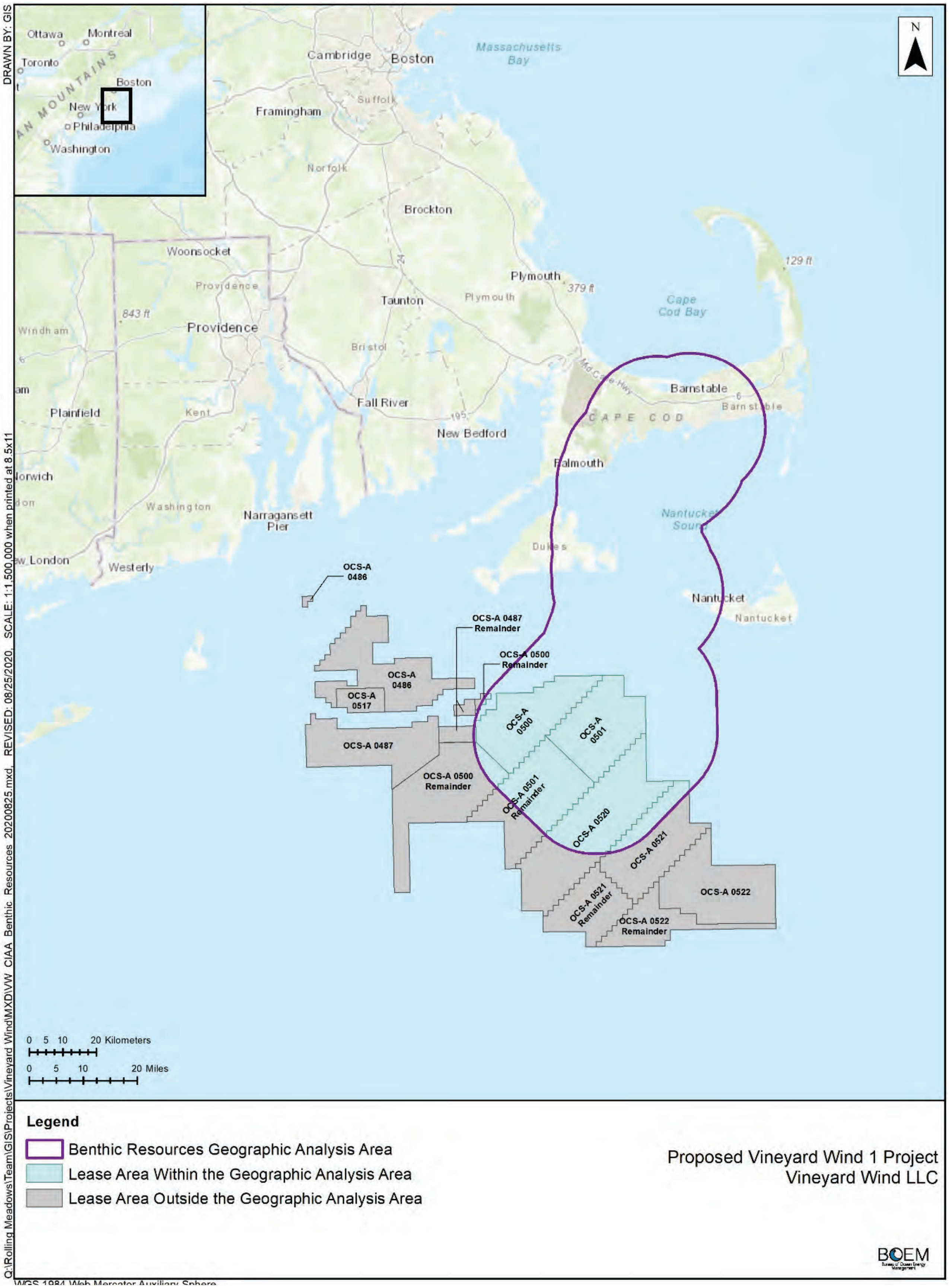
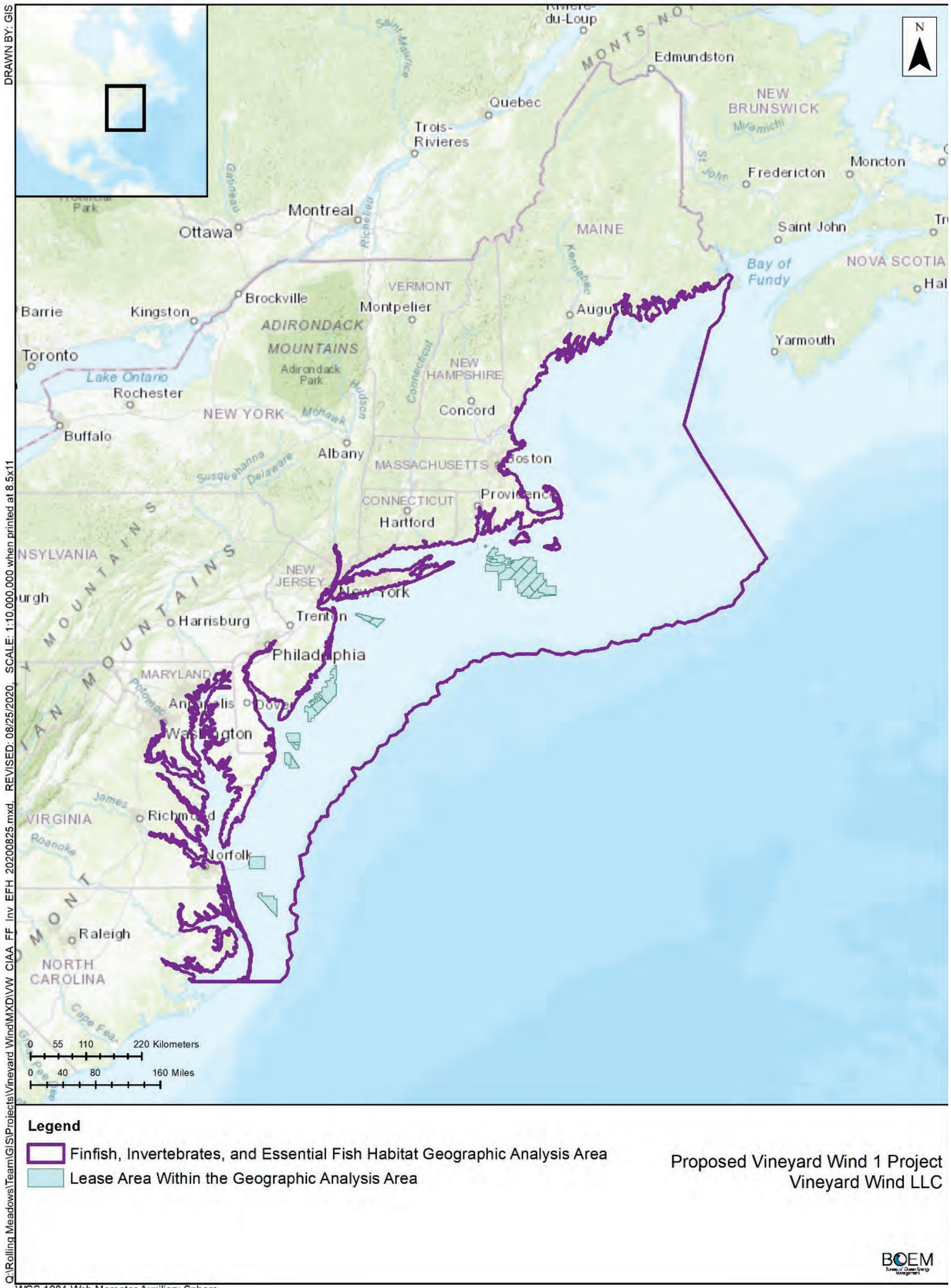


Figure A.7-3: Benthic Geographic Analysis Area



Note: The geographic analysis area for the endangered Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*) extends beyond the boundary shown here and is equivalent to the area shown in Figure A.7-5.

Figure A.7-4: Finfish, Invertebrates, and Essential Fish Habitat Geographic Analysis Area

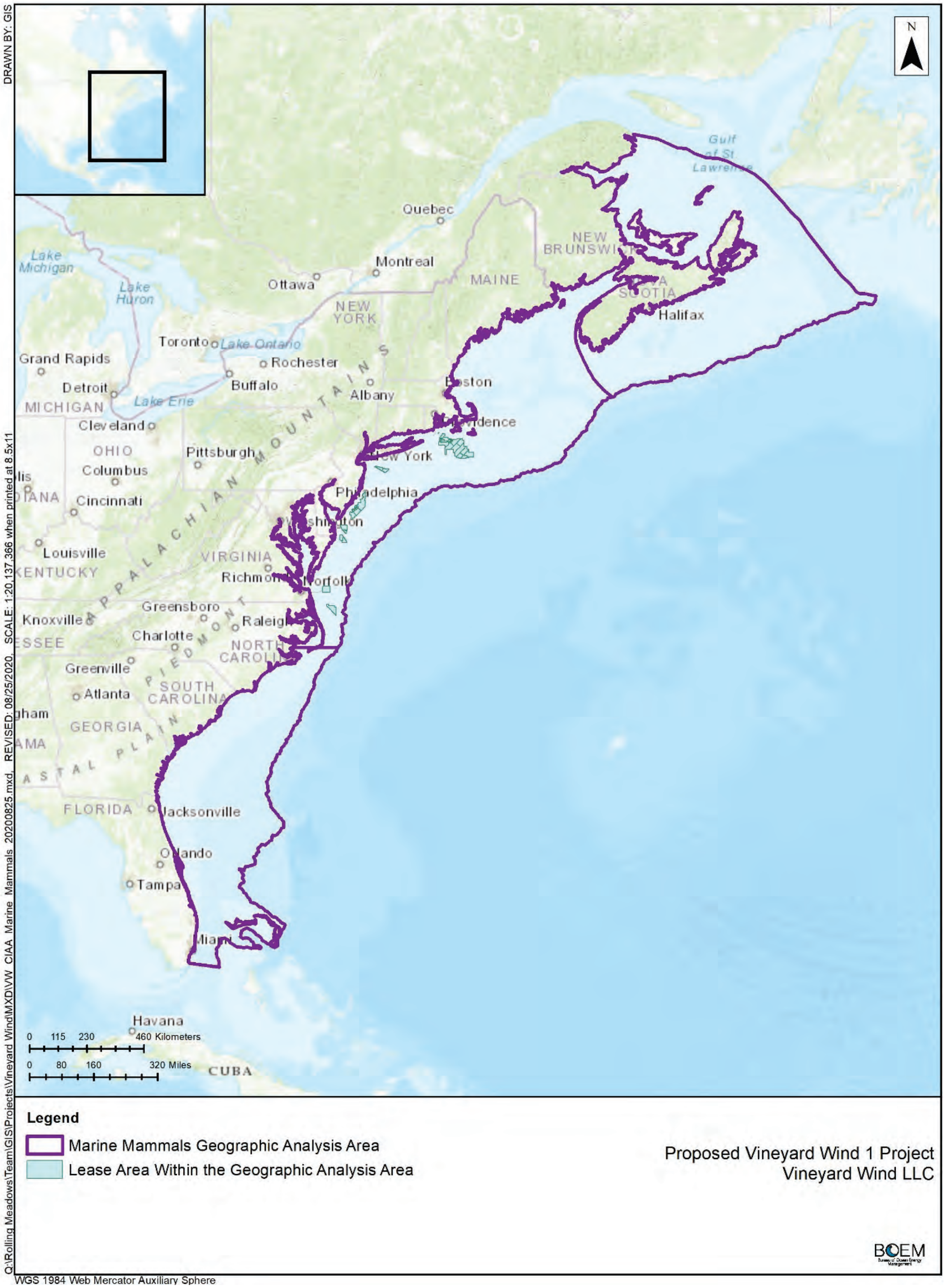


Figure A.7-5: Marine Mammals Geographic Analysis Area

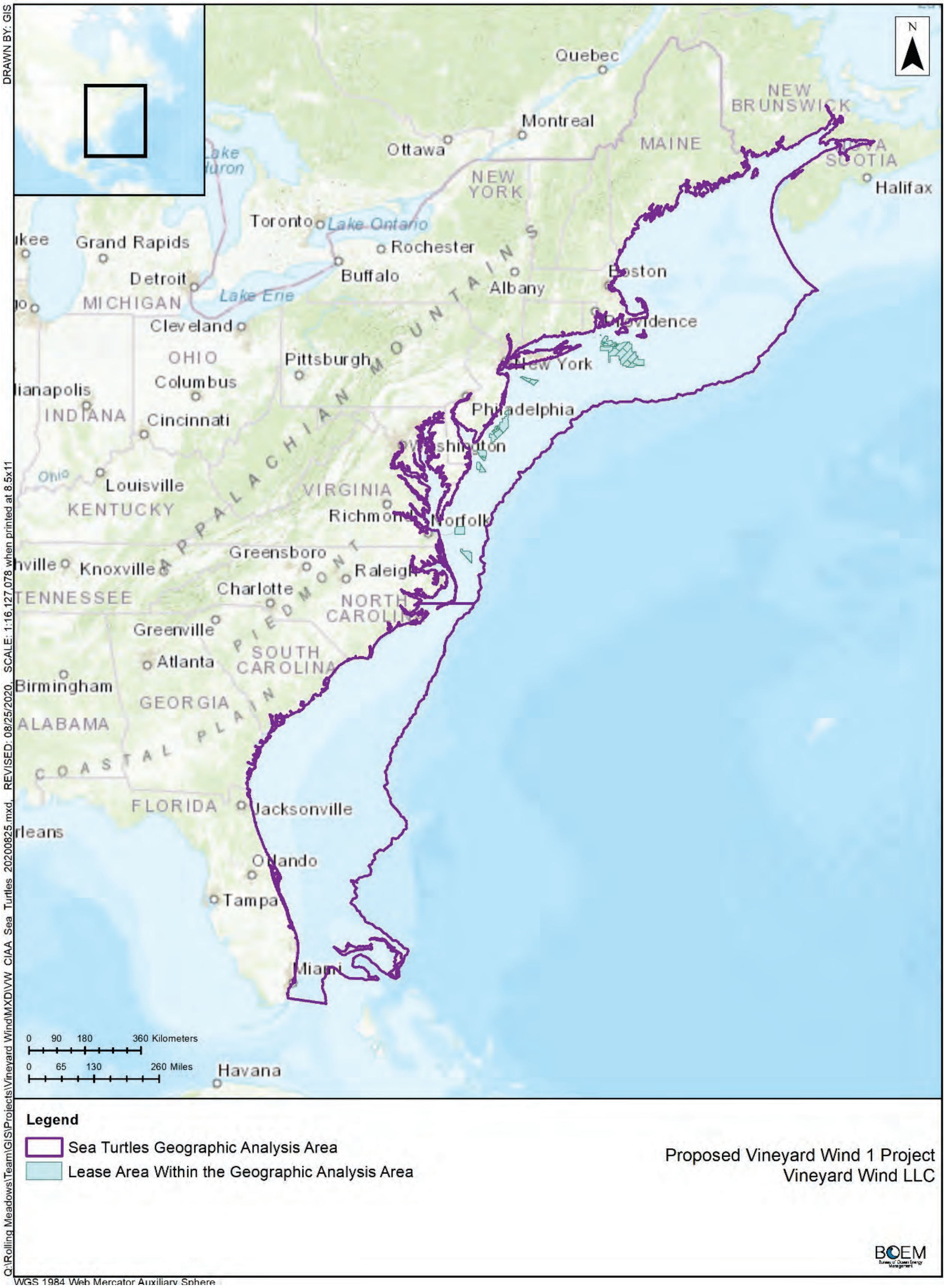


Figure A.7-6: Sea Turtles Geographic Analysis Area

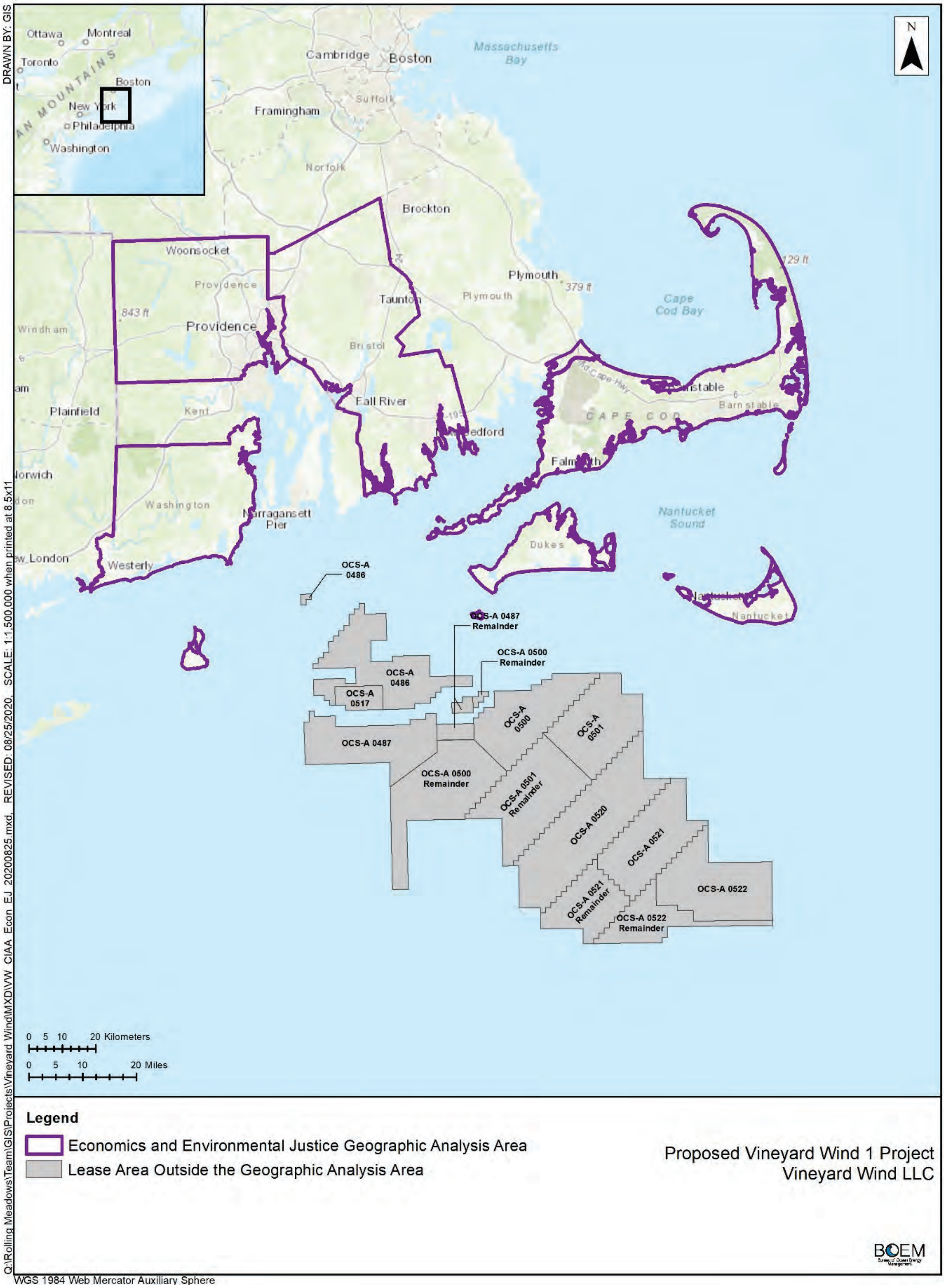


Figure A.7-7: Economics and Environmental Justice Geographic Analysis Area

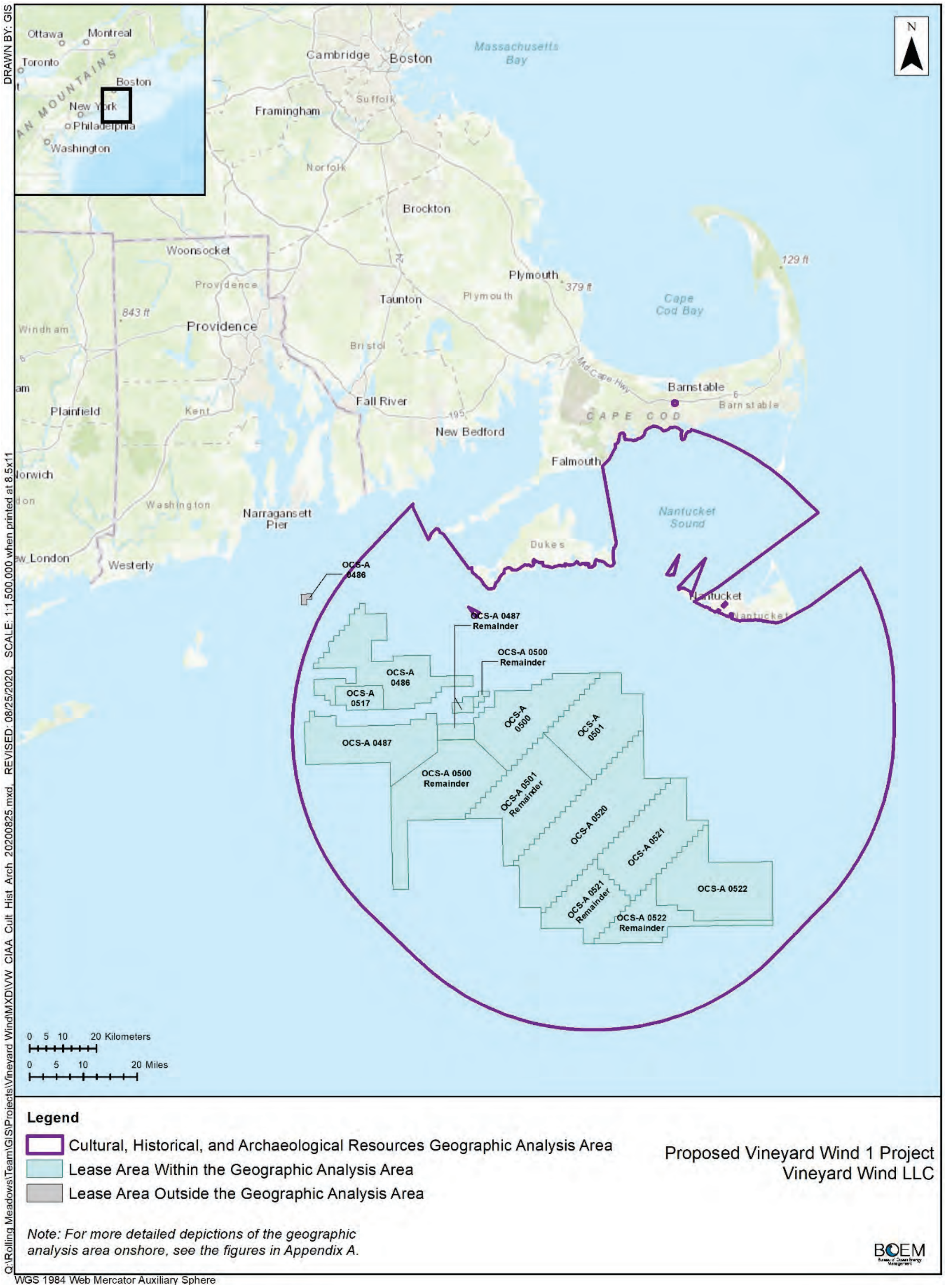


Figure A.7-8: Cultural, Historical, and Archaeological Resources Geographic Analysis Area

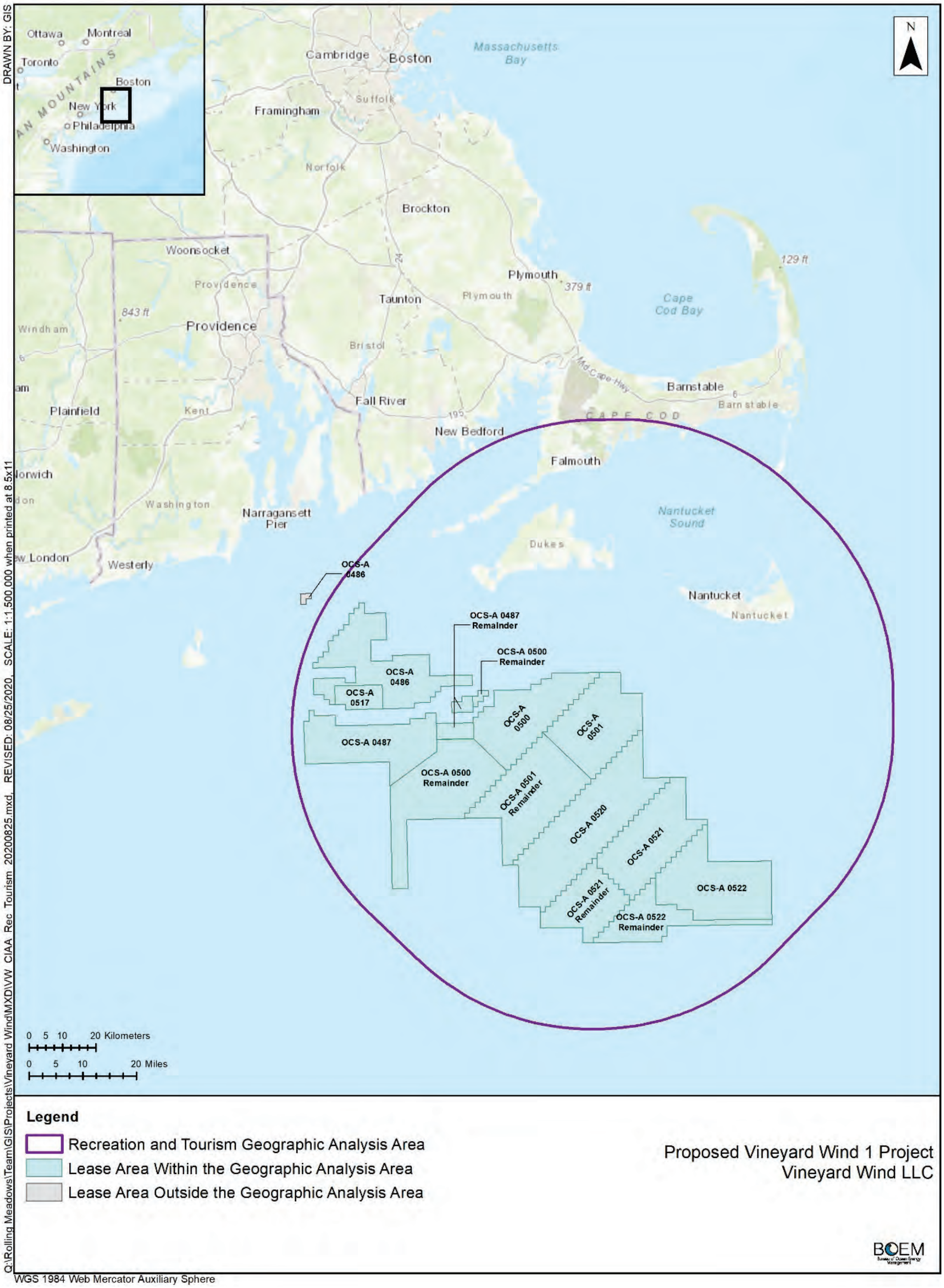


Figure A.7-9: Recreation and Tourism Geographic Analysis Area

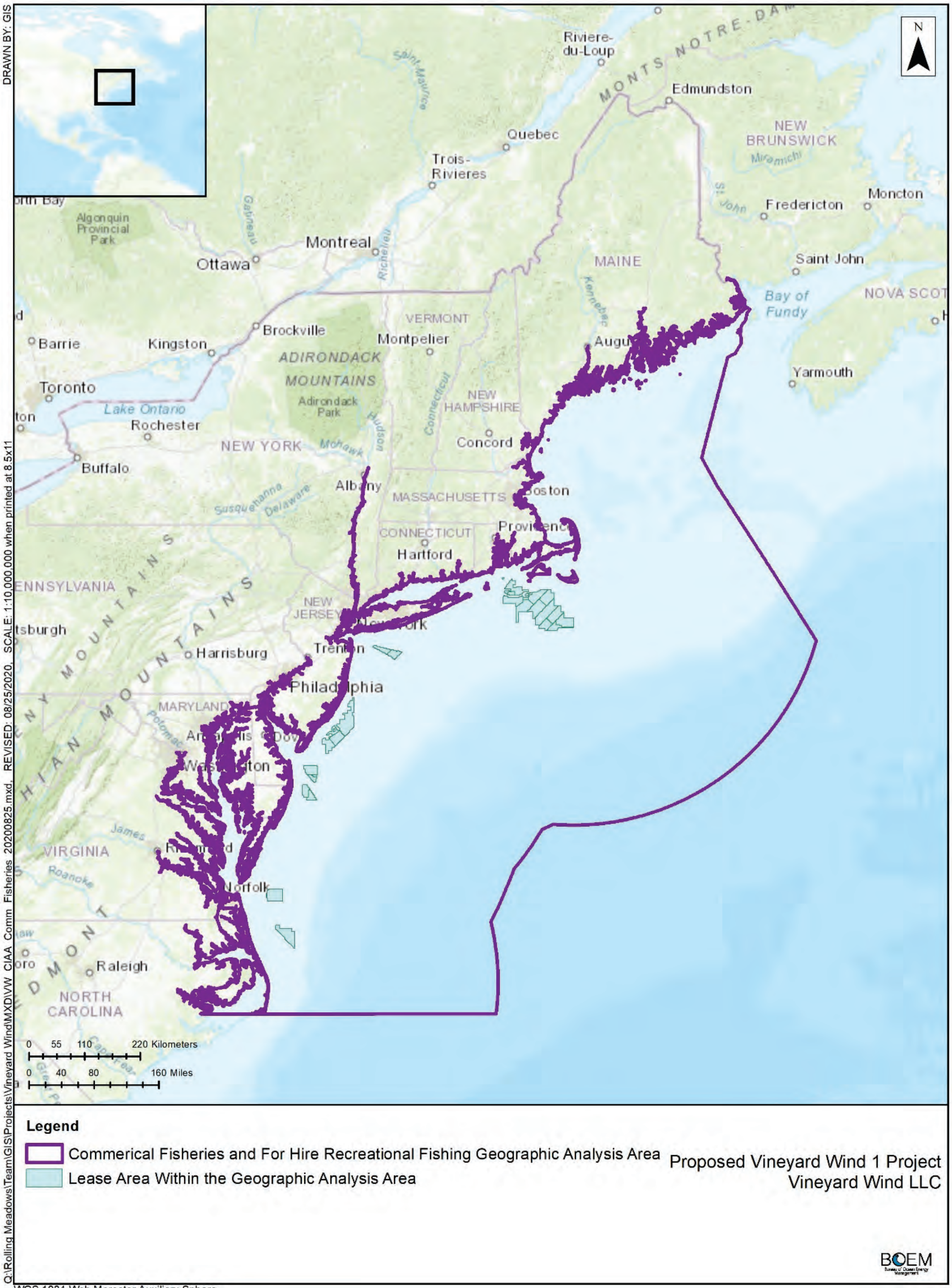


Figure A.7-10: Commercial Fisheries and For-Hire Recreational Fishing Geographic Analysis Area

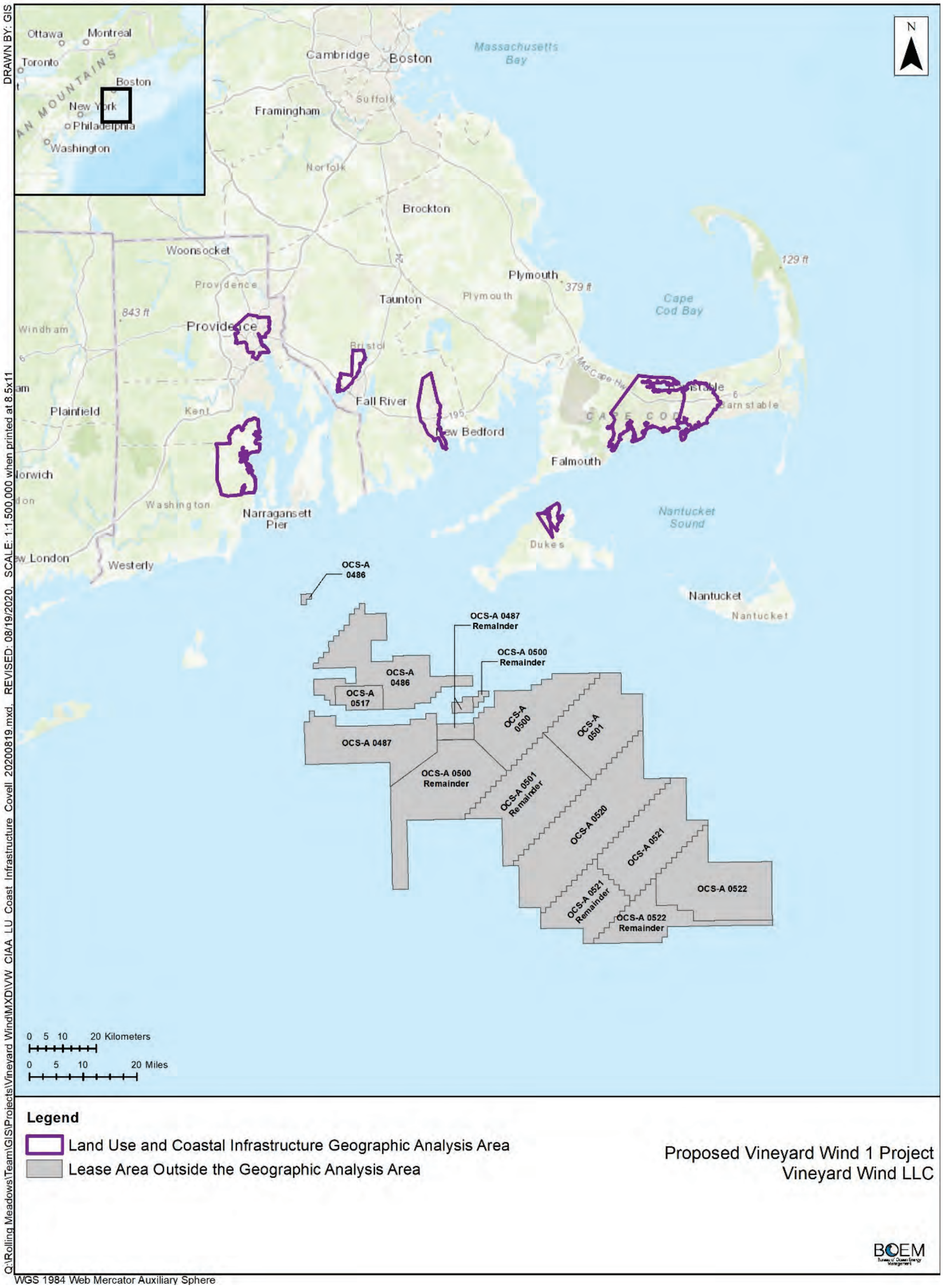


Figure A.7-11: Land Use and Coastal Infrastructure Geographic Analysis Area

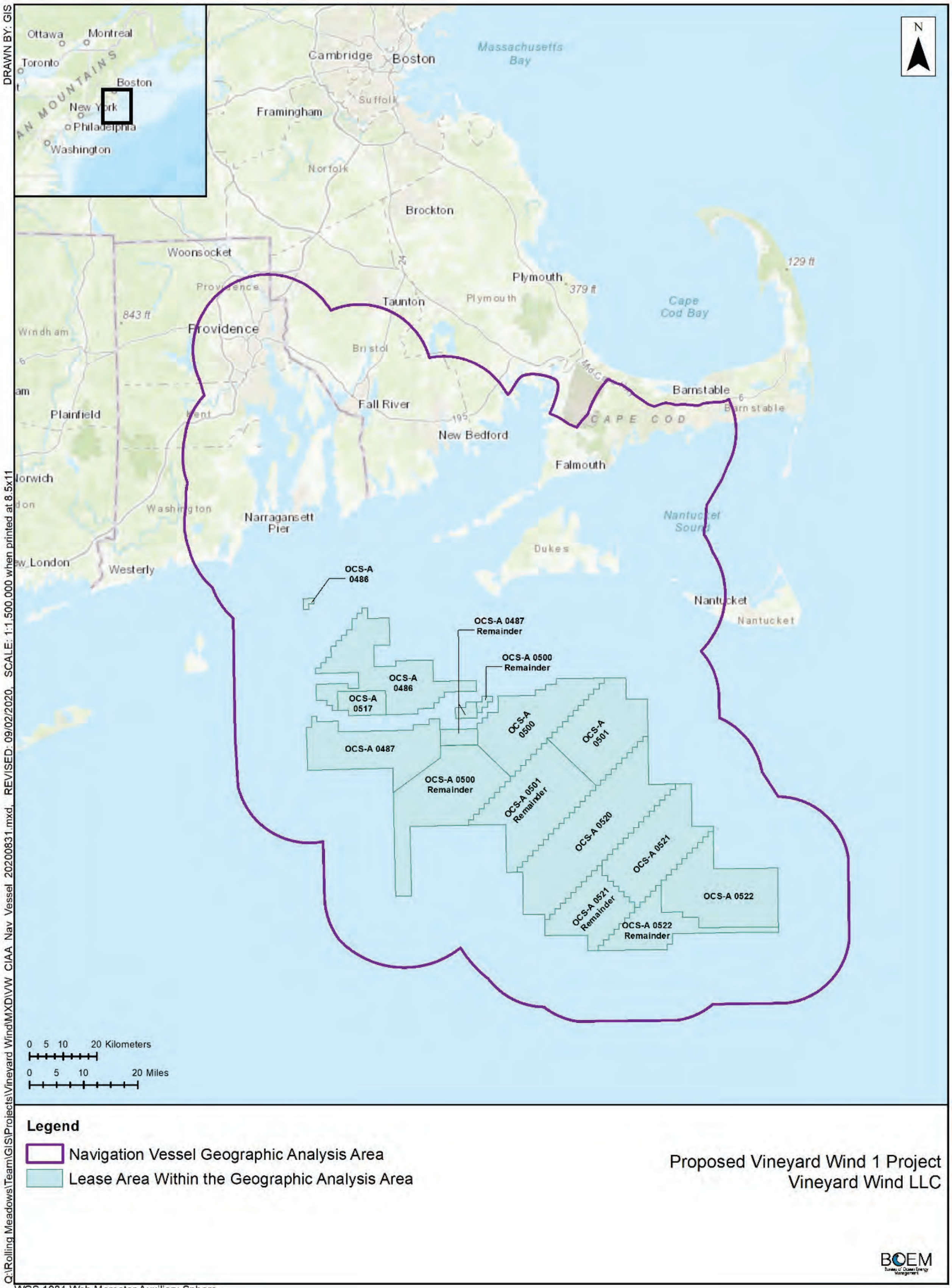


Figure A.7-12: Navigation and Vessel Traffic Geographic Analysis Area

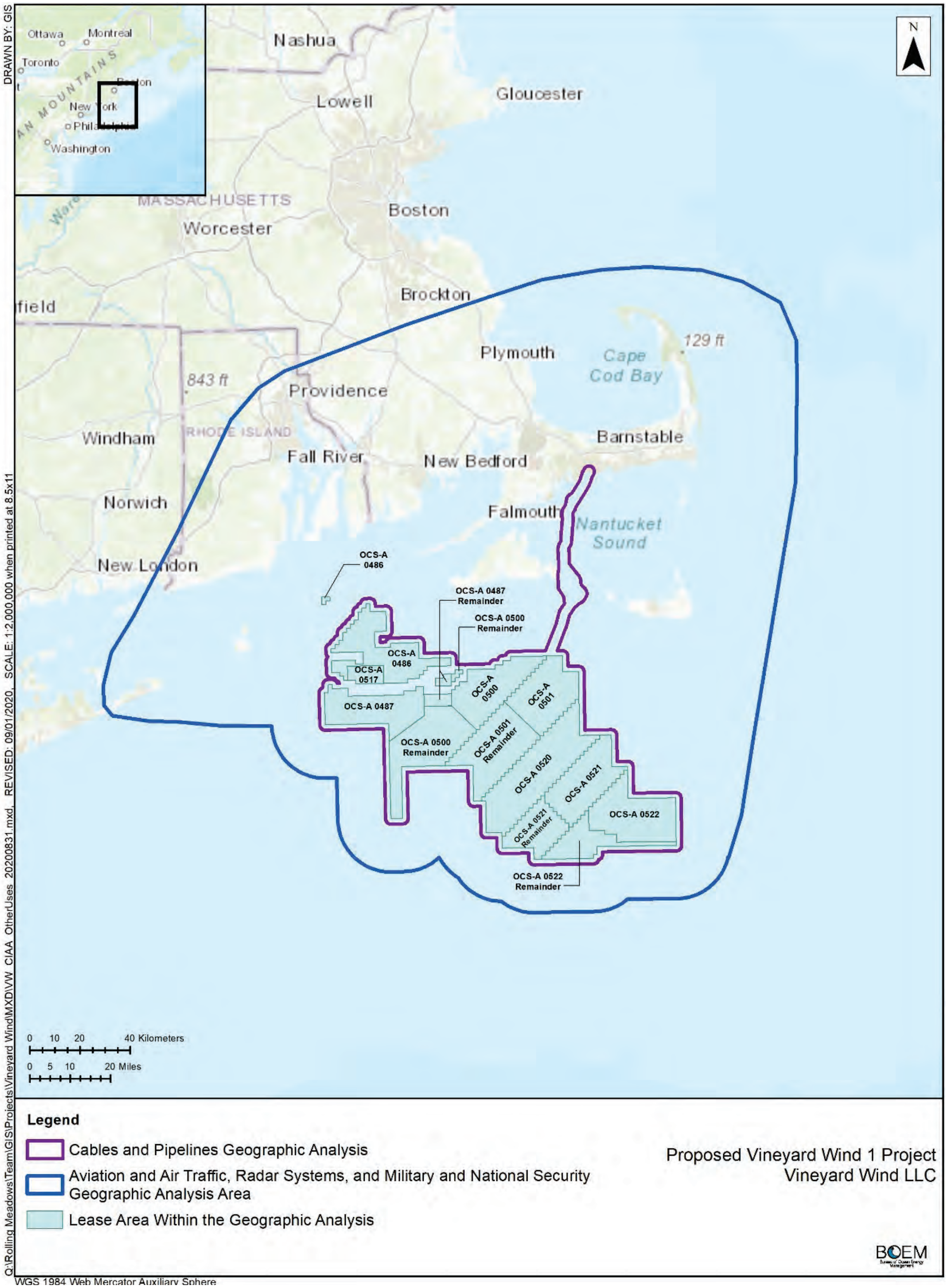


Figure A.7-13: Other Uses Geographic Analysis Area

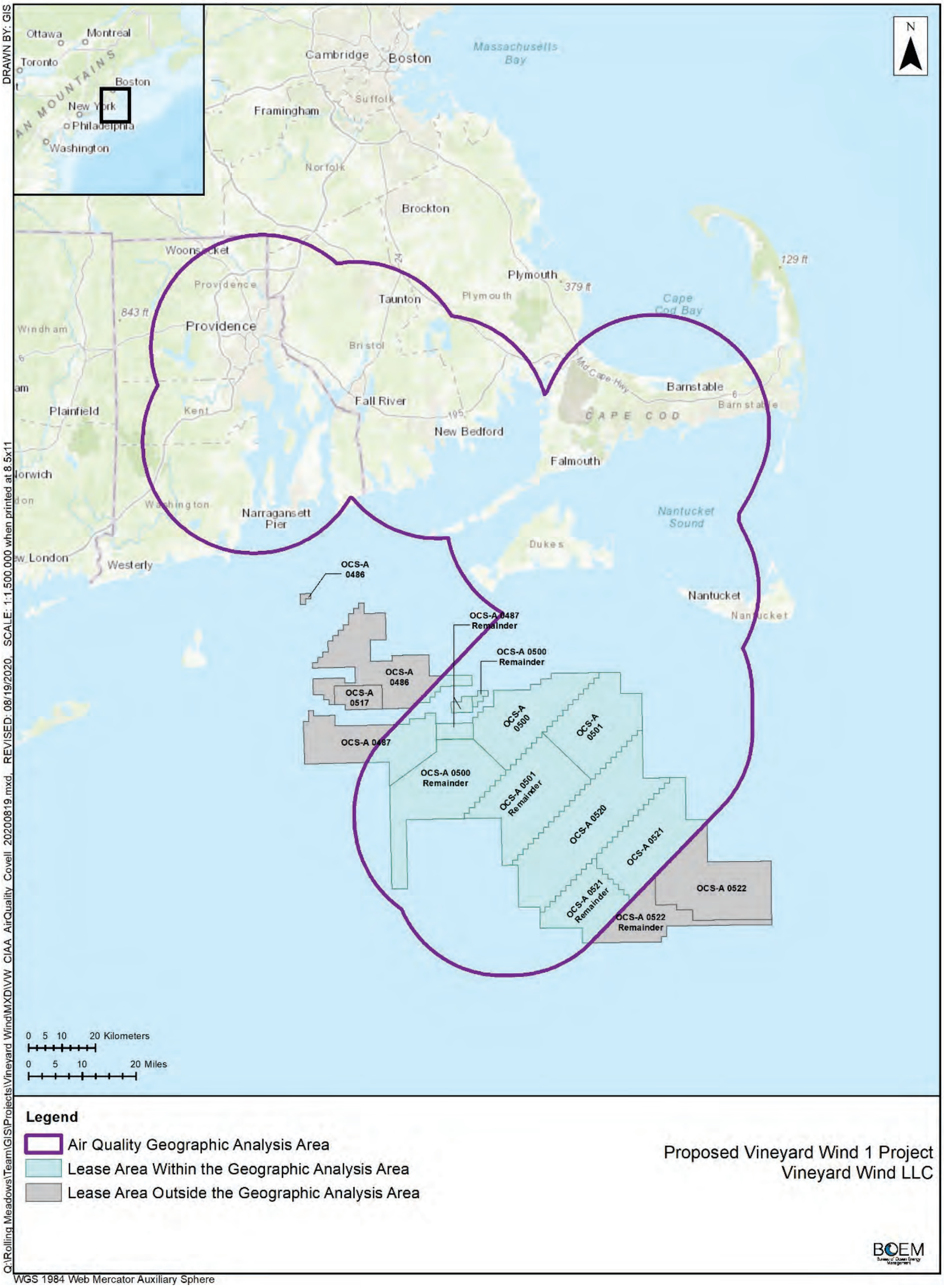


Figure A.7-14: Air Quality Geographic Analysis Area

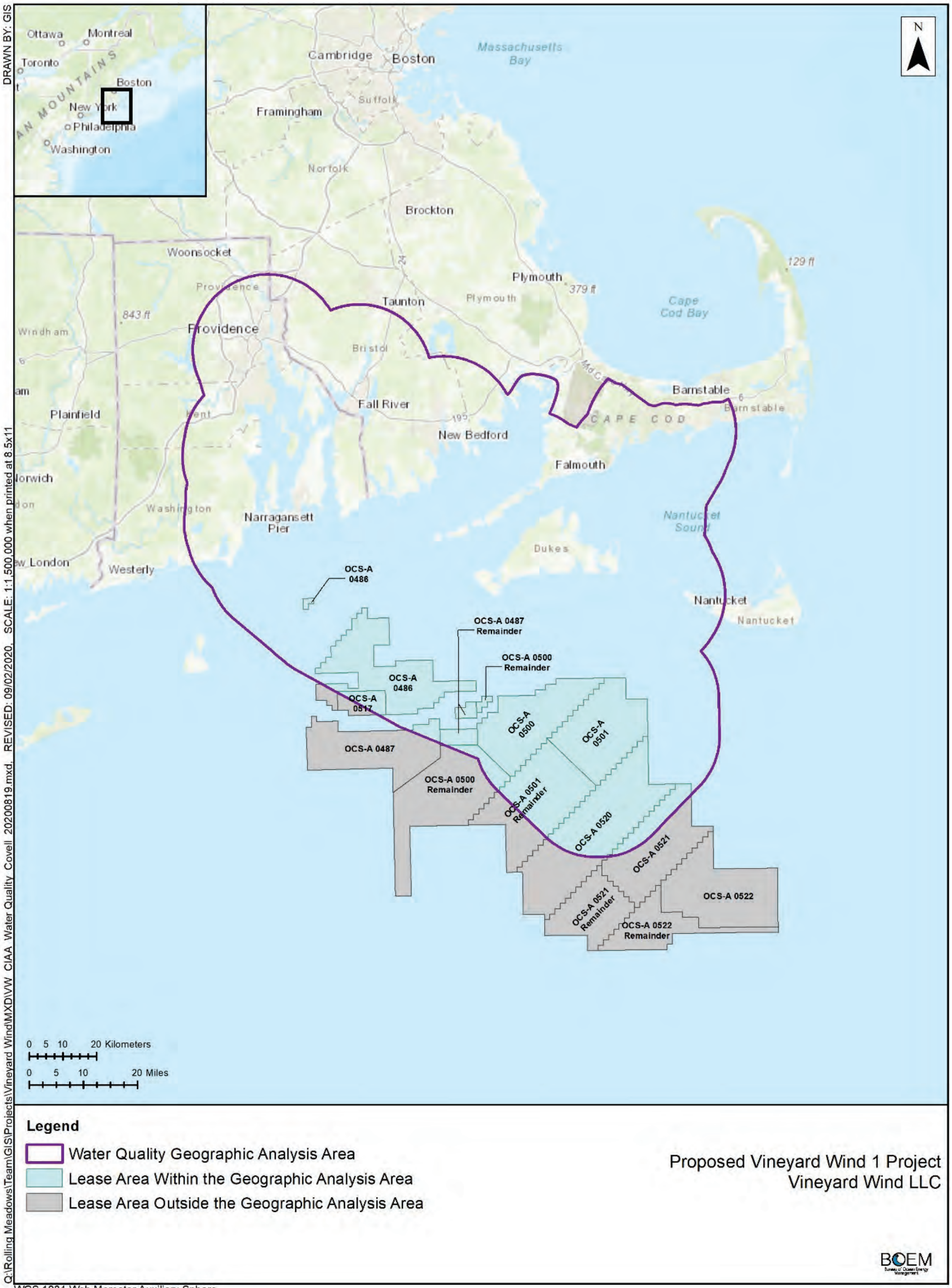
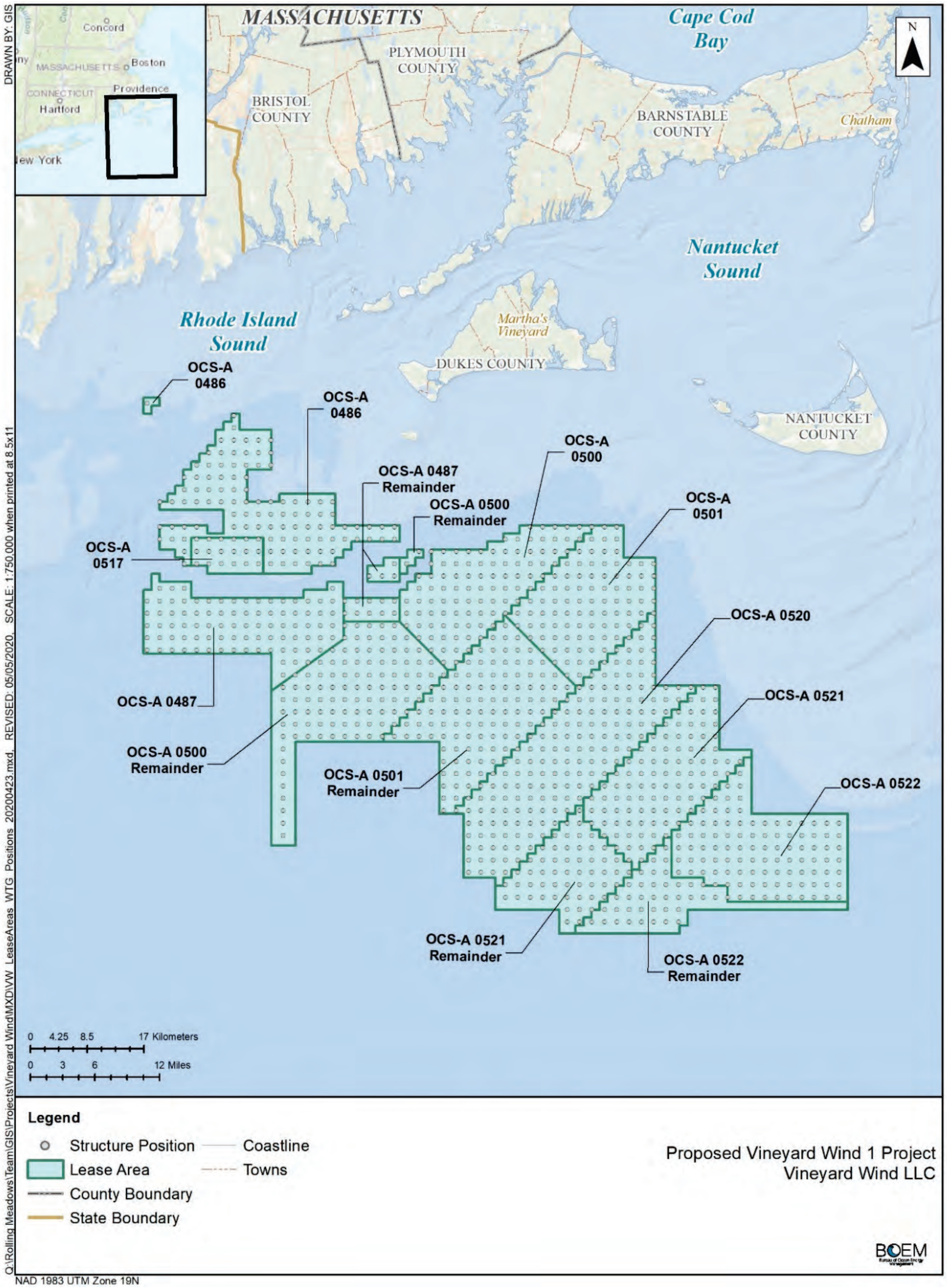


Figure A.7-15: Water Quality Geographic Analysis Area

Figure A.7-16: Birds and Bats Geographic Analysis Area



Note: The layout shown is for illustrative purposes only and does not guarantee that the positions identified are buildable. The layout is based on the RI and MA Lease Area developers' agreement for east-west orientation and 1 nautical mile by 1 nautical mile spacing (Geijerstam et al. 2019). The positions shown do not necessarily represent future WTG locations, and these locations are not based on a specific WTG size.

Figure A.7-17: Joint Developer Agreement Layout

A.8. ASSESSMENT OF RESOURCES WITH MINOR IMPACTS

A.8.1. Air Quality

The proposed Project's WTGs, ESPs, and OECC do not generate air emissions during normal operations. However, air emissions from equipment used in the construction, operations and maintenance, and decommissioning phases could impact air quality in the proposed Project area and nearby coastal waters and shore areas. Most emissions would occur temporarily during construction, offshore in the Wind Development Area (WDA), onshore at the landfall site, along the OECC and Onshore Export Cable Route (OECR), at the onshore substation, and at the construction staging area. Additional emissions related to the proposed Project could also occur at nearby ports used to transport material and personnel to and from the Project site. However, as described in COP Section 1.5 (Volume I; Epsilon 2020a) and COP Section 5.1 (Volume III, Epsilon; 2020b), the proposed Project would provide beneficial impacts on the air quality near the proposed Project location and the surrounding region in comparison to fossil-fuel power generating stations. These benefits include a reduction of more than 1.6 million tons of carbon dioxide (CO_2), more than 1,000 tons of nitrogen oxides (NO_x), and more than 800 tons of sulfur dioxide (SO_2) per year.

A.8.1.1. No Action Alternative and Affected Environment

This section discusses the baseline conditions for air quality in the geographic analysis area for air as described in Table A-1 and shown on Figure A.7.14. The overall geographic analysis area for air quality covers most of Rhode Island, southeastern Massachusetts eastward across Cape Cod, southward across Martha's Vineyard and over the open ocean south of Martha's Vineyard, which includes the air above the WDA and adjacent OCS, along the OECC and OECR, at the onshore construction and proposed Project-related sites, and at the ports used to support proposed Project activities. Specifically, this includes the airshed within 15.5 miles (25 kilometers) of each area potentially impacted by the proposed Project, including the lease area, the on-land construction areas, and the mustering port(s). Table A.8.1-1 describes baseline conditions and the impacts, based on the impact-producing factors (IPFs) assessed of ongoing and future offshore activities other than offshore wind, which is discussed below.

Air quality within a region is measured in comparison to the National Ambient Air Quality Standards (NAAQS), which are standards established by the U.S. Environmental Protection Agency (USEPA) pursuant to the Clean Air Act (CAA) (42 United States Code [USC] § 7409) for criteria pollutants to protect human health and welfare. The criteria pollutants are carbon monoxide (CO), sulfur dioxide, particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), nitrogen dioxide (NO_2), ozone, and lead.

The USEPA classifies all areas of the country as in attainment, nonattainment, or unclassified for each criteria pollutant. An attainment area complies with all NAAQS. A nonattainment area does not meet NAAQS for one or more pollutants. Unclassified areas are where attainment status cannot be determined based on available information and are treated as attainment areas. Note that an area can be in attainment for some pollutants and nonattainment for others.

The attainment status of an area can be found at 40 CFR § 81 and in the USEPA Green Book, which the agency revises from time to time (USEPA 2018). Attainment status is determined through evaluation of air quality data from a network of monitors.

The CAA amendments directed USEPA to establish requirements to control air pollution from OCS oil- and gas-related activities along the Pacific, Arctic, and Atlantic coasts, and along the U.S. Gulf Coast off Florida, eastward of 87^o 30′ West longitude. The OCS Air Regulations (40 CFR § 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for facilities subject to the CAA. These regulations apply to OCS sources that are located beyond state seaward boundaries. Applicants locating within 25 nautical miles of a state seaward boundary are required to comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements.

This section assesses the expected level of impacts from each phase of the proposed Project. Emissions from the proposed Project exceed USEPA major source thresholds under the Prevention of Significant Deterioration and New Source Review programs. The “major” source definition is unrelated to the assessment of expected impacts described in the following sections. Air quality impacts would be permitted as part of the OCS permitting process that is underway by Vineyard Wind, which includes a detailed emissions inventory for the proposed Project design activities, such as engine sizes and durations of activities.

The proposed Project may generate air emissions within Massachusetts in Barnstable County, Bristol County, Dukes County, and Nantucket County (offshore Nantucket only). The proposed Project intends to use the MCT as the primary construction staging area. However, Vineyard Wind may need to stage certain activities from other commercial seaports. If a port besides MCT is used during construction, proposed Project-related air emissions could potentially occur in one or more of the following counties: Suffolk County (New York); or Washington, Newport, Kent, Providence, and Bristol (Rhode Island). Vineyard Wind is considering operations and maintenance facilities at Vineyard Haven Harbor in Tisbury. FEIS Section A.8.6 in Appendix A provides additional information on land use and proposed ports.

Air quality in the geographic analysis area may be impacted due to the emission of criteria pollutants from sources involved in the construction or maintenance of the proposed Project as well as potentially during operations. These impacts, while generally localized to the emission source in question, may occur at any location associated with the proposed Project, be it offshore in the WDA or at any of the onshore construction or support sites. Additionally, ozone levels in the region could potentially be impacted.

All of southeastern Massachusetts is presently designated as unclassifiable or in attainment for all criteria pollutants (COP Volume III, Section 5.1; Epsilon 2020b), except for Dukes County on Martha’s Vineyard, which is designated as marginally in nonattainment for the 2008 ozone NAAQS. This designation was based on data collected at the Herring Creek Road Aquinnah monitor (Monitor #25-007-0001) from 2009 to 2011, which showed a monitored concentration of 76 parts per billion (ppb) against the 2008 NAAQS of 75 ppb. While the 2008 NAAQS are still technically in effect, Dukes County was designated in attainment in August 2018 against the more stringent 2015 ozone NAAQS of 70 ppb (80 Fed. Reg. 206 [October 26, 2015]), based on a monitored concentration of 64.3 ppb between 2014 and 2016. Thus, while the 2008 designation has not yet been changed, monitored values in Dukes County have significantly improved since 2011. Dukes County is in attainment with the 2015 ozone NAAQS standard; however, its official designation is as a “marginal nonattainment area” based on the 8-hour ozone standard in 2008. Administratively, the USEPA must change this designation to attainment, but has not done so yet. The entire State of Rhode Island is currently in attainment for all criteria pollutants.

COP Figure 5.1-1 (Volume I; Epsilon 2020a) shows air quality trends for $PM_{2.5}$, SO_2, NO_2, and ozone at regional ambient monitors. The graphs show that for each of these pollutants and periods, ambient concentrations have either decreased or, at worst remained constant over the last decade.

Under the No Action Alternative, the proposed Project would not be built. If the Vineyard Wind 1 Project were not approved, then impacts from the proposed Project (Section A.8.1.2) would not occur as proposed. Impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur (Table A.8.1-1). The following analysis addresses reasonably foreseeable offshore wind projects (or portions of projects) that fall within the geographic analysis area and considers the assumptions included in Section 1.7 and in this Appendix A. The analysis assumes that state offshore wind power demand could not be accommodated entirely by projects in the geographic analysis area for air quality, and the analysis does not include the impacts associated with the proposed Project. BOEM acknowledges that, if approved, the proposed Project could be the nation’s first large-scale offshore wind energy project. Comments received on the SEIS from companies in the offshore wind industry have noted that approval of the Project would encourage and support continued investment in other offshore wind projects and the creation of a domestic supply chain for the offshore wind industry in the eastern United States. This could accelerate the offshore wind industry and could lead to additional future project announcements. While it is possible that the selection of the No Action Alternative could affect the development of the U.S. offshore wind industry, for the purposes of capturing the maximum-case scenario, this analysis assumes that the outstanding state demand for offshore wind is still met.

The No Action Alternative, without implementation of other future offshore wind projects, would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. As indicated by recent market and permitting trends, future electric generating units would most likely include natural-gas-fired and oil-fired dual fuel facilities, and a mix of natural gas, dual fuel natural gas/oil, solar, wind, and energy storage would likely occur in the future due to market forces and state energy policies. Nonetheless, impacts from fossil-fuel facilities are expected to be mitigated partially by installation of other offshore wind projects surrounding the proposed geographic analysis area, including in the region off New York and New Jersey, as described below, to the extent that these wind projects would result in a reduction in fossil-fuel-type emissions from power generating facilities.

A.8.1.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects future offshore wind activities to affect air quality through the following primary IPFs.

Accidental releases: Future offshore wind activities could release air toxics or hazardous air pollutants (HAPs) because of accidental chemical spills within the air quality geographic analysis area. Section A.8.2 includes a discussion of the nature of releases anticipated. As shown in Table A-4, up to about 246,069 gallons (931,473 liters) of coolants, 2,959,524 gallons (11.2 million liters) of oils and lubricants, and 494,632 gallons (1.8 million liters) of diesel fuel would be contained in the construction of 581 foundations (WTGs and ESPs) for the wind energy projects within the air quality geographic analysis area. Accidental releases would be most likely during construction, but could occur during operations and decommissioning of offshore wind facilities. These may lead to short-term periods of HAP emissions through surface evaporation. HAPs emissions would consist of volatile organic compounds (VOCs), which may be important for ozone production. By comparison, the smallest tanker vessel operating in these waters (a general purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million to 30.3 million liters). As described in A.8.2, tankers are relatively common in these waters, and the total WTG chemical storage capacity within the geographic analysis area for air is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). BOEM expects air quality impacts from accidental releases would be short-term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 30-year period with a higher probability of spills during future project construction, but they would not be expected to appreciably contribute to overall impacts on air quality.

Air emissions: Most air pollutant emissions and air quality impacts from future offshore wind projects would occur during construction, potentially from multiple co-occurring projects. All projects would be required to comply with the CAA. During the limited times of construction and decommissioning, emissions might exceed *de minimis* thresholds, requiring offsets and mitigation. Primary emission sources would include increased commercial vehicular traffic, air traffic, public vehicular traffic, construction equipment, and fugitive emissions leaks. As projects come online, emissions overall would decline and the projects would benefit air quality overall.

The future offshore wind projects that may result in air emissions and air quality impacts within the air quality geographic analysis area include projects within all or portions of the following lease areas: OCS-A-0486, OCS-A-0487, OCS-A-0500, OCS-A-0501 South, OCS-A-0520, and OCS-A-0521 (Table A-4). Based on the expanded planned action assumptions in Table A-4, these projects would produce 5,939 MW of renewable power from the installation of 593 foundations. Based on the assumed offshore foundation construction schedule in Table A-6, those projects within the geographic analysis area would have overlapping construction periods beginning in 2023 and continuing through 2030. During the construction phase, the total emissions of criteria pollutants (CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, and VOCs) within the air quality geographic analysis area would be approximately 38,220 tons, distributed as follows: approximately 17 percent CO, approximately 75 percent NO_x, approximately 5 percent particulates, approximately 1 percent SO_2, and approximately 2 percent VOCs. The CO_2 construction emissions make up the largest percentage of total construction-phase emissions, resulting in about 1.9 million tons of CO_2 emissions for the projects within the air quality geographic analysis area. Overall, construction and decommissioning phases would have the largest emissions. The largest emissions of criteria pollutants would be NO_x (28,840 tons) and CO (6,486 tons), most from diesel construction equipment, vessels, and commercial vehicles. The magnitude of the air emissions and the air quality impacts would vary spatially and temporally during the construction phases even for overlapping projects. This spatial and temporal variability assumes that construction activity would occur at different locations and would always overlap with activities at other locations. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area.

Future offshore wind projects within the air quality geographic analysis area would overlap during operations, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning and would come largely from commercial vessel traffic and emergency diesel generators. Most emissions would be NO_x (412 tons per year [74 percent of the total operations criteria pollutant emissions]) and CO (105 tons per year [19 percent of the total operations criteria pollutant emissions]). The other criteria pollutants would each account for approximately 7 percent of the total operations emissions. Operations air emissions would overall be short-term, intermittent, widely dispersed, and would generally contribute to small and localized air quality impacts.

CO_2 emissions comprise about 98 percent (31,898 tons per year) of the total operation emissions. CO_2 is a GHG and important for assessing climate change impacts. However, it is not a criteria pollutant and is not included in air quality impact analyses. Offshore wind energy development would help offset emissions from fossil fuels, improving regional air quality and reducing GHGs. An analysis by Katzenstein and Apt (2009), for example, estimates that CO_2 emissions can be reduced by up to 80 percent and NO_x emissions can be reduced up to 50 percent by implementing wind energy projects.

Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about the air emission contributions of the existing mix of power generation sources, and generally determine the annual health benefits of an individual commercial scale offshore wind project to be valued in the hundreds of millions of dollars (Kempton et al. 2005; Buonocoure et al. 2016). An evaluation of health and climate benefits of offshore wind projects in the Mid-Atlantic United States examined a range of project sizes and connecting states (Buonocoure et al. 2016). While the air emissions profile for a particular grid region will affect the level of benefits experienced, a representative range of potential annual health benefits (in dollars) and annual premature deaths avoided with 22 GW of future offshore wind development is presented in Table A.8.1-2. These ranges were created by converting the scenarios analyzed in Buonocoure et al. (2016) to dollars and annual premature deaths avoided per megawatt-hour, and assuming a conservative 45 percent average net capacity factor across all future offshore wind development in the Atlantic. Net capacity factor refers to the proportion of actual energy generation over time over the maximum generation capacity over time.

Table A.8.1-2: Representative Range of Annual Health and Climate Benefits and Annual Premature Deaths Avoided from 22 GW of Offshore Wind Development

Planned Action Estimate Range Level	Annual Air Quality Health Benefit ($)	Annual Premature Deaths Avoided	Notes [a]
Low	$4.64 billion	463	Lowest $ and deaths avoided per MWh
Medium	$7.42 billion	571	Mean $ per MWh and deaths avoided
High	$10.32 billion	971	Highest $ per MWh and deaths avoided

GW = gigawatt; MWh = megawatt-hour
[a] Source: Buonocoure et al. 2016

Climate change: Construction and operation of offshore wind projects would produce GHG emissions (nearly all CO_2) that contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and for the most part mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects would likely decrease GHGs emissions by replacing energy from fossil fuels. This reduction would more than offset the very limited GHG emissions from offshore wind projects. U.S. offshore wind projects would by themselves probably have a limited impact on global emissions and climate change, but they may be significant and beneficial as a component of many actions addressing climate change, and integral for fulfilling state plans regarding climate change.

A.8.1.1.2. Conclusions of the No Action Alternative

Under the No Action Alternative, air quality would continue to follow current regional trends and respond to current and future environmental and societal activities. Furthermore, additional, more polluting, fossil-fuel energy facilities would come, or be kept, on-line to meet future power demand, fired by natural gas, oil, or coal. These larger impacts would be mitigated partially by other future offshore wind projects surrounding the geographic analysis area, including offshore New York and New Jersey.

While the proposed Project would not be built under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing regional air quality impacts primarily through air emissions, accidental releases, and climate change. BOEM anticipates that the impacts of ongoing activities, such as air emissions and GHGs, would be **moderate**. In addition to ongoing activities, reasonably foreseeable activities other than offshore wind may also contribute to impacts on air quality. Reasonably foreseeable activities other than offshore wind include increasing air emission and GHG through construction and operation of new energy generation facilities to meet future power demands (Table A.8.1-1). These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. BOEM anticipates that the impacts of reasonably foreseeable activities other than offshore wind would be **moderate**. BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **moderate** impacts on air quality, primarily driven by recent market and permitting trends indicating future electric generating units would most likely include natural-gas-fired and oil-fired dual fuel facilities, a mix of natural gas, and dual fuel natural gas/oil.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable activities other than offshore wind would result in **minor** adverse impacts due to emissions of CO, NO_2, SO_2, particulates, and some air toxics, mostly released during construction and decommissioning. Emissions during operations would be generally lower and more transient, with emissions of NO_x and CO from combustion sources predominating. CO_2, a GHG but not a criteria pollutant, would contribute most emissions during construction and operations. Most air emissions and air quality impacts would occur during multiple overlapping project construction phases from 2023 through 2027 (Table A-6). Overall, adverse air quality impacts from future offshore wind projects are expected to be relatively small and transient. The proposed Project and other future offshore wind projects would in fact probably lead to reduced emissions from fossil-fuel power generating facilities and **minor** to **moderate** beneficial impacts on air quality.

A.8.1.2. Consequences of Alternative A

The following proposed-Project design parameters (Appendix G) would influence the magnitude of the impacts on air quality:

- Air emission ratings of construction equipment engines
- Location of construction laydown areas
- Choice of cable-laying locations and pathways
- Choice of marine traffic routes to and from the WDA and OECC
- Soil characteristics at excavation areas for fugitive emissions determination
- Emission control strategy for fugitive emissions due to excavation and hauling operations

Changes to the design capacity of the turbines would not alter the maximum potential air quality impacts for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the Project Design Envelope (PDE). In addition, the additional acreage required for the proposed onshore substation would not alter the air quality impacts for the Proposed Action and all other action alternatives.

The vast majority of air emissions from Alternative A alone would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during construction activities. Fugitive emissions would occur as a result of excavation and hauling of soil.

Fuel combustion and some incidental solvent use would cause construction-related air emissions. The air pollutants would include CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2, VOCs, carbon dioxide equivalent or GHG emissions, ozone, and total HAPs. COP Appendix III-B provides a complete description of all emission points associated with the construction and operation phases of the Proposed Action, including engine sizes, hours of operation, load factors, emergency generators, emission factors, and fuel consumption rates, along with a description of the air emission calculation methodology (Volume III; Epsilon 2020b). The total construction emissions of each pollutant are summarized Table A-4 as well as in COP Tables 4-4, 4-5, and 4-6 (Volume III, Appendix III-B; Epsilon 2020b). Construction equipment would use appropriate fuel-efficient engines and would comply with all applicable air emission standards in an effort to keep combustion emissions and associated air quality impacts at a minimum.

During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses could have impacts on air quality.

A more detailed description of offshore and onshore construction activities can be found in COP Sections 3.1, 3.2, 4.1, and 4.2 (Volume I; Epsilon 2020a).

The Proposed Action would probably lead to reduced emissions from fossil- fuel power generating facilities and benefit air quality. Although some air quality impacts would be due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. BOEM could reduce potential impacts by requiring the use of fuel-efficient engines and dust control plans for onshore construction areas. The most impactful IPFs would likely include air emissions. Most impacts would likely be during construction and decommissioning because of increased emissions from vessel traffic and commercial vehicles and from both end-of-pipe and fugitive emissions during construction. Other IPFs would likely contribute impacts of lesser intensity and extent, primarily during construction and decommissioning but also during operations (Table A.8.1-1).

In context of reasonably foreseeable environmental trends, the combined impacts of ongoing and planned actions, including Alternative A, would be of similar types as those described in Section A.8.1.1, but may differ in intensity and extent. BOEM assumes that the impacts on resources with a “restricted” geographic analysis area, such as air quality, would not be equal with or without the Proposed Action. In the absence of the Proposed Action, BOEM assumes that the total generating capacity of offshore wind facilities in the geographic analysis area would be 5,939 MW, 800 MW less than if the Proposed Action were approved.

Accidental releases: The proposed Project could release air toxics or HAPs because of accidental chemical spills. Alternative A alone would have up to about 42,346 gallons (160,297 liters) of coolants, 506,559 gallons (1.9 million liters) of oils and lubricants, and 84,996 gallons (321,745 liters) of diesel fuel in its 102 foundations (WTGs and ESPs) within the air quality geographic analysis area. These may lead to short-term periods of hazardous air toxic pollutant emissions such as VOCs through evaporation. VOC emissions would also be an important precursor to ozone formation. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. BOEM anticipates that these activities would have a **negligible** air quality impact as a result of Alternative A alone. The change in risk to, or impact on, air quality in the air quality geographic analysis area due to offshore wind development is very small. The frequency of accidental release events would be very small. If it occurs, it is anticipated that the overall air quality impact would be short-term and spatially limited. Collectively, there would be up to about 288,415 gallons (1.13 million liters) of coolants, 3,466,083 gallons (13.1 million liters) of oils and lubricants, and 579,628 gallons (2.2 million liters) of diesel fuel contained within the 695 foundations between Alternative A alone and future planned actions in the air quality geographic analysis area. BOEM expects that in context of reasonably foreseeable environmental trends, combined accidental release impacts on air quality from ongoing and planned actions, including Alternative A, would have **negligible** impacts if they occurred due to the short-term nature and localized potential effects. Accidental spills would occur infrequently over the 30-year period with a higher probability of spills during construction of projects, but they would not be expected to contribute appreciably to overall impacts on air quality as the total storage capacity within the air quality geographic analysis area is considerably less than the volumes of hazardous liquids being transported by ongoing activities.

Air emissions: Onshore activities of Alternative A would consist of horizontal directional drilling (HDD), duct bank construction, cable-pulling operations, and substation construction. Emissions from HDD would be due to the operation of diesel-powered equipment (e.g., drilling rigs or other machinery). The HDD would take several weeks to complete. Duct bank construction and cable pulling operations could take up to 6 months. Vineyard Wind's voluntarily committed measures include the following: fuel-efficient engines; Tier 2 or higher engines for marine diesel engines; use of ultra-low sulfur diesel fuel for some engines and 1,000 parts per million sulfur fuel in others; compliance with International Maritime Organization energy-efficiency regulations; compliance with applicable VOC content limits and requirements involving the use of adhesives and sealants; following smoke and opacity standards; implementing anti-idling practices; covering and securing all loose materials and construction wastes that are transported to and from the WDA and OECC; and other emission-reducing measures to further reduce air quality impacts (Epsilon 2018d). It is anticipated that emissions and the corresponding air quality impacts of onshore construction activities would be limited to approximately 1 year. Because such activities for Alternative A alone would occur for short periods and be limited to combustion emissions, they would only have a **negligible** impact on air quality. Other activities involving excavation, such as duct bank construction and hauling operations during cable pulling and splicing activities, would result in combustion emissions from vehicle activity such as bulldozers, excavators, and diesel trucks, and fugitive particulate emissions from excavation and hauling of soil. These emissions would be highly variable and limited in spatial extent at any given period and would result in **minor** impacts, as they are temporary in nature. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, and soil moisture content, and the magnitude and direction of ground-level winds. Fugitive emissions could be partially mitigated by imposing limits on the surface area of exposed soils in a specific area and by spraying water for dust control when possible, thereby resulting in **minor** impacts. BOEM expects **minor** impacts from onshore construction and installation from Alternative A alone. In addition, the potential impacts from construction could be further reduced if the mitigation measure related to dust control plans, as outlined in Appendix D, became a condition of COP approval.

Emissions from onshore operations and maintenance activities would be limited to periodic use of construction vehicles and equipment. Onshore operations and maintenance activities would include occasional inspections and repairs to the onshore substation and splice vaults, which would require minimal use of worker vehicles and construction equipment. Vineyard Wind intends to use port facilities at both Vineyard Haven on Martha's Vineyard and the MCT to support operations and maintenance activities. Smaller vessels used for operations and maintenance activities would likely be based out of Vineyard Haven while larger vessels used for major repairs during operations and maintenance would likely use the MCT. BOEM anticipates that air quality impacts due to onshore operations and maintenance from Alternative A alone would be **minor**, occurring for short periods and temporary. Vineyard Wind has also committed to allowing emergency management services the use of Vineyard Wind's storage battery array, which would reduce local carbon emissions and be an additional help in offsetting any local impacts from the proposed Project.

For onshore decommissioning activities, Vineyard Wind would remove onshore export cables from the duct bank using truck-mounted winches, cable reels, and cable reel transport trucks. Vineyard Wind could leave the concrete-encased duct bank and splice vaults in place for future reuse, as well as elements of the onshore substation and grid connections. Consequently, onshore decommissioning emissions would be significantly less than onshore construction emissions. BOEM anticipates **minor** and temporary air quality impacts from Alternative A alone due to decommissioning.

Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. Thus, BOEM expects that in context of reasonably foreseeable environmental trends, combined air emission impacts on air from ongoing and planned actions, including Alternative A, would result in **minor** to **moderate** onshore impacts.

Emissions from offshore activities occur during pile and scour protection installation, offshore cable laying, turbine installation, and ESP installation. Offshore activities would have more significant power requirements, resulting in a greater need for diesel-generating equipment to supply temporary power to WTGs or ESPs and other construction equipment. Offshore construction-related emissions would come from diesel generators used to temporarily supply power to the WTGs and ESPs so that workers could power up lights, controls, and other equipment before cabling is in place. There would also be emissions from engines used to power pile-driving hammers and air compressors used to supply compressed air to noise mitigation devices during pile driving (if used). Emissions from vessels used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. Vineyard Wind may need emergency generators at times, potentially resulting in increased emissions for limited periods.

The overall air quality impacts of offshore activities would continue for a longer period than those of onshore activities, potentially as long as 2 years. Specific emissions from potential sources or construction activities would vary throughout the construction/installation of offshore components. For pollutants such as NO_2, $PM_{2.5}$, and SO_2, USEPA bases NAAQS attainment status on monitored 3-year pollutant concentrations. Because the construction and installation phase of the offshore components would likely not extend past 2 years and because the emissions would vary throughout the phase, BOEM does not expect projected air quality impacts to exceed the NAAQS for these pollutants. Alternative A alone would have a contribution of up to 325,255 tons of construction emissions, which would be additive with the impact(s) of any and all other construction activities, including future offshore wind activities, that occur within the air quality geographic analysis area before the resource has recovered from the impact caused by the proposed Project. For Alternative A alone, construction emissions are estimated to be 1,116 tons of CO, 4,961 tons of NO_x, 172 tons of PM_{10}, 38 tons of SO_2, and 122 tons of VOC. Note that both NO_x and VOC are ozone precursors and these emissions may contribute to some increase in ozone production during construction. BOEM anticipates **minor** air quality impacts due to the construction and installation of Alternative A alone. Using the assumptions in Table A-4, the reasonably foreseeable environmental trends, combined emission impacts on air quality from ongoing and planned actions, including Alternative A, could generate up to approximately 2,215,929 tons of construction emissions between 2021 and 2030. Offshore foundation construction overlap between projects would begin in 2023 based on the lease areas within the air quality geographic analysis area (Table A-6). Primary emission sources would be increased commercial vessel traffic, air traffic, public vehicular traffic, combustion emissions from construction equipment, and some fugitive emissions. The largest emissions and air quality impacts would occur during construction and decommissioning. Construction impacts would also likely affect air quality over a larger spatial area in comparison to operations because of the increased emissions during various construction activities. Smaller emissions and lower magnitude air quality impacts would occur during decommissioning. As the Proposed Action and other future offshore wind projects come online, power generation emissions in the region overall would reduce emissions over time and this would contribute to a net benefit on air quality regionally. Most air quality impacts would remain offshore since the highest emissions would occur in this region and the westerly prevailing winds would result in most plumes remaining offshore. In context of reasonably foreseeable environmental trends, combined air emission impacts from ongoing and planned actions, including Alternative A, would be required to comply with the CAA and emissions might exceed *de minimis* thresholds, requiring offsets and mitigation.

As discussed above under the No Action Alternative, Alternative A, an 800 MW offshore wind facility, would result in air quality health and climate benefits and premature deaths avoided in the region due to the reduction in emissions associated with energy generation. The potential air quality and health benefits of an individual project in a specific power generation region can be evaluated using USEPA’s AVERT (AVoided Emissions and geneRation Tool) and COBRA (CO-Benefits Risk Assessment) health impacts screening and mapping tool (USEPA 2020a, 2020b). AVERT uses information about the historical patterns of power generation throughout the year to evaluate the potential for emissions avoided on an hourly basis throughout the year in a specific region, for a given category and size of renewable energy or energy efficiency project. The avoided emissions output can then be analyzed with COBRA. The annual potential avoided emissions calculated by AVERT for an 800 MW offshore wind facility in the New England AVERT region are shown in Table A.8.1-3. These emissions are equivalent to the emissions generated by 213,348 passenger vehicles in a year (USEPA 2020c).

Table A.8.1-3: AVERT Output for Annual Avoided Emissions from the Proposed Project

	Original	Post Change	Change
Generation (MWh)	41,709,790	38,554,790	-3,155,000
Total emissions from fossil generation fleet			
SO_2 (lb)	1,605,630	1,374,960	-230,680
NO_x (lb)	6,991,920	6,460,700	-531,220
CO_2 (tons)	22,265,850	20,657,110	-1,608,740
$PM_{2.5}$ (lb)	1,219,700	1,134,470	-85,230

lb = pound; MWh = megawatt-hour

COBRA was used to analyze the avoided emissions that were calculated using AVERT (Table A.8.1-3). COBRA is a tool that estimates the health and economic benefits of clean energy policies, and the analysis results are presented in Table A.8.1-4.

Table A.8.1-4: COBRA Output for Annual Avoided Emissions from the Proposed Project

Discount Rate (2023)	$ Total Health Benefits (low estimate)	$ Total Health Benefits (high estimate)	Mortality (low estimate)	Mortality (high estimate)
3%	12,057,485.95	27,185,112.13	1.0833	2.451
7%	10,761,065.87	24,248,215.11	1.0833	2.451

Air quality impacts due to offshore wind projects within the air quality geographic analysis area is anticipated to be small relative to larger emission sources such as fossil-fuel facilities. The largest air quality impacts are anticipated during construction with smaller and more infrequent impacts anticipated during decommissioning. Alternative A alone would contribute an approximately 15 percent increase from each criteria pollutant due to construction and decommissioning activities when compared to the projects within the air quality geographic analysis area. This suggests that most of the air quality impacts resulting from offshore wind development would be due to other offshore wind projects in total and the addition of Alternative A would yield a very small contribution to the total air quality impacts. The largest combined air quality impacts from offshore wind would occur during overlapping construction/decommissioning of multiple offshore wind projects. Based on the expanded planned action assumptions in Table A-4, the Vineyard Wind 1 Project, Sunrise Wind Project, and Revolution Wind are anticipated to overlap for 2 years of construction beginning in 2023 (Table A-6), resulting in about 10,362 tons of criteria pollutants and about 502,208 tons of CO_2 construction emissions. Construction of other wind projects within the air quality geographic analysis area would overlap with the Vineyard Wind 1 Project's operations (Table A-6). In context of reasonably foreseeable environmental trends, combined air emission impacts on air quality from ongoing and planned actions, including Alternative A, would be **minor** during construction and decommissioning. During overlapping construction activities, there could be higher levels of impacts, but these effects would be short-term in nature as the overlap in the air quality geographic analysis area would be limited in time.

As described in COP Section 4.4 (Volume I; Epsilon 2020a), the decommissioning process would be largely the reverse of the installation process. As a result, the impacts of decommissioning on air quality would resemble the impacts of the construction phase. During decommissioning, Vineyard Wind would use commercial marine vessels to remove the offshore cable system, WTGs, foundations, and scour protection. It is anticipated that equipment and vessels used for decommissioning would be similar to those used during construction, but would likely have lower polluting engines (historically, emission standards for marine vessels have become increasingly stringent over time).

During operations and maintenance, air quality impacts are anticipated to be smaller in magnitude compared to construction/decommissioning. The operations and maintenance of Alternative A would generate fewer emissions than construction since it would involve only limited vessel and commercial traffic, and operation of emergency equipment would only occur infrequently. COP Section 4.3 provides a more detailed description of offshore and onshore operations and maintenance activities (Volume I; Epsilon 2020a), and COP Table 4-7 (COP Volume III, Appendix III-B; Epsilon 2020b), summarizes emissions during operations and maintenance. Operations and maintenance activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance. The WTGs operating in Alternative A would have no pollutant emissions. Emergency generators located on the WTGs and the ESPs would only operate during emergencies or testing, so emissions from these sources would be transient and therefore negligible. Pollutant emissions from operations and maintenance would be mostly the result of operations of ocean vessels and helicopters used for maintenance activities. Crew transfer vessels and helicopters would transport crews to the WDA for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would infrequently travel to the WDA for significant maintenance and repairs. The proposed Project's contribution of up to 5,583 tons per year of operations emissions, of which 96 tons per year would be from criteria pollutants, would be additive with the impact(s) of any and all other operations activities, including offshore wind activities, that occur within the air quality geographic analysis area. Alternative A operations emissions for the criteria pollutants are about 71 tons per year of NO_x, 2 tons per year of VOC, 18 tons per year of CO, 2 tons per year of both PM_{10} and $PM_{2.5}$, and less than 1 ton per year of SO_2. Both NO_X and CO have the highest estimated emissions due to operations. BOEM anticipates that air quality impacts from operations and maintenance of Alternative A alone would be **minor**, occurring for short blocks of time several times per year during the proposed 30 years. Using the assumptions in Table A-4, in context of reasonably foreseeable environmental trends, operations and maintenance air emissions from ongoing and planned actions, including Alternative A, could generate up to approximately 38,038 tons per year of operations emissions in the air quality geographic analysis area beginning in 2023 and continuing through 2030. Emissions would largely be due to commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions. Planned actions, including Alternative A, are estimated to emit 482 tons per year of NO_x, 14 tons per year of VOC, 123 tons per year of CO, 16 tons per year both of PM_{10} and $PM_{2.5}$, and 2 tons per year of SO_2. Anticipated impacts on air quality from operations and maintenance air emissions would be transient, small in magnitude, and localized. Additionally, some emissions associated with operations and maintenance activities could overlap with other projects' construction-related emissions. This shows that Alternative A alone contributions are less for the operations and maintenance phase than for the construction phase, and that the increase in air quality impacts are anticipated to be small relative to the other planned offshore wind projects. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the multiple offshore wind projects within the air quality geographic analysis area. In context of reasonably foreseeable environmental trends, combined air emission impacts on air quality due to operations and maintenance from ongoing and planned actions, including Alternative A, would be **minor**. A net improvement in air quality is expected on a regional scale as projects come online and offset emissions from fossil-fuel-type sources.

Increases in renewable energy can result in significant reductions in fossil-fuel-type emissions. Once operational, the Vineyard Wind 1 Project would result in annual avoided emissions of 1,632,822 tons CO_2, 1,046 tons NO_x, and 855 tons SO_2. Accounting for construction emissions and assuming decommissioning emissions would be the same, the Vineyard Wind 1 Project would offset emissions related to its development and eventual decommissioning within 8 years of operation; from that point, it would be offsetting emissions that would otherwise be generated from another source. BOEM anticipates that air emissions would result in a small reduction of fossil-fuel emissions and would result in a **minor beneficial** impact on air quality. Since total actual fossil- fuel emissions are much higher than total actual emissions due to renewable energy sources, a relatively small percentage reduction in fossil-fuel emissions can lead to much larger emissions reductions relative to the smaller emission increases that would result from implementation of offshore wind projects. In context of reasonably foreseeable environmental trends, combined emission impacts on air quality from ongoing and planned actions within the geographic analysis area, including Alternative A, would help reduce fossil-fuel emissions, and would result in an overall **moderate beneficial** impact on air quality.

Climate change: The Proposed Action and other future offshore wind projects would produce GHG emissions (nearly all CO_2) that contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions, and would be less than the emissions offset during operation of the offshore wind facility. CO_2 is relatively stable in the atmosphere and for the most part mixed uniformly throughout the troposphere and stratosphere. Hence, the impact of GHG emissions does not depend upon the source location.

Additional offshore wind projects would likely contribute a relatively small emissions increase of CO_2. The additional GHG emissions anticipated from the planned actions including the Proposed Action over the next 30-year period would have a **negligible** incremental contribution on existing GHG emissions. Therefore, Alternative A would have **negligible** impacts on climate change during these activities and an overall net **minor beneficial** impact on both GHG emissions and criteria pollutants including ozone precursors such as NO_x compared to a similarly sized fossil-fuel power generating station or to the generation of the same amount of energy by the existing grids. Because GHG emissions spread out and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are likely a function of global emissions. Development of offshore wind projects including the Proposed Action and the construction, operations and maintenance, and the eventual decommissioning activities would cause some GHG emissions to increase primarily through emissions of CO_2. However, these contributions would be small compared to the aggregate global emissions. In context of reasonably foreseeable environmental trends, combined GHG impacts on air quality from ongoing and planned actions, including Alternative A, would likely result in a **minor beneficial** impact from the net decrease in GHGs as fossil-fuel-type facilities reduce operations as a result of increased energy generation from offshore wind projects. Overall, it is anticipated that there would be a net reduction in GHG emissions, and no collective adverse impact on climate change as a result of offshore wind projects.

In summary, Alternative A would result in a net decrease in overall emissions over the region compared to the installation of a traditional fossil-fuel power generating station. Although there would be some air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. BOEM could reduce potential impacts by requiring the use of fuel-efficient engines and by requiring dust control plans for onshore construction areas as a condition of COP approval (Appendix D). As a result, while **minor** air quality impacts would be anticipated for a limited time during these phases, there would be a **minor beneficial** impact on the air quality near the WDA site and the surrounding region overall due to offset emissions from fossil-fuel power generating stations. Vineyard Wind's self-imposed measures described above would be implemented, where possible, to ensure compliance with NAAQS in accordance with the OCS CAA permit. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section A.8.1.1.2. Vineyard Wind may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario evaluated above, but doing so would not likely result in different impact ratings than those described above. Alternative A would result in air quality health benefits and premature deaths avoided in the region due to the reduction in emissions associated with energy generation (Table A.8.1-3 and A.8.1-4).

In context of other reasonably foreseeable environmental trends, impacts resulting from individual IPFs affecting air quality would range from **negligible** to **minor** and **moderate beneficial**. Considering all the IPFs together, BOEM anticipates that the impacts associated with ongoing and planned actions, including Alternative A, would result in **minor** impacts on air quality in the geographic analysis area. The main driver for this impact rating is air emissions related to construction activities increasing commercial vessel traffic, air traffic, public vehicular traffic, combustion emissions from construction equipment, and fugitive emissions, which would be higher during overlapping construction activities, but short-term in nature as the overlap would be limited. Alternative A would contribute to the overall impact rating primarily through short-term construction emissions from construction vessels. Thus, the overall impacts on air quality would likely be **minor** because the measurable impact that would occur would be small and would be expected to recover completely without remedial or mitigating action.

The potential impacts from construction activities and the operation of the various vehicles, sea vessels, and temporary power generating and maintenance equipment would be further reduced if the potential mitigation measures related to fuel-efficient engines and dust control plans outlined in Appendix D became a condition of COP approval. While the significance level of impacts would remain the same, BOEM could further reduce the temporary impacts on air quality impacts with mitigation measures.

A.8.1.3. Consequences of Alternatives C, D1, and D2

Alternative C would exclude six of the northernmost WTG locations and relocate them in the southern portion of the WDA primarily for the purpose of reducing visual impacts and minimizing conflicts with commercial fishing boats. Alternative D1 increases the spacing between WTGs in the WDA to 1 nautical mile to reduce potential conflicts with ocean uses. Alternative D2 would align WTGs in an east-west orientation with 1-nautical-mile spacing between all turbines to allow greater spacing between WTG rows, which would facilitate the established practice of mobile and fixed gear fishing vessels. While the alternatives would result in slightly altered travel routes for construction and maintenance sea vessels, the changes would still result in virtually identical emissions as those quantified for Alternative A. No change in the assessed level of air quality impacts would occur.

The majority of air emissions from Alternative C, D1, and D2 would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during construction activities and from construction activities such as excavation and hauling of soil and materials. Emission sources from onshore construction activities would include non-road equipment and vehicles used during the unloading and loading of equipment at the construction staging areas, HDD, installation of the onshore export cable, and construction of the onshore substation. For Alternatives C, D1, and D2, BOEM does not expect a significant change in overall emissions, and as a result, emissions would be similar to those of Alternative A. Some changes in locations of emissions from Alternative C may occur due to shifting some turbines further offshore. This could reduce some onshore air quality impacts while slightly increasing the overall emissions due to the slightly longer travel times for construction-related vessels to the proposed Project site. BOEM anticipates Alternative C, D1, and D2 to have temporary **minor** air quality impacts during construction and installation similar to Alternative A.

As with Alternative A, the health benefits associated with offshore wind development for Alternatives C, D1, and D2 would be the same as Alternative A, which would result in air quality health benefits and avoided premature deaths in the region due to the reduction in emissions associated with energy generation (Table A.8.1-3).

Operations and maintenance activities of Alternative C would be similar to those of Alternative A, with similar impacts in the immediate area, slightly increased emissions from maintenance vessels due to the longer travel distance to the site, additional required use of survey vessels, and smaller impacts on shore due to the longer distance. Operations and maintenance activities of Alternatives D1 and D2 would be the same as those of Alternative A. BOEM expects **minor** air quality impacts for Alternatives C, D1, and D2.

Emissions during the decommissioning of Alternatives C, D1, and D2 would be similar to those of Alternative A except that the travel routes for Alternative C to the WTGs would shift slightly to the south. BOEM expects **minor** air quality impacts for the decommissioning phase of Alternatives C, D1, and D2.

Accidental air emissions due to collisions or spills and occasional corrective action activities, should they occur, would have the same impact as Alternative A: **negligible** air quality impact on the proposed Project area and surrounding region.

The impacts resulting from individual IPFs associated with Alternatives C, D1, and D2 would be very similar to those of Alternative A—**negligible** to **minor**. Alternative C may have slightly higher emissions due to increased travel routes and distance for construction and maintenance vessels because of the shift in the six northernmost turbine locations. Alternatives D1 and D2 could potentially have some slight change to where the emissions occur due to different travel patterns, and additional site characterization surveys may cause local temporary impacts that are difficult to detect. However, the resulting emissions from these alternatives would be very similar to those of Alternative A. No change in the assessed level of air quality impacts would occur. There would be a net **minor beneficial** impact on the air quality of the proposed Project area and the surrounding region for Alternatives C, D1, and D2.

In context of reasonably foreseeable environmental trends, impacts resulting from individual IPFs associated with Alternatives C, D1, and D2 would be very similar to those of Alternative A, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **minor** and **minor beneficial**). The overall reasonably foreseeable environmental trends and planned action impacts of Alternatives C, D1, and D2 on air quality would be of the same level as under Alternative A**—minor**. This impact rating is driven mostly by construction emissions.

As with Alternative A, the implementation of Alternatives C, D1, and D2 would result in a net decrease in overall emissions over the region compared to the installation of a traditional fossil-fuel power generating station. While some emissions might change due to modifications in planned construction activity, BOEM does not expect significant differences in air quality impacts for this alternative compared to Alternative A. As a result, BOEM anticipates that Alternatives C, D1, and D2 would have **minor** air quality impacts for a limited period and a net **minor beneficial** impact on the air quality of the proposed Project area and the surrounding region when compared to fossil-fuel power generating stations. Vineyard Wind's voluntary measures described above under Alternative A would be implemented, where possible, to ensure compliance with NAAQS in accordance with the OCS CAA permit. BOEM could implement dust control plans and other measures as described in Appendix D, where possible, to reduce potential impacts from construction activities and ensure compliance with NAAQS in accordance with the OCS CAA permit.

A.8.1.4. Consequences of Alternative E

Under Alternative E, up to 84 WTGs would be installed instead of the 100 WTGs, resulting in a reduction in the overall size of the proposed Project. The impacts under Alternative E alone would result in overall fewer emissions from construction and installation than Alternative A due to the use of smaller amounts of construction equipment that would reduce combustion emissions, and the decrease in vessel traffic and material handling, including potential reductions in excavation and vehicular dust that would minimize fugitive emissions. A smaller number of WTGs would also translate to a reduced number of emergency generation equipment, thus decreasing combustion emissions.

IPFs associated with the installation of no more than 84 WTGs, including air emissions, would be reduced by up to approximately 16 percent compared to the maximum-case scenario under Alternative A, namely 100 WTGs. As a result, BOEM anticipates **negligible** to **minor** air quality impacts for limited periods and a net **minor beneficial** impact on the air quality of the proposed Project area and the surrounding region for Alternative E.

Operations and maintenance activities of Alternative E would be the same as those of Alternative A except that activities may occur on a smaller scale, resulting in reduced air quality impacts. Although less than Alternative A, BOEM expects **minor** air quality impacts for Alternative E.

Emissions during the decommissioning phase of Alternative E would be less than emissions during the decommissioning phase of Alternative A due to the reduced scale of Alternative E. BOEM expects **minor** air quality impacts for the decommissioning phase of Alternative E.

As with Alternative A, the health benefits associated with offshore wind development for Alternative E would be the same as Alternative A, which would result in air quality health benefits and avoided premature deaths in the region due to the reduction in emissions associated with energy generation (Table A.8.1-3).

Accidental air emissions due to collisions or spills and occasional corrective action activities, should they occur, would have the same impact as with Alternative A—**negligible** air quality impact on the proposed Project area and surrounding region.

Changes to the design capacity of the WTG would not alter the maximum potential impacts on air because the maximum-case scenario involves assessing 84 WTGs, the maximum number for this analysis. Furthermore, the additional acreages required for the proposed onshore substation would not alter the air quality impacts.

In context of reasonably foreseeable environmental trends, impacts resulting from individual IPFs associated with Alternative E would be very similar to the impacts under Alternative A (with individual IPFs leading to impacts ranging from **negligible** to **minor** and **minor beneficial**). The overall reasonably foreseeable environmental trends and planned action impacts of Alternative E would be of the same level as under Alternative A—**minor**. This impact rating is driven mostly by construction emissions. Vineyard Wind's voluntary measures described above under the Proposed Action would be implemented, where possible, to ensure compliance with NAAQS in accordance with the OCS CAA permit. BOEM could implement dust control plans and other measures as described in Appendix D, where possible, to reduce potential impacts from construction activities and ensure compliance with NAAQS in accordance with the OCS CAA permit.

A.8.1.5. Consequences of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the lease area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile, northwest-southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTGs and a 12 to 61 percent increase in the size of the WDA, and therefore, a likely increase in the amount of inter-array cables. As stated previously, the geographic analysis area includes the airshed within 15.5 miles (25 kilometers) of each area potentially impacted by the proposed Project. As a result, and because WTGs would be relocated farther south of the WDA as a result of the transit lane, Alternative F, in combination with any other alternative or combination of alternatives, would expand the area of potential effect for air quality. The impacts of Alternative F alone on air quality would be similar to those of Alternative A and Alternative D2, but potentially with some slightly higher emissions due to increased travel routes and distance for construction and maintenance vessels. The northern transit lane could require up to 34 WTGs from the WDA to be shifted to the southern portion of the lease area, and require additional surveys. Such site characterization surveys may cause local temporary impacts that are difficult to detect; however, the resulting emissions would be similar to those of Alternative A and Alternative D2. No change in the assessed level of air quality impacts would occur. As a result, BOEM anticipates that there would be **negligible** to **minor** air quality impacts for limited periods and a net **minor beneficial** impact on the air quality within the proposed Project area and the surrounding region for Alternative F. The impacts from the combination of Alternative F with Alternative A or Alternative D2 alone are expected to be similar to combinations with the other action alternatives. Consequently, these other potential combinations are not separately analyzed here.

As with Alternative A, the health benefits associated with offshore wind development for Alternative F would be similar to Alternative A, which would result in air quality, health, and climate benefits, and avoided premature deaths in the region due to the reduction in emissions associated with energy generation (Table A.8.1-3 and A.8.1-4). However, the health and climate benefits associated with Alternative F would be less than Alternative A and result in diminished health and climate benefits and premature deaths avoided commensurate with the reduction in future offshore wind capacity.

BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521, and northwest through lease area OCS-A 0500. In context of reasonably foreseeable environmental trends, the impacts of Alternative F would be very similar to the planned action impacts under Alternative A (with individual IPFs leading to impacts ranging from **negligible** to **minor** and **minor beneficial**). The overall impacts of Alternative F combined with planned actions would be of the same level as under Alternative A—**minor**. This impact rating is driven by a blend of higher impacts during construction emissions to a minor beneficial impact during the operations phase.

BOEM has qualitatively evaluated the collective impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA’s suggestion, the WTGs for future offshore wind projects may need to be located farther from shore, similar to the proposed Project under Alternative F. As discussed in FEIS Section 3.12.2, if all the proposed transit lanes were implemented, this would not allow the technical capacity of offshore wind power generation assumed in FEIS Chapter 1 to be met. If in the future all six transit lanes were implemented, the overall number of WTGs would likely be less, but the additional transit lanes could require longer vessel trips for all phases of future projects (construction, operations, maintenance, and decommissioning). As would be the case for the proposed Project, other project infrastructure located farther from shore could also require longer timeframes for cable installation. These effects could result in more air emissions overall due to construction vessels transiting the OCS.

A.8.1.6. Comparison of Alternatives

As discussed, the impacts resulting from individual IPFs associated with Alternative A would not change substantially under Alternatives C through F, with **negligible** to **minor** air quality impacts for a limited time during construction, operations, and decommissioning phases. Alternatives C, D, and F may have slightly higher emissions than Alternative A due to increased travel distances for vessels and some shift in the locations of turbines and other offshore infrastructure. As a result, some additional air quality impacts may occur for Alternatives C, D, and F when compared with Alternative A. For Alternative E, BOEM expects lower air quality impacts than those of Alternative A due to a reduction in size of the wind energy project compared to the other alternatives. BOEM anticipates a net **minor beneficial** air quality impact as a result of Alternative A and any action alternative from a potential reduction in the need to install additional fossil-fuel power generating stations or modify existing fossil-fuel power generating stations.

Under any of the action alternatives, an 800 MW offshore wind facility would be built that would result in air quality health benefits and avoided premature deaths in the region due to the reduction in emissions associated with energy generation. While the air emissions profile for a particular grid region would affect the level of benefits experienced, a representative range of the potential annual health benefits (in dollars) and annual premature deaths avoided from an 800 MW offshore wind project is presented in Table A.8.1-3.

Air emissions and other IPFs in the context of reasonably foreseeable environmental trends from ongoing and planned actions, including Alternative A, could result in impacts whenever the resource is stressed before it has completely recovered from previous impacts. Reasonably foreseeable environmental trends and planned action impacts under any action alternative would likely be very similar because the majority of the impacts of any alternative come from other future offshore wind development, which does not change between alternatives. Because the emissions related to onshore and offshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. Thus, BOEM expects short-term transient increases in air quality impacts from the interaction of emissions at various locations within the air quality geographic analysis area. BOEM expects that in the context of reasonably foreseeable environmental trends from ongoing and planned actions, including Alternative A and action alternatives, would result in **negligible** to **minor** impacts. However, there would still be net **minor beneficial** air quality impacts. Since Alternative A and action alternatives in combination with other reasonably foreseeable offshore wind facility developments would provide additional power generation to the area and help states reach established renewable energy generation goals, existing fossil-fuel facilities may spend less time generating energy and additional fossil-fuel facilities may not be needed or would be limited, resulting in a net regional air quality benefit. BOEM expects that in the context of reasonably foreseeable environmental trends from ongoing and planned actions, including Alternative A and action alternatives, would result in short-term transient increases in air emissions; however, there would still be net **minor beneficial** air quality impacts. The overall level of impacts of any alternative would be **minor**, which is largely driven by construction emissions.

A.8.1.7. Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C, D2, and E with certain mitigation measures. While some emissions relative to the Preferred Alternative might change from Alternative A due to modifications in some construction activities and dust control plans, BOEM does not expect significant differences in air quality impacts. As a result, BOEM anticipates that the Preferred Alternative would have **minor** air quality impacts for limited periods and a net **minor beneficial** impact on the air quality and the surrounding region when compared to fossil-fuel power generating stations.

Table A.8.1-1: Summary of Activities and the Associated Impact-Producing Factors for Air Quality

Baseline Conditions: Air quality within a region is measured in comparison to the NAAQS, which are standards established by the USEPA pursuant to the CAA (42 USC § 7409) for criteria pollutants to protect human health and welfare. The criteria pollutants are CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, ozone, and lead. The overall geographic analysis area for air quality covers most of Rhode Island, southeastern Massachusetts eastward across Cape Cod, southward across Martha's Vineyard and over the open ocean south of Martha's Vineyard.

This air quality geographic analysis area is changed from that described in the DEIS due to removal of ports. At its nearest point, the WDA is just over 14 miles (23 kilometers) from the southeast corner of Martha's Vineyard, in Dukes County. All of southeastern Massachusetts is presently designated as unclassifiable or attainment for all criteria pollutants. The exception is Dukes County on Martha's Vineyard, which is designated as marginally nonattainment for the 2008 ozone NAAQS. This designation was based on data collected at the Herring Creek Road Aquinnah monitor (Monitor #25-007-0001) from 2009 to 2011, which showed a monitored concentration of 76 ppb versus the 2008 NAAQS of 75 ppb. While the 2008 NAAQS is still technically in effect, Dukes County was recently (August 2018) designated attainment against the more stringent 2015 ozone NAAQS of 70 ppb, based on the 2014 to 2016 monitored concentration of 64.3 ppb. Thus, while the 2008 designation has not yet been changed, monitored values in Dukes County have significantly improved since 2011 and are now in attainment with the 2008 ozone NAAQS standard.

The entire state of Rhode Island is currently in attainment for all criteria pollutants.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	Accidental releases of air toxics HAPs are due to potential chemical spills. Ongoing releases occur in low frequencies. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. According to the U.S. Department of Energy, 31,000 barrels (4.9 million liters) of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels (6.4 billion liters) of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and offshore it was up to less than 70,000 barrels.	Accidental releases of air toxics or HAPs would be due to potential chemical spills. Table A.8.2-1 provides a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. These may lead to short-term periods of toxic pollutant emissions through evaporation. Air quality impacts would be short-term and limited to the local area at and around the accidental release location.	Accidental releases of air toxics or HAPs would be due to potential chemical spills over the next 30 years infrequently during construction, but could also occur during operations. Up to about 246,069 gallons (931,473 liters) of coolants, 2,959,524 (11.2 million liters) of oils and lubricants, and 494,632 gallons (1.8 million liters) of diesel fuel would be contained in the 581 foundations (WTGs and ESPs) for the wind energy projects within the air quality analysis area, excluding the Proposed Action. These may lead to short-term periods of toxic pollutant emissions through evaporation. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. Accidental releases from future offshore wind development would not be expected to contribute appreciably to overall impacts on air quality.	Accidental releases of air toxics or HAPs would be due to potential chemical spills. The Proposed Action would have up to about 42,346 gallons (160,297 liters) of coolants, 506,559 gallons (1.9 million liters) of oils and lubricants, and 84,996 gallons (321,745 liters) of diesel fuel in its 102 foundations (WTGs and ESPs). These may lead to short-term periods of toxic pollutant emissions through evaporation. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. Accidental releases from future offshore wind development would not be expected to contribute appreciably to overall impacts on air quality. BOEM anticipates that these activities would have a **negligible** air quality impact on the proposed Project area and the surrounding region.	The accidental release of air toxics or HAPs from the Proposed Action would be due to potential spills. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. Air quality impacts due to accidental releases associated with the Proposed Action would be **negligible**. The impacts from ongoing activities and future non-offshore wind activities would also be due to the potential for chemical spills and may lead to short-term periods of toxic pollutant emissions through evaporation. Future offshore wind activities would contribute a small amount to the change in risk or impact on air quality as the frequency of accidental release events would be very small and likely infrequent. If a release were to occur, the air quality impact would be short-term and spatially limited. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. In context of reasonably foreseeable environmental trends, the combined accidental impacts on air quality are expected to be localized and temporary due to the likely limited extent and duration of a release. Accidental releases would not be expected to contribute appreciably to overall impacts on air quality. BOEM expects that impacts from ongoing and planned actions, including the Proposed Action, would have **negligible** impacts from this sub-IPF due to the short-term nature and localized potential effects, if they occur.
Air emissions: Construction and decommissioning	Air emissions originate from combustion engines and electric power generated by burning fuel. These activities are regulated under the CAA to meet set standards. Air quality has generally improved over the last 30 years; however, some areas in the Northeast have experienced a decline in air quality over the last 2 years. Some areas of the Atlantic coast remain in nonattainment for ozone, with the source of this pollution from power generation. Many of these states have made commitments toward cleaner energy goals to improve this, and offshore wind is part of these	The largest air quality impacts over the next 30 years would occur during the construction phase of any one project; however, projects would be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and would require offsets and mitigation. Primary emission sources would be increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from	Projects will be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and will require offsets and mitigation. Primary emission sources from future offshore wind activities would be increased commercial vessel traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment. The wind projects under development or planned within the air quality geographic analysis area are all located adjacent to each other and would increase the air quality impacts in general during the construction phase. The magnitude of the air quality emissions would vary and be dependent on which projects overlap during the construction	The Proposed Action would result in up to 325,255 tons of construction emissions. Because the construction and installation phase of the offshore components would likely not extend past 2 years and because the emissions would vary throughout the phase, BOEM does not expect projected air quality impacts to exceed the NAAQS for these pollutants. Overall, BOEM anticipates **minor** air quality impacts due to the construction and installation of offshore components due to the limited time of the activities. As the Proposed Action comes online, power generation emissions in the region overall would reduce emissions and this would contribute to a net benefit on air quality regionally.	The Proposed Action would result in 325,255 tons of construction emissions. Although there would be some air quality impacts due to various activities associated with construction and eventual decommissioning, these emissions would be relatively small and limited in duration. Overall, BOEM anticipates **minor** air quality impacts during the limited time of construction and installation of offshore components. The impacts from ongoing activities and future non-offshore wind activities would also result in construction-related emissions primarily from increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. Future offshore wind activities would contribute construction-related emissions, but would also be relatively small and limited in duration similar to the Vineyard Wind 1 Project. Short-term and variable collective impacts on air quality are possible during the construction and decommissioning phase. The overall construction-related air quality impacts due to offshore wind projects are anticipated to be small relative to larger emission sources such as fossil-fuel facilities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	goals. Primary processes and activities that can affect the air quality impacts are expansions and modifications to existing fossil-fuel power plants, onshore and offshore activities involving renewable energy facilities, and various construction activities.	construction-generated dust. As projects come online, power generation emissions overall would decline and the industry as a whole would have a net benefit on air quality.	phase. It is anticipated that Sunrise Wind and Revolution Wind projects would overlap within 1 year of the Proposed Action's construction phase. The other offshore wind projects within the air quality geographic analysis area would overlap during the operations phase. As projects come online, power generation emissions overall would decline and the industry as a whole would have a net benefit on air quality. For all the construction-phase emissions of criteria pollutants (CO, NO_X, PM_{10}, $PM_{2.5}$, SO_2, and VOCs) within the geographic analysis area, the percentage of CO is approximately 17%, NO_X is approximately 75%, particulates are approximately 5%, SO_2 is approximately 1%, and VOC are approximately 2% of the total construction criteria pollutant emissions (38,220 tons) for the construction phase. The CO_2 construction emissions make up the largest percentage of total construction-phase emissions, resulting in about 1.9 million tons of CO_2 emissions for the projects within the air quality geographic analysis area. Based on the assumed construction schedule presented in Appendix A Table A-4, projects within the analysis area would have overlapping construction periods beginning from 2023 through 2027.		In context of reasonably foreseeable environmental trends, the combined air emissions on air quality from ongoing and planned actions, including the Proposed Action, could generate up to approximately 2,215,929 tons of construction emissions within the air quality geographic analysis area between 2021 and 2030. The largest air quality impacts are anticipated during the construction phase with smaller and more infrequent impacts anticipated during decommissioning. The largest and most spatially widespread air quality impacts would occur during overlapping construction/ decommissioning phases of multiple wind projects. Based on the assumptions in Table A-6, the Vineyard Wind 1 Project, Sunrise Wind Project, and Revolution Wind are anticipated to overlap for 2 years of construction beginning in 2023, resulting in a total of about 10,362 tons of criteria pollutants and about 502,208 tons of CO_2 construction emissions. The other wind projects within the geographic analysis area would overlap with the Vineyard Wind 1 Project operations phase. Anticipated collective air quality impacts would be transient, small in magnitude, and localized. In context of reasonably foreseeable environmental trends, the combined air emissions on air quality from ongoing and planned actions, including the Proposed Action, from construction air emissions would be **minor** during construction and decommissioning. During overlapping construction activities there could be increased impacts, but these effects would be short-term in nature as the overlap in the air quality geographic analysis area would be limited in time.
Air emissions: O&M		Activities associated with operation and maintenance of onshore wind projects would have a proportionally very small contribution to emissions compared to the construction and decommissioning activities over the next 30 years. Emissions would largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions and small air quality impacts.	Operations and maintenance activities would have a proportionally very small contribution to emissions compared to the construction and decommissioning phases, but could occur each month during operations and maintenance. Emissions would largely be due to commercial vessel traffic and operation of emergency diesel generators. Such activities would result in short-term, intermittent, and widely dispersed emissions. Anticipated air quality impacts would be transient and small in magnitude. The largest air quality impacts would occur during overlapping operational activities. Anticipated air quality impacts would be transient and small in magnitude. Operational phase air emissions of criteria pollutants (CO, NO_X, SO_2, PM_{10}, $PM_{2.5}$, and VOC) within the air quality geographic analysis area show that most of the emissions would be from NO_X (412 tons per year [74% of the total operational criteria pollutant emissions]) and CO (105 tons per year [19% of the total operational criteria pollutant emissions]) due to	Operations and maintenance activities would have a proportionally very small contribution to emissions compared to the construction and decommissioning phases, but could occur each month during operations and maintenance. The air emissions from operation of the Proposed Action would begin in 2023 and continue through 2030. Emissions would largely be due to commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions. Anticipated air quality impacts would be transient, small in magnitude, and localized. Possible use of larger but fewer turbines would reduce the air quality impacts. The operations and maintenance of the Proposed Action would be less than the construction phase since it would only involve limited vessel and commercial traffic and operation of emergency equipment that would not occur frequently. The Proposed Action's incremental contribution of up to 5,583 tons per year of operations emissions, of which 96 tons per year would be from criteria pollutants, would be additive with the impact(s) of any and all	The operations and maintenance of the Proposed Action would generate fewer emissions than the construction phase since it would only involve limited vessel and commercial traffic and emergency equipment operation would occur infrequently. The Proposed Action would result in 5,583 tons per year of operations emissions during the proposed 30 years. BOEM anticipates that air quality impacts of operations and maintenance of the Proposed Action would be **minor**, occurring for short blocks of time several times per year. The impacts from ongoing activities and future non-offshore wind activities would largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activities would result in short-term, intermittent, and widely dispersed emissions and small air quality impacts. Future offshore wind activities would contribute operations-related emissions, but would have a proportionally very small contribution to emissions compared to the construction and decommissioning phases. Emissions would largely be due to commercial vessel traffic and operation of emergency diesel generators. In context of reasonably foreseeable environmental trends, the combined air emissions on air quality from ongoing and planned actions, including the Proposed Action, from operations and maintenance air emissions could be up to approximately 38,038 tons per year of operations emissions in the air quality geographic analysis area beginning in 2023 and continuing through 2030 (Table A-6). Emissions would largely be due to commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions. In context of reasonably foreseeable environmental trends, the combined air emissions on air quality from ongoing and planned

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			combustion emissions. The other criteria pollutants for the future offshore wind projects within the air quality geographic analysis area, such as PM_{10}, $PM_{2.5}$, and SO_2, each account for approximately 7% of the total operational emissions for all future offshore wind projects within the air quality analysis area.	other operations activities, including offshore wind activities, that occur within the air quality geographic analysis area. BOEM anticipates that air quality impacts of operations and maintenance of offshore components would be **minor**, occurring for short blocks of time several times per year during the proposed 30 years.	actions, including the Proposed Action, from operations and maintenance air emissions would be localized, transient, and **minor**. The largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the multiple wind projects within the air quality geographic analysis area. Additionally, some emissions associated with operations and maintenance activities could overlap with other projects' offshore construction-related emissions (Table A-6). A net improvement in air quality is expected on a regional scale as projects come online and offset emissions from fossil-fuel-type sources.
Air emissions: Power generation emissions reductions		Many Atlantic states have committed to clean energy goals, with offshore wind being a large part of that. Other reductions include transitioning to onshore wind and solar. The No Action Alternative without implementation of other future offshore wind projects would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. These types of facilities would likely have larger and continuous emissions and result in greater regional scale impacts on air quality.	Significant reductions in fossil-fuel-type emissions can result from the increases in renewable energy. Based on an analysis by Katzenstein and Apt (2009), CO_2 emissions can be reduced by up to 80% and NO_X emissions can be reduced up to 50% due to implementation of wind energy projects. A quantitative emissions inventory analysis is needed to more accurately assess these overall emissions reductions. Since fossil-fuel-type emissions are much higher than emissions due to renewable energy sources, a relatively small percentage reduction in fossil-fuel emissions can lead to much larger emissions reductions relative to the smaller emissions increases that would result from implementation of offshore wind projects.	Once operational, the Proposed Action would have annual avoided emissions of 1,632,822 tons CO_2, 1,046 tons NOx, and 855 tons SO_2. Accounting for construction emissions and assuming decommissioning emissions would be the same, the Proposed Action would offset emissions related to its development and eventual decommissioning within 8 years of operation, which is a conservative estimate;[7] from that point, the Proposed Action would be offsetting emissions that would otherwise be generated from another source. BOEM anticipates that air emissions would result in a small reduction of fossil-fuel emissions and would result in a **minor beneficial** impact on air quality.	The Proposed Action would result in avoided emissions that would be generated otherwise by another power source. Once operational, the Vineyard Wind 1 Project would avoid annual emissions of 1,632,822 tons CO_2, 1,046 tons NO_x, and 855 tons SO_2. BOEM anticipates that air emissions would result in a small reduction of fossil-fuel emissions and would result in a **minor beneficial** impact on air quality. The impacts from ongoing activities and future non-offshore wind activities would continue to contribute emissions from non-renewable sources until states meet their committed clean energy goals. Future offshore wind activities would contribute an increase in renewable energy production ultimately leading to reductions in fossil-fuel emissions similar to the Vineyard Wind 1 Project. Based on an analysis by Katzenstein and Apt (2009), CO_2 emissions can be reduced by up to 80% and NO_x emissions can be reduced up to 50% due to implementation of wind energy projects. Since fossil-fuel-type emissions are typically much higher than emissions from renewable energy sources, a relatively small percentage reduction can lead to much larger emissions reductions relative to the smaller emissions increases that would result from implementation of offshore wind projects. In context of reasonably foreseeable environmental trends, the combined air emissions on air quality from ongoing and planned actions, including the Proposed Action, would help to reduce fossil-fuel emissions and result in a net **minor beneficial** impact on air quality.

[7] Other estimates have found that the offset would exceed project emissions in as little as 4 years (Nugent and Sovacool 2014).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change	The construction, operation, and decommissioning of offshore wind projects would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects would likely decrease GHGs emissions by replacing energy from fossil fuels.	Development of future onshore wind projects would produce a small overall increase in GHG emissions over the next 30 years. However, these contributions would be very small compared to the aggregate global emissions. The impact on climate change from these activities would be very small. As more projects come online, some reduction in GHG emissions would be expected from modifications of existing fossil-fuel facilities to reduce power generation. Overall, it is anticipated that there would be no collective impact on global warming as a result of onshore wind project activities.	Development of offshore wind projects and the construction, implementation, operation, maintenance, and the eventual decommissioning would cause some minuscule GHG emissions increases primarily through emissions of CO_2. Overall there should be some net reduction on both GHG emissions and criteria pollutants, including ozone precursors such as NOx, through reduction in emissions from fossil-fuel power generating facilities. In general, the GHG emissions associated with the construction, maintenance, and eventual decommissioning of future offshore wind projects can be assumed to contribute to climate change. However, these contributions would be minuscule compared to the aggregate global emissions of GHGs; therefore, they cannot be deemed significant, if their impact could even be detected.	The construction, operation, and decommissioning activities associated with the Proposed Action would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects would likely decrease GHGs emissions by replacing energy from fossil fuels. In general, the GHG emissions associated with the construction, maintenance, and eventual decommissioning of the Proposed Action can be assumed to contribute to climate change. However, these contributions would be small compared to the aggregate global emissions of GHGs; therefore, they cannot be deemed significant, if their impact could even be detected. The additional GHG emissions anticipated from the Proposed Action over the 30-year period would have a **negligible** incremental contribution to existing GHG emissions. Therefore, the Proposed Action would have **negligible** impacts on climate change during these activities and an overall **minor beneficial** impact on both GHG emissions and criteria pollutants, including ozone precursors such as NOx, compared to a similarly sized fossil-fuel power generating station or to the generation of the same amount of energy by the existing grids.	The Proposed Action would produce GHG emissions as stated above; however, the contributions would be minuscule compared to aggregate global emissions. The additional GHG emissions anticipated from the Proposed Action over the 30-year period would have a **negligible** incremental contribution on existing GHG emissions. Therefore, the Proposed Action would have **negligible** impacts on climate change during these activities and an overall **minor beneficial** impact on GHG emissions compared to the generation of the same amount of energy by the existing grids. Because GHG emissions spread out and mix within the troposphere, the climatic impact of GHG emissions does not depend on the source location. Therefore, regional climatic impacts are a function of global emissions. Development of offshore wind projects and the construction, implementation, operation, maintenance, and the eventual decommissioning activities would cause some GHG emissions increases primarily through emissions of CO_2. However, these contributions would be minuscule compared to aggregate global emissions. In context of reasonably foreseeable environmental trends, the combined GHG emissions on air quality from ongoing and planned actions, including the Proposed Action, would likely result in a **minor beneficial** impact from the net decrease in both GHG emissions and criteria pollutants, including ozone precursors such as NO_x, as fossil-fuel-type facilities reduce operations as a result of increased energy generation from offshore wind projects. Overall, it is anticipated that there would be no collective impact on global warming as a result of offshore wind projects, including the Proposed Action alone, though they may beneficially contribute to a broader combination of actions to reduce future impacts from climate change.

% = percent; BOEM = Bureau of Ocean Energy Management; CAA = Clean Air Act; CO = carbon monoxide; CO_2 = carbon dioxide; DEIS = Draft Environmental Impact Statement; GHG = greenhouse gas; HAP = hazardous air pollutant; hazmat = hazardous materials; IPF = impact producing factor; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; O&M = operations and maintenance; $PM_{2.5}$ = particulate matter with diameters 2.5 microns or smaller; PM_{10} = particulate matter with diameters 10 microns or smaller; ppb = parts per billion; SO_2 = sulfur dioxide; USC = United States Code; USEPA = U.S. Environmental Protection Agency; VOC = volatile organic compounds; WDA = Wind Development Area

A.8.2. Water Quality

A.8.2.1. No Action Alternative and Affected Environment

This section identifies existing water quality in the geographic analysis area for water quality, as described in Table A-1 and shown on Figure A.7-15. Specifically, this includes a 10-mile (16.1-kilometer) radius around the WDA, the OECC, and vessel approach routes to port facilities that would be used by the proposed Project. Table A.8.2-1 describes baseline conditions and, based on the IPFs assessed, the impacts of ongoing and future offshore activities other than offshore wind on water quality, which is discussed below. This information comes primarily from the DEIS and SEIS, supplemented by information developed in responding to public comments and additional information.

The following are the key parameters characterizing ocean water quality, and are important measures of the ability to support and maintain a healthy ecosystem. Some of these parameters are accepted proxies for ecosystem health (e.g., dissolved oxygen [DO], nutrient levels), while others delineate coastal habitats from marine habitats (e.g., temperature, salinity):

- *Water temperature*: Water temperature heavily affects species distribution in the ocean. Large-scale changes to water temperature may impact seasonal phytoplankton blooms, an important part of New England marine ecosystems (Oviatt 2004).
- *Salinity*: Salinity, or salt concentration, also affects species distribution. In general, seasonal variation in the region is smaller than year-to-year variation and less predictable than temperature changes (Kaplan 2011).
- *Dissolved oxygen*: The amount of DO in water determines the amount of oxygen that is available for marine life to use. Temperature strongly influences DO content, which is further influenced by local biological processes. For a marine system to maintain a healthy environment, DO concentrations should be above 5 milligrams per liter (mg/L); lower levels may affect sensitive organisms (USEPA 2000).
- *Chlorophyll a*: Chlorophyll *a* is a measure of how much photosynthetic life is present. Chlorophyll *a* levels are sensitive to changes in other water parameters, making it a good indicator of ecosystem health. The USEPA considers estuarine and marine levels of chlorophyll *a* under 5 micrograms per liter (µg/L) to be good, 5 to 20 µg/L to be fair, and over 20 µg/L to be poor (USEPA 2015).
- *Turbidity:* Turbidity is a measure of water clarity. Turbid water lets less light reach the seafloor, which may be detrimental to photosynthetic marine life (CCS 2017). In estuaries, a turbidity level of 0 to 10 nephelometric turbidity units (NTU) is healthy while a turbidity level over 15 NTU is detrimental (NOAA 2018). Marine waters generally have less turbidity than estuaries.
- *Nutrients*: Key ocean nutrients include nitrogen and phosphorous. Photosynthetic marine organisms need nutrients to thrive (with nitrogen being the primary limiting nutrient), but excess nutrients can cause problematic algal blooms. Algal blooms can significantly lower DO concentration, and toxic algal blooms can contaminate human food sources. Both natural and human-derived sources of pollutants contribute to nutrient excess.

Large-scale regional water circulation is strongest in late spring and summer. The clockwise movement around Georges Bank and flow toward the equator dominates the regional water circulation (Gulf of Maine Census 2018). The edge of the continental shelf creates a shelf-break front that encourages upwelling. Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011). Appendix E includes additional regional setting information.

The water quality geographic analysis area is a typical subset of the regional setting and includes coastal waters in nearshore areas where bottom depth is less than 98.4 feet (30 meters) and marine waters in deeper offshore areas. The 98.4-foot (30-meter) isobath delineates between these ecologically distinct nearshore and offshore systems (FGDC 2012). The OECC is located entirely within coastal waters, and the WDA is located within marine waters. Coastal waters include the OECC, parts of navigation routes to access the WDA from shore, and ports that Vineyard Wind may use during construction, operations, maintenance, and decommissioning.

The export cable would pass through Nantucket Sound to link the WDA to the coast (Figure 2.1-2 in Chapter 2 of this FEIS). Water depth generally decreases with proximity to shore (COP Volume I, Section 2.1; Epsilon 2020a). Waters adjacent to Nantucket Island are Class SA water bodies, which are designated as “an excellent source of habitat for fish, other aquatic life and wildlife” (Appendix M in MMS 2009). Table A.8.2-2 shows ranges of water quality parameters taken from three locations in Nantucket Sound from 2010 to 2016. The large temperature range is due to the strong seasonality of New England waters; within-year data from 2016 at the same three stations demonstrate these seasonal patterns (CCS 2016a; 2016b; 2016c). Salinity levels have low variability. DO levels in Nantucket Sound show a small decrease in oxygenation from south to north, but are within healthy range. Local chlorophyll *a* levels are also highly seasonal; the chlorophyll *a* concentrations in Table A.8.2-2 likely reflect seasonal variation and difference in location. The north station has a significantly higher maximum nitrogen level, likely because this station is the closest to mainland Cape Cod and potentially subject to more sources of nitrogen influx such as discharge from estuaries and groundwater.

Table A.8.2-2: Ranges Observed in Nantucket Sound for Selected Water Quality Parameters (2010-2016)

Parameter	South	Central	North	Mean [a]
Temperature (°C)	8.7–22.8	8.2–24.2	9.9–26.3	19.2
Salinity (psu)	30.7–32.7	30.7–32.5	30.6–32.5	31.7
Dissolved oxygen (mg/L)	6.9–9.6	6.4–11.4	5.4–11.8	7.6
Chlorophyll *a* (µg/L) [b]	0.5–4.7	0.2–4.8	0.6–4.3	1.8
Turbidity (NTU)	0.1–3.2	0.1–2.3	0.1–2.2	0.7
Nitrogen (µM)	4.4–18.1	3.3–20.4	3.1–75.8	11.6
Phosphorous (µM)	0.3–1.6	0.2–1.9	0.3–2.6	0.8

Source: Modified from COP Table 5.2-1 (Volume III; Epsilon 2020b); originally obtained from buoy data from the Center for Coastal Studies from 2010-2016. The specific stations sampled are South = Station NTKS_1; Central = NTKS_6; North = Station NTKS_1. COP Figure 5.2-1 shows locations for each buoy (Volume III.; Epsilon 2020b)

°C = degrees Celsius; µg/L = microgram per liter; µM = micromolar; mg/L = milligrams per liter; NTU = nephelometric turbidity units; psu = practical salinity units

[a] “Mean” is an unweighted mean combining the calculated means for all three stations.

[b] Chlorophyll *a* values in the COP are incorrectly described as being in mg/L but are actually given in µg/L.

Average DO concentration in Narragansett Bay from 2005 through 2015 ranged from an average of 3.4 (in the Seekonk and Providence Rivers) to 4.8 (in the Lower Bay); hypoxic events, which typically occur at the bottom, reduce these averages (NBEP 2017). Average summer surface temperature during the same study ranged from 21.1 to 24.2 degrees Celsius (°C); salinity ranged from 23.7 to 28.4. Narragansett Bay’s history of good water clarity has fluctuated in recent years. Chlorophyll concentrations are seasonal and decrease from north to south; it can be greater than 60 µg/L in the Seekonk River (nearest nutrient sources) during the growing season, but sampling in the lower Bay has found concentrations of 5 to 20 µg/L and below (NBEP 2017).

The WDA is 75,614 acres (306 km^2) and located in marine waters, approximately 14 miles (22.5 kilometers) south of Nantucket and Martha’s Vineyard at its nearest point. Water depths in the WDA range from approximately 115 to 161 feet deep (approximately 35 to 49 meters) (COP Volume I; Epsilon 2020a). Offshore temperatures also vary with depth and season due to seasonal thermoclines (Ullman and Codiga 2010), shown in Table A.8.2-3. DO concentration in temperate climates generally decreases with depth and changes seasonally with temperature: it is highest in winter and lowest in the summer and fall (Ullman and Codiga 2010). DO concentration in 2016 (the most recent available year) fell during May through late summer as waters warmed, and rose in late September as waters cooled (CCS 2016a; 2016b; 2016c). Ullman and Codiga (2010) found turbidity near the proposed Project area ranged from 0.25 to 0.5 NTU in September, March, and June, but in December increased to a range of 0.75 to 1.25 NTU. Nutrient concentrations in the Project area are not well sampled.

Table A.8.2-3: Seasonal Ranges Observed near the WDA for Selected Water Quality Parameters

Season	Surface Temp (°C)	Bottom Temp (°C)	Surface Salinity (psu)	Bottom Salinity (psu)	Chlorophyll *a* (µg/L)
Spring	6.3	7.2	32.9	33.5	0.7-1.6
Summer	na	na	na	na	0.4-1.0
Fall	17.5	12.7	32.9	33.4	0.9-1.9
Winter	5.4	7.5	32.9	33.8	0.9-2.4

Source: Modified from COP Table 5.2-2 (Volume III; Epsilon 2020b) for temperature and salinity and from Figure 4-3 in BOEM 2014b for chlorophyll *a*. Collection dates and locations are described by their respective sources. Chlorophyll *a* data solely represent the range at the surface. The study that collected the temperature and salinity data did not sample during the summer.

°C = degrees Celsius; µg/L = microgram per liter; na = not available; psu = practical salinity units

As shown on Figure 2.1-1 in Chapter 2 of this FEIS, Vineyard Wind's landfall location is Covell's Beach in Barnstable, which would then continue underground to the proposed substation site. An onshore export cable would connect the landfall site to a new onshore substation in Barnstable, which would connect to the existing power grid at the Barnstable Switching Station. The onshore substation site is located in a Wellhead Protection District (Town of Barnstable 2016).

A portion of the proposed western OECR may cross into the Lewis Bay Watershed, which the Massachusetts Department of Environmental Protection considers impaired due to excessive nitrogen (from septic systems, stormwater, and fertilizers). This impairment has resulted in loss of eelgrass beds, periodic algae blooms, drops in DO concentration, and reduction in benthic diversity (Cape Cod Commission 2017a). Parts of the proposed western OECR may also cross into the Centerville River Watershed (the Covell's Beach landfall site is near the border of this watershed), which is also designated as impaired due to nitrogen excess (Cape Cod Commission 2017b). Cape Cod Commission's Watershed Reports (2017a, 2017b) and the Total Maximum Daily Load reports (MassDEP 2007, 2015) provide detailed information on sources and levels of contamination within each watershed.

The MCT is the primary port identified to support proposed Project activities; four additional ports in Narragansett Bay and several other commercial seaports in the region may also be used (COP Tables 3.2-1 and 3.2-2, Volume I; Epsilon 2020a). These ports are located within protected embayments and urban estuaries that typically have worse water quality conditions than waters farther offshore (e.g., in Buzzards Bay or Nantucket Sound) due to groundwater discharge, which results in nutrient pollution and other water quality issues. The MCT is located in the estuarine section of the Acushnet River, in lower New Bedford Harbor. New Bedford Harbor is the most urbanized and contaminated area in Buzzards Bay (Pesch et al. 2011). Inner New Bedford Harbor was given a score of 44.9 (Fair) out of 100 in the Buzzards Bay Coalition's Bay Health Index score, which combines water turbidity, nitrogen levels, DO concentration, and algae content. Outer New Bedford Harbor had a score of 67 (Good), while the Acushnet River had a score of 17.4 (Poor) (Buzzards Bay Coalition 2011).

Northeastern coastal waters in general are experiencing a long-term warming trend; average temperatures from 1980 to 2005 are 0.5 to 1.3°C warmer than average temperatures from 1890 to 1905. The warming trend in surface temperature is greater than warming in local air temperature over the same period, suggesting that changes in water temperature in the nearby Gulf of Maine are not caused by local air temperature, but by movement of warmer water from other waterbodies that have shown warming trends in both sea-surface temperature and air temperature (Shearman and Lentz 2010).

Nutrient overloading in estuaries and coastal waters goes back several decades, and increased coastal development on Cape Cod is causing increased nutrient pollution in communities, approximately 80 percent of which is due to groundwater contamination by septic systems (Cape Cod Commission 2013). Both development and increased boat traffic contribute to other contaminant levels, and these would continue regardless of the offshore development.

In the geographic analysis area for water quality, non-Project impacts on water quality include terrestrial runoff, terrestrial point source discharges, and atmospheric deposition. Additional activities that impact the water quality condition include urbanization; forestry practices; municipal waste discharges; agriculture; marine vessel traffic-related discharges; wastewater; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; military and National Aeronautics and Space Administration (NASA) operations; renewable energy development; natural events; and climate change. Ongoing water quality impacts, especially from dredging and harbor, port, and terminal operations, would continue regardless of offshore development and are expected to be localized and temporary to permanent, depending on the nature of the activities and associated IPFs.

Under the No Action Alternative, the proposed Project would not be built. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project (Section A.8.2.2) would not occur as proposed. Impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur (Table A.8.2-1). The following analysis addresses reasonably foreseeable offshore wind projects (or portions of projects) that fall within the geographic analysis area and considers the assumptions included in Section 1.7 and here in Appendix A. The analysis assumes that state offshore wind power demand could not be accommodated entirely by projects in the geographic analysis area for water quality, and the analysis does not include the impacts associated with the proposed Project. Therefore, the impacts on water quality would be similar, but the exact impact would not be the same due to temporal and geographical differences. As described in FEIS Chapter 3, BOEM assumes that the impacts on resources with a “restricted” geographic analysis area, such as water quality, would not be equal with or without the Proposed Action. In the absence of the Proposed Action, BOEM assumes that the total generating capacity of offshore wind facilities in the geographic analysis area would be 3,526 MW, 800 MW less than if the Proposed Action were approved.

A.8.2.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects future offshore wind activities to affect water quality through the following primary IPFs.

Accidental releases: Future offshore wind activities could expose coastal offshore waters to contaminants (such as fuel, sewage, solid waste, or chemicals, solvents, oils, or grease from equipment) in the event of a spill or release during routine vessel use. Future offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. During the construction period for an individual project (estimated to be 2 years), an average of 25 and a maximum of 46 vessels may be present in the WDA or OECC; this could occur for an estimated 6 to 10 projects. Vessel activity associated with construction is expected to occur regularly in the RI and MA Lease Areas beginning in 2022 and continuing through 2027 and then lessen to near-baseline levels during operation activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic in the region associated with construction for the future offshore wind scenario could increase the probability of collisions and allisions, which could result in oil or chemical spills.

Using the assumptions in Table A-4, up to about 154,144 gallons (583,499 liters) of coolants and 1.4 million gallons (5.3 million liters) of oils and lubricants will be contained in the construction of 373 foundations (WTGs and ESPs) for the wind energy projects within the water quality geographic analysis area. If lease areas within the water quality geographic analysis area are developed, there is a low risk of a leak from any of the approximately 364 WTGs, each of which stores approximately 3,830 gallons (about 14,500 liters) of oil mixture. It is assumed that each WTG would contain approximately 1,717 gallons (6,500 liters) of transformer oil, 2,113 gallons (8,000 liters) of general oil (for hydraulics and gearboxes), and 423 gallons (1,601 liters) of coolants. Each ESP (nine) would contain a maximum of approximately 123,559 gallons (467,720 liters) of oils and lubricants and 46 gallons (174 liters) of coolants. The estimated total amount of the fluids housed at the ESPs under the No Action Alternative would be approximately 534,551 gallons (2.0 million liters) of oils and lubricants and 199 gallons (753 liters) of coolants. The total quantity of diesel fuel for all WTGs and ESPs would be 313,617 gallons (1.2 million liters) for the 373 foundations. The smallest fuel tanker operating in these waters (a general purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million to 30.3 million liters) and the total chemical storage capacity under the No Action Alternative (2,398,190 gallons [9.1 million liters]) is similar to, or less than, the volumes being transported by ongoing activities, depending on the actual sizes of vessels transiting the area (U.S. Energy Information Administration 2014).

BOEM has conducted extensive modeling to determine the likelihood and effects of a chemical spill at offshore wind facilities at three locations along the Atlantic Coast, including an area near the proposed Project area

(Bejarano et al. 2013). Results of the model indicated a catastrophic, or maximum-case scenario, release of 128,000 gallons (484,533 liters) of oil mixture has a “Very Low” probability of occurring, meaning it could occur one time in 1,000 or more years. In other words, the likelihood of a given spill resulting in a release of the total container volume (such as from a WTG, ESP, or vessel) is low. The modeling effort also revealed the most likely type of spill (i.e., non-routine event) to occur is from the WTGs at a volume of 90 to 440 gallons (341 to 1,666 liters), at a rate of one time in 1 to 5 years, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 20 years. The likelihood of a spill occurring from multiple WTGs and ESPs at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. The modeling effort was conducted based on information collected from multiple companies and projects and would therefore apply to the 7 to 10 other projects within the Northeast region assumed in BOEM’s water quality geographic analysis area. For the purposes of this discussion, small-volume spills equate to the most likely spill volume between 90 and 440 gallons (341 to 1,666 liters) of oil mixture or up to 2,000 gallons (7,571 liters) of diesel fuel, while large-volume spills are defined as a catastrophic release of 128,000 gallons (484,533 liters) of material, based on modeling conducted by Bejarano et al. (2013). Small-volume spills could occur during maintenance or transfer of fluids, while low-probability small- or large-volume spills could occur due to vessel collisions, allisions with the WTGs/ESPs, or incidents such as toppling during a storm or earthquake.

The likelihood of a spill occurring during construction is low, as BOEM anticipates small vessel allisions would not cause significant damage to ESPs or WTGs. Vessels would likely have their own onboard containment measures that would further reduce the impact of an allision. The model calculates the likelihood of allision with a WTG by assuming 30 miles of exposed WTGs that could potentially be struck by an off-course vessel. However, the likelihood of a vessel crossing into the row of WTGs and actually hitting a WTG is low because a vessel is more likely to pass between the WTGs than allide with them. The likelihood of a vessel crossing into the WTG line and alliding with a WTG in any one lease area is 14.5 percent (Section 3.2.6 in Bejarano et al. 2013). Due to the low likelihood of a large (i.e., catastrophic) or small (most likely) spill for offshore wind projects, impacts on water quality from future offshore wind activities alone via spills during construction are expected to be adverse and short-term. Small volume spills are more likely to occur and would have localized impacts on water quality. In the unlikely event an allision or collision involving project vessels or components resulted in a large spill, impacts on water quality would be adverse and short-term to long-term, depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. Impacts from spills during decommissioning would be similar in nature to construction, but smaller in magnitude because fewer vessels would be used.

Under normal operations, the WTGs and ESPs are self-contained and do not generate discharges except under highly unusual circumstances. Therefore, during operations, if a spill of the most likely volume (90 to 440 gallons [341 to 1,666 liters]) did occur, localized impacts would be temporary and short-term due to dispersion in the surrounding waters. The impacts would vary depending on the spill size, type of material, and conditions at the location of the spill. Table A.8.2-4 presents a selection of potential spill-causing events and their calculated probabilities for an individual lease area.

Table A.8.2-4: Selected Estimated Annual Incident Rates Modeled for the Rhode Island Lease Areas

Incident Type	Estimated Annual Incident Rate	Estimated Years Between Incidents
Small vessel allision	0.29	3.45
Large vessel allision	0.22	4.55
Large vessel multiple WTG (5) allision	0.04	25.00
Seismic event over 5.0	0.0014	714.29
Seismic event over 7.0 and tsunami	0.00006	16,666.67
Storm exceeding Category 3	0.04545	22.00
Transfer error	0.01	100.00

Source: Modified from Tables 3.14, 3.16, 3.17, and 3.19 in Bejarano et al. 2013, which models incident rates in the Deepwater Wind Lease Area which is the Rhode Island Lease Areas. The Rhode Island Lease Areas are OCS-A 0486, OSC-A 0487, OCS-A 0500, and OSC-A 0517 situated west of the Vineyard Wind lease area as shown on Figure 1.1-1 (Section 1.1).

Note: Bejarano et al. (2013) and the COP refer to the Deepwater Wind Lease Areas as the Rhode Island-Massachusetts WEA.

Other chemicals would also be used at the offshore wind projects, including, but not limited to, grease, paints, and sulfur hexafluoride. While anti-fouling paint is not necessary on most parts of the WTG and ESP foundations, anti-fouling paint may be used at each foundation in the immediate area of the opening for the cable pull-in (within an approximately 4-foot [1.2-meter] diameter circle centered on the opening for the cable). A release of any of these small amounts of materials during construction or operation would be localized and short-term, and would result in little change to water quality.

All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by USCG and the Bureau of Safety and Environmental Enforcement (BSEE). Oil Spill Response Plans are required for each project and would provide for rapid spill response, clean-up, and other measures that would help to minimize potential impact on affected resources from spills.

The use of heavy equipment onshore could result in potential spills during use or refueling activities. Onshore construction and installation activities and associated equipment would involve fuel and lubricating and hydraulic oils.

Trash and debris may be accidentally discharged from vessels supporting the construction, operation, and decommissioning of offshore wind projects, which are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.

Accidental releases of fuel/fluids/hazardous materials and/or trash and debris may increase and would primarily occur during construction, but also during operations and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases.

In summary, due to the low likelihood of a spill occurring and the expected size of the most likely spill, the overall impact of accidental releases is anticipated to be short-term and localized, resulting in little change to water quality. As such, accidental releases from future offshore wind development would not be expected to contribute appreciably to overall impacts on water quality.

Anchoring: Where future offshore wind activities overlap the water quality geographic analysis area, there would be increased anchoring of vessels during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. In addition, there could be increased anchoring/mooring of met towers or buoys. BOEM estimates that 86 acres (0.3 km^2) of seabed would be disturbed by anchoring associated with future offshore wind activities and cause temporary increases in suspended sediment and turbidity levels. These disturbances would be local and limited to the anchorage area. High suspended sediment concentrations (between 45 and 71 mg/L) already occur in Nantucket Sound due to natural tidal conditions, and increase during storms, trawling, and vessel propulsion. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement, and would therefore be unlikely to have an incremental impact beyond the immediate vicinity. If multiple projects are undergoing construction during the same period, the impacts would be greater than for one project, and multiple areas would experience water quality impacts from anchoring but, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically.

Due to the current ambient conditions and the localized area of disturbances around each of the individual anchors, the overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be adverse, localized, and short-term, resulting in little change to ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

New cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. Using the assumptions in Table A-4, future offshore wind development would result in seabed disturbance of about 1,015 acres (4.1 km^2) during offshore cable installation and 875 acres (3.5 km^2) during inter-array installation. Sediment transport modeling was conducted for the Proposed Action; based on what is known about other offshore wind projects within the water quality geographic analysis area, the modeling results would likely also be applicable to these projects. The modeling results from pre-cable installation dredging show that sediment concentrations greater than 10 mg/L could extend up to 10 miles

(16.1 kilometers) from the site and spread throughout the water column (Attachment F in Epsilon 2018c). These plumes typically settle within 3 hours but could persist in small areas (15 acres [60,702.8 square meters (m^2)] or less) for 6 to 12 hours (Epsilon 2018c). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). It is expected that future offshore wind projects within the water quality geographic analysis area will use dredging only when necessary and rely on other cable laying methods for reduced impacts (such as jet plow or mechanical plow). The modeling results specific to cable installation indicate impacts would remain within the lower portion of the water column (from 0 to 9.8 feet [0 to 3 meters] above the seafloor), and the portion of the plume that could exceed 10 mg/L would likely only extend 656 feet (200 meters) from the impact area, but could extend up to 1.2 miles in the water column (2 kilometers). While new cable emplacement would disturb bottom sediment and result in temporary increases in suspended sediment, these disturbances would either be limited to the emplacement corridor or fairly localized. The majority of potential impacts within the Northeast lease areas resulting from cable laying activities would fall within the range of variability caused by tidal currents, storms, trawling, and vessel propulsion (Appendix H in MMS 2009).

Due to the current ambient conditions, localized areas of disturbances, and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance is anticipated to be localized, short-term, and adverse, resulting in little change to ambient water quality. If multiple projects are being constructed at the same time (Table A-6), the impacts would be greater than those identified for one project and would likely not overlap each other geographically due to the localized natures of the plumes. New cable emplacement and maintenance activities would not be expected to appreciably contribute to overall impacts on water quality.

Port utilization: Future offshore wind development could include port expansion/modification that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during port use as a result of increased vessel traffic. Vessel traffic would peak during construction activities and decrease during operations, but increase again during decommissioning. In addition, any related port expansion and construction activities, including channel deepening, related to the additional offshore wind projects would add to increased suspension and turbidity in the coastal waters. The increased sediment suspension could be long-term depending on the vessel traffic increase. Construction activities would occur beginning in 2022 and continuing through 2030 (Table A-6); the overall impact on water quality from port utilization would primarily be limited to that timeframe. Following construction and moving into normal operations, vessel activity would decrease to near-baseline conditions. Vessel use during operation would consist of scheduled inspection and maintenance activities (an example schedule is provided in COP Volume I, Figure 4.3-1; Epsilon 2020a), with corrective maintenance as needed. Vessel activity would then increase again during decommissioning. This increase in traffic could result in suspension of sediments leading to turbidity increases and the potential for accidental discharges (such as trash, debris, fuels, and other liquids). During future project operations, the Vineyard Haven port would be utilized. Depending on the amount of use and associated vessel traffic, increased turbidity could occur.

Due to construction timeframes and decreased operational traffic, the overall impact of accidental spills and sedimentation during port utilization is anticipated to be localized, short- to long-term, and adverse resulting in little change to water quality. Port utilization would not be expected to appreciably contribute to overall impacts on water quality.

Presence of structures: Using the assumptions in Table A-4, the presence of up to 373 structures in the water quality geographic analysis area and could result in alteration of local water currents (Chakrabarti 1987; COP Volume III, Epsilon 2020b). These disturbances would be localized but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes. In addition, future offshore wind activities would result in 317 acres (1.3 km^2) of impact from installation of foundations and scour protection and 537 acres (2.2 km^2) of impact from hard protection for the offshore export cables and inter-array cables.

For offshore wind facilities in Europe, scour processes have been a concern due to the potential impacts on water quality through the formation of sediment plumes (Harris et al. 2011). However, European offshore wind facilities are generally located at shallower depths with tidally dominated currents. BOEM anticipates the scour potential for the proposed Project would be significantly less than the European offshore wind facilities due to the difference in local hydrodynamic forces (COP Volume III, Section 2.1, Appendix III K; Epsilon 2020b). The WTG and ESP foundations would result in some alteration of local water current leading to increased movement, suspension, and deposition of sediments. Significant scour is not expected in the water quality geographic analysis area even without scour protection due to the low current speeds and minimal seabed mobility in the WDA (COP Volume II-A, Section 3.2.2; Epsilon 2018a). Scouring processes are more prevalent in portions of the proposed OECC in shallower water where tidal current flow can have a greater effect, but the buried depth of cables would likely be below the mobile sand layer in hard- and soft-bottom areas. Where burial is not possible in hard-bottom areas, the addition of cable armoring and the coarseness of the local sediment are anticipated to prevent scour (COP Volume III, Section 3.2.1 and 3.2.2, Appendix III-K; Epsilon 2020b). BMPs would be in place to mitigate scour, which would minimize impacts on water quality and facilitate the return to baseline conditions following construction; therefore, no long-term water quality impacts are expected. This scour protection would be removed during decommissioning, which would lead to sediment resuspension from vessel activity and bottom disturbance. However, the disturbance is expected to be less than that which would occur during construction because there is no cause for disturbance along the OECC. The disturbance associated with decommissioning would occur regularly over a 7- to 10-year period for the various offshore wind projects, but would be localized and temporary due to hydrodynamic forces in the area and would quickly return to baseline conditions.

In addition, structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016; Cazenave et al. 2016). Alterations in currents and mixing would affect water quality parameters, such as temperature, DO, and salinity, but would vary seasonally and regionally.

Due to the use of BMPs and the low scour potential, the overall impact of changes in local water currents and sedimentation from presence of structures is anticipated to be interim over the life of the offshore wind projects, and localized, resulting in little change to water quality. Additionally, impacts on various water quality parameters due to changes in local water currents and vertical mixing are anticipated to be interim over the life of the offshore wind projects and localized. Presence of structures would not be expected to appreciably contribute to overall impacts on water quality.

Discharges: Future offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with future offshore wind project construction is expected to occur regularly in the RI and MA Lease Areas beginning in 2022 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Future offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be staggered over time and localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162. Furthermore, each project’s vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with future offshore wind projects, BOEM expects that impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

One active dredged material ocean disposal site is in the area, which could be used for ocean dumping/dredge disposal. Impacts on water quality from ocean disposal would be minimized because approval for dredged material disposal is regulated by the U.S. Army Corps of Engineers (USACE), and the USEPA enforces spoil criteria for permits issued by the USACE. If dredged material disposal occurs, sediment suspension would occur above baseline levels on a localized and short-term basis.

Due to the staggered increase in vessels from various projects, the current regulatory requirements administered by the USEPA, USACE, USCG, and BSEE, and the restricted allowable discharges, the overall impacts of discharges from vessels is anticipated to be localized and short-term. Based on the above, the level of impact in the water quality geographic analysis area from future offshore wind development would be similar to existing conditions and would not be expected to appreciably contribute to overall impacts on water quality.

Land disturbance: Future offshore wind development could include onshore components that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during the construction and installation of onshore components (e.g., equipment, substation). Construction and installation of onshore components near waterbodies may involve ground disturbance, which could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially erode the soils, resulting in sedimentation of nearby surface waters and subsequent increased turbidity. Erosion and sedimentation controls would likely be implemented during the construction period to minimize impacts, resulting in infrequent and temporary erosion and sedimentation events.

In addition, onshore construction and installation activities would involve the use of fuel and lubricating/hydraulic oils. Use of heavy equipment onshore could result in potential spills during active use or refueling activities. It is assumed that a Spill Prevention, Control, and Countermeasure Plan would be prepared for each project in accordance with applicable regulatory requirements, and would outline spill prevention plans and measures to contain and clean up spills if they were to occur. Additional mitigation and minimization measures (such as refueling away from wetlands, waterbodies, or known private or community potable wells) would be in place to decrease impacts on coastal water quality. Impacts on water quality would be limited to periods of onshore construction and periodic maintenance over the life of each project.

Overall, the impacts from onshore activities that occur near waterbodies could result in temporary introduction of sediments or fluids into coastal waters in small amounts where erosion and sediment controls fail. Land disturbance for future offshore wind developments that are located at a distance from waterbodies and that implement erosion and sediment control measures would be less likely to impact water quality. In addition, the impacts would be localized to areas where onshore components were being built near waterbodies. While it is possible that multiple projects could be under construction at the same time, the likelihood that construction of the onshore components overlaps in time or space is minimal, and the total amount of erosion that occurs and impacts on water quality at any one given time could be minimal. Land disturbance from future offshore wind development is anticipated to be localized and short-term, and would not be expected to appreciably contribute to overall impacts on water quality.

A.8.2.1.2. Conclusions for the No Action Alternative

Under the No Action Alternative, water quality would continue to follow current regional trends and respond to current and future environmental and societal activities.

While the proposed Project would not be built as proposed under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have temporary impacts on water quality primarily through accidental releases, increased anchoring, new cable emplacement and/or maintenance, port utilization, presence of structures, discharges, and land disturbance. BOEM anticipates that the impacts of ongoing activities, such as vessel traffic, military use and survey, commercial activities, recreational activities, and ground disturbance, would be **minor**. In addition to ongoing activities, reasonably foreseeable activities other than offshore wind may also contribute to impacts on water quality. Reasonably foreseeable activities other than offshore wind include increasing vessel traffic, new submarine cables and pipelines, increasing onshore construction, marine surveys, marine minerals extraction, port expansion, and the installation of new offshore structures (Table A.8.2-1). BOEM anticipates that the impacts of reasonably foreseeable activities other than offshore wind would be **minor**. BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **moderate** impacts on water quality, primarily driven by vessel traffic and associated accidental releases.

During the construction period for an individual project (estimated to be 2 years), an average of 25 and a maximum of 46 vessels may be present in the WDA or OECC; this could occur for an estimated 6 to 10 projects. Vessel activity associated with construction of these projects is expected to occur regularly in the RI and MA Lease Areas beginning in 2022 and continuing through 2030, and then lessen to near-baseline levels during operation activities. This increase would not lead to long-term alterations to water quality within the coastal and offshore waters because the hydrodynamic forces within the WDA lead to efficient dispersion of suspended sediments. The potential impacts from all of these activities would be minimized through the regulations administered by the USEPA, USACE, USCG, and BSEE. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area would result in **minor** impacts due to cable emplacement and maintenance, port utilization, presence of structures, and discharges. These activities affect offshore water quality through either sediment suspension and turbidity or potential spill and marine debris risks. Construction and decommissioning activities associated with future offshore wind activities would lead to temporary and localized increases in sediment suspension and turbidity in the WDA during the first 6 to 10 years of construction of projects and in the latter part of the 30-year life spans of offshore wind projects due to decommissioning activities. However, based on ambient conditions and the results of modeling (Epsilon 2018c), the turbidity increases projected from construction are not expected to exceed the present baseline conditions in the northeast lease areas, and the amount of turbidity in the area would be similar to preexisting conditions.

A.8.2.2. Consequences of Alternative A

The following proposed-Project design parameters (Appendix G) would influence the magnitude of the impacts on water quality:

- The amount of vessel use during installation, operations, and decommissioning.
- The number of WTGs and ESPs and the amount of cable laid determines the area of seafloor and volume of sediment disturbed by installation. Representing the maximum-case scenario, a maximum of 100 WTGs installed, one large 800 MW ESP or two 400 MW ESPs, 171 miles (275 kilometers) of inter-array cable, and 98 miles (158 kilometers) of export and inter-link cable would be installed in the WDA (Appendix G).
- Installation methods chosen and the duration of installation.
- Proximity to sensitive groundwater or surface water sources and mitigation measures used for onshore proposed-Project activities.
- In the event of a non-routine event such as a spill, the quantity and type of oil, lubricants, or other chemicals contained in the WTGs, vessels, and other proposed-Project equipment.

Changes to the design capacity of the turbine would not alter the maximum potential water quality impacts for Alternative A and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the PDE. Changes to the proposed onshore substation site could modify the impacts of Alternative A and all other action alternatives on water quality; however, the expansion area does not appear to be located within any U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory mapped wetlands and/or streams and would not likely affect any other special aquatic sites as defined by the Clean Water Act, and impacts would likely be **negligible** with implementation of BMPs or mitigation measures during construction.

Impacts from Alternative A alone would include temporary consequences resulting from accidental releases, increased turbidity, sediment deposition, and erosion and sedimentation. Other impacts associated with Alternative A may occur as a consequence of routine activities after Vineyard Wind completes construction, although the overall impact on water quality is likely to be **minor**, based on the temporary nature of activities and the relatively small analysis area compared to the larger ocean.

Alternative A would likely result in impacts (e.g., accidental releases, vessel discharges, seafloor disturbance) that are expected to be local and that would not alter the overall character of water quality in the geographic analysis area. Impacts would be adverse, but overall the impacts of Alternative A alone on water quality would be **negligible** to **moderate**.

Alternative A would contribute to impacts through all of the IPFs named in Section A.8.2.1.1. The most impactful IPFs would likely include new cable emplacement/maintenance that could cause noticeable temporary impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredged material disposal.

Other IPFs would likely contribute impacts of lesser intensity and extent, primarily during construction, but also during operations and decommissioning (Table A.8.2-1).

Routine activities that would impact offshore water quality from Alternative A alone include Proposed Action-related vessel activity (and associated vessel discharges, such as bilge, ballast water, trash, and sanitary waste) and, to a lesser extent, activities that disturb the seafloor. Vessel discharges can introduce contaminants to the water column, while activities that disturb the seafloor cause temporary sediment suspension and turbidity.

Accidental releases: Alternative A would have a maximum of 5,046 gallons (19,101 liters) of oils, lubricants, diesel fuel, and coolant per turbine (504,600 gallons [1.9 million liters] total), and a maximum of 129,301 gallons (489,458 liters) for 800 MW ESP storage (COP Volume I; Epsilon 2020a). As discussed previously, the risk of a spill from any single offshore structure would be low, and any effects would likely be localized. A reduction in the number of WTGs required due to increased capacity would result in a smaller total amount of materials being stored offshore. Modeling conducted for an area near the proposed Project area indicates that the most likely type of spill (i.e., non-routine event) to occur during the life of a project is 90 to 440 gallons (341 to 1,666 liters), which would have brief, localized impacts on water quality (Bejarano et al. 2013). The models used in this analysis incorporated extensive information from the Rhode Island Lease Areas and the project parameters used in the Cape Wind Project Final Environmental Impact Statement (Appendix M in MMS 2009). Differences between the Proposed Action and the Cape Wind Project parameters could lead to increased or decreased likelihood of spill events compared to the Bejarano et al. (2013) model. Several features of the Proposed Action compared to Cape Wind are likely to decrease the probability of a spill event, including: (1) fewer WTGs (100 instead of 130); (2) wider spacing of WTGs (0.88 by 1.2 miles [1.4 by 1.9 kilometers] apart instead of 0.39 by 0.62 mile [0.63 by 1 kilometer] apart); and (3) greater distance from typical vessel routes (COP Volume III, Section 8; Epsilon 2020b; Appendix M in MMS 2009). The oil spill modeling (COP Volume I, Appendix I-A, Annex 11) assumed one ESP toppling with no containment. The modeling study shows a 1 to 40 percent probability of oil reaching the shoreline and that it would take 1 to 3 days for the oil to reach Martha’s Vineyard and Nantucket. Furthermore, the study showed a less than 10 percent probability of oil reaching Rhode Island or Massachusetts, taking more than 3 days. After 10 days, the modeling shows a less than 10 percent chance of oil reaching Long Island or Connecticut. Overall, the probability of an oil or chemical spill occurring that is large enough to impact water quality is extremely low and the degree of impact on water quality would depend on the spill volume. The impacts of Alternative A alone on water quality from accidental releases would be localized, short-term, and **minor**.

Increased vessel traffic in the region associated with the Proposed Action could increase the probability of collisions and allisions, which could possibly result in oil or chemical spills. However, the Navigational Risk Assessment (COP Volume III, Appendix III-I; Epsilon 2020b) found that no significant disruption of normal traffic patterns is anticipated in the WDA associated with the Proposed Action. Therefore, even if vessel traffic in the region increases, the Proposed Action is not expected to significantly increase the risk of vessel allisions or collisions. Vineyard Wind would implement its Oil Spill Response Plan (COP Volume I, Appendix I-A; Epsilon 2020a), which would provide for rapid spill response, clean-up, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events. In the unlikely event an allision or collision involving vessels or components associated with the Proposed Action resulted in a large spill, impacts from Alternative A alone on water quality would be short-term to long-term and **minor** to **moderate** depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.

Onshore construction activities would require heavy equipment use, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Vineyard Wind would perform the majority of fueling and equipment maintenance activities at service stations or a contractor’s yard (Section 9.8.1 in Epsilon 2018b). Less-mobile equipment, such as excavators or paving equipment, would be refueled on site, but Vineyard Wind has stated that this would not be done within 100 feet (30.5 meters) of wetlands, waterbodies, or known private or community potable wells, or within any Zone I area (Section 9.8.1 in Epsilon 2018b). Additionally, a Spill Prevention, Control, and Countermeasure Plan would be prepared in accordance with applicable requirements, and would outline spill prevention plans and measures to contain and clean up spills if they were to occur. Lastly, Vineyard Wind would use solid cables that do not contain fluids for the export cables.

Therefore, BOEM anticipates Alternative A alone would result in **negligible**, temporary, and long-term impacts on surface and groundwater quality as a result of releases from heavy equipment during construction and other cable installation activities.

Onshore export cables would not contain fluids and would not be susceptible to leaks that could affect water quality. The transformers at the proposed substation would each contain between 15,000 and 20,000 gallons (56,781.2 to 75,708.2 liters) of dielectric fluid; each iron core reactor could contain 10,000 gallons (37,854.1 liters) and the capacitor banks would contain up to 1,500 gallons (5,678.1 liters) (Epsilon 2018b).[8] The Covell's Beach landfall site would not pass through a Zone I area, but would pass through 4.3 miles (6.9 kilometers) of Zone II protection areas. In addition, much of the OECR associated with the Covell's Beach landfall would be located within the Barnstable Groundwater Protection Overlay District, and it would also cross a Freshwater Resource Area (Section 8.1.2 in Epsilon 2018b). The proposed substation site is located within a Zone II Wellhead Protection Area and the Barnstable Groundwater Protection Overlay District. According to the Town of Barnstable (2018b), the site would reside above the aquifer that is the sole source of drinking water for the village of Hyannis. The proposed substation would be equipped with full volume impervious containment sumps capable of capturing 110 percent of stored fluids for any components containing dielectric fluid, including all transformers and capacitor banks (Sections 2.3.2 and 8.1 in Epsilon 2018b). In response to a request made by the Town of Barnstable, Vineyard Wind stated that it is "willing to adjust the 110 percent containment volume upwards to account for simultaneous 100-year, 24-hour rainfall events, which on Cape Cod is conservatively established at 9 inches of rain" (Epsilon 2018c). Vineyard Wind also provided the following additional information related to substation components and measures to minimize or avoid potential impacts on water quality in the event of a potential spill (Section 1.4.4.1 in Epsilon 2018c):

- The substation design includes routing each individual containment area through an oil-absorbing device and to an oil/water separator before draining into an infiltration basin.
- Spill response would be included in the emergency response plans as part of the safety management system.
- Spill containment kits and control accessories would be strategically located at the substation.
- Vineyard Wind would train substation operators to use spill prevention equipment.
- Per the Oil Spill Response Plan, a third-party licensed spill response contractor would be on call.

Vineyard Wind has and is investigating the possible use of biodegradable dielectric fluid for the main transformers. In addition, Vineyard Wind would develop Project-specific operations and maintenance plans (described in COP Volume I, Section 4.3; Epsilon 2020a) including scheduled inspections and maintenance over the life of the project, and continuous review and improvement. Based on the information provided above, BOEM anticipates **negligible** temporary impacts on water quality in the event of a potential release at the substation.

Vineyard Wind would use a new operations and maintenance facility in Vineyard Haven on Martha's Vineyard. Although unlikely, some potential also exists for water quality impacts resulting from accidental fuel spills during the use of the port in Vineyard Haven; however, BOEM anticipates **negligible** impacts on water quality in the event of a potential release at the port.

In context of reasonably foreseeable environmental trends, there would be up to about 196,689 gallons (744,549 liters) of coolants, 2,436,789 gallons (9.2 million liters) of oils and lubricants, and 398,613 gallons (1.5 million liters) of diesel fuel contained within the 475 foundations between Alternative A and future offshore projects in the water quality geographic analysis area. The combined accidental release impacts on water quality from ongoing and planned actions, including Alternative A, would likely be short-term and **minor** due to the low risk and the localized nature of the most likely spills, and the use of an Oil Spill Response Plan for projects. These impacts would occur primarily during construction, but also during operation and decommissioning to a lesser degree. In the unlikely event that an allision or collision involving Project vessels or components resulted in an oil or chemical spill, it would be expected that a small spill would have **negligible** temporary impacts, while a larger spill would have potentially **moderate** temporary impacts. Given the low probability of these spills occurring,

[8] Fluids used in substation components would not contain polychlorinated biphenyls.

BOEM does not expect ongoing and planned actions, including Alternative A, to contribute to impacts on water quality resulting from oil and/or chemical spills.

Anchoring: There would be increased vessel anchoring over 4 acres during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components of Alternative A. Anchoring would cause increased turbidity levels. Impacts on water quality from Alternative A alone due to anchoring would be localized, short-term, and **minor** during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in **negligible** impacts. Alternative A's contribution of an average of 25 and a maximum of 46 vessels during construction, and 4 acres (0.02 km^2) of impact from anchoring, would be additive with the impact(s) of any and all other anchoring activities, including offshore wind activities that occur within the water quality geographic analysis area during the same timeframe, resulting in a total of 90 acres (0.36 km^2) of seabed impact from anchoring.

In context of reasonably foreseeable environmental trends, combined anchoring impacts on water quality from ongoing and planned actions, including Alternative A, are anticipated to be localized, short-term, and **minor**, primarily during construction and decommissioning. In context of reasonably foreseeable environmental trends, during operations, combined anchoring impacts on water quality from ongoing and planned actions, including Alternative A, would likely be localized, short-term, and **negligible**.

New cable emplacement and maintenance: Other projects using similar installation methods (e.g., jet plowing, pile driving) have been characterized as having minor impacts on water quality due to the short-term and localized nature of the disturbance (Latham et al. 2017). The Hydrodynamic and Sediment Dispersion Modeling Study done for the proposed Project predicted a similar short-term and localized disturbance, as described in the COP Volume III, Appendix III-A (Epsilon 2020b). The model predicted that disturbed sediments would typically settle within 4 to 6 hours. Vineyard Wind would use pile driving to install both monopile and jacket foundations, which should only cause sediment resuspension local to the pile outer diameter (COP Volume III, Sections 5.2.2.1.1 and 5.3.2.1.1; Epsilon 2020b). Vineyard Wind would install the submarine cable mostly by jet plow or mechanical plow, and Vineyard Wind has modeled that the resultant plume is predicted to stay in the lower portion of the water column (bottom 9.8 feet [3 meters]). The portion of the cable installation plume that exceeds a concentration of 10 mg/L[9] should typically extend 656 feet (200 meters) from the route centerline, but could extend to a maximum of approximately 1.2 miles (2 kilometers) (Attachment F in Epsilon 2018c). Suspended sediment concentrations between 45 and 71 mg/L can occur in Nantucket Sound under natural tidal conditions, and increases in suspended sediment concentrations due to jet plow are within the range of variability already caused by tidal currents, storms, trawling, and vessel propulsion (Appendix M in MMS 2009). Installation of the OECC would mostly be done by jet or mechanical plow. Modeling showed that the resultant sediment plume is predicted to stay in the bottom 10 feet (3 meters) of the water column. Vineyard Wind expects to use dredging only when necessary in sand wave areas. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018c). A total of 117 acres (0.47 km^2) of seabed would be disturbed for offshore cable emplacement and 204 acres (0.82 km^2) would be affected during inter-array cable installation.

Sediment transport modeling was conducted for the Proposed Action as detailed in Section A.8.2.1.1. Based on the results of this modeling, the footprint of potential impacts on water quality from cable installation would be less by using jetting than by using mechanical dredging due to the amount of material that would be dredged and subsequently placed or disposed of elsewhere (COP Volume III, Section 5.2; Epsilon 2020b). However, as there are multiple methods that may be used for new cable emplacement and maintenance for the Proposed Action, it is difficult to precisely model the sediment plumes that would be caused by these activities and the plumes' resultant impacts on water quality. Although turbidity is likely to be high in the affected areas, impacts on water quality decrease considerably as the sediment settles. BOEM anticipates Alternative A alone would have **negligible**, long-term impacts on water quality via this mechanism. Overall, impacts on water quality from Alternative A alone due to cable emplacement and resulting suspension of sediment and turbidity would be short-term and **minor**.

[9] A suspended sediment concentration of 10 mg/L is a typical value for coastal waters; therefore, modeling is designed to predict concentrations above this ambient level (Bejarano et al. 2013).

The contribution from Alternative A to increased sediment concentration and turbidity would be additive with the impact(s) of any and all other cable installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended. As such, these activities in the context of reasonably foreseeable environmental trends would result in 1,132 aces (4.6 km^2) of impact for offshore cable installation and 1,079 acres (4.4 km^2) of impact for inter-array cable installation. The combined new cable emplacement and maintenance impacts on water quality from ongoing and planned actions, including Alternative A, would likely be short-term, and **minor** to **moderate**. There could be limited overlap in construction schedules for cable installation for the proposed Project and the South Fork Wind Project in 2022 with additional future offshore wind construction overlap occurring in 2023 and 2024. These impacts would not occur during operation.

Port utilization: The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014). During the proposed Project operations, the Vineyard Haven port would be utilized. No port expansion activities are anticipated for the Proposed Action. The incremental increases in ship traffic at the ports would be small; multiple authorities regulate water quality impacts from these operations (BOEM 2019b). Therefore, the impacts of Alternative A alone on water quality from port utilization would be **negligible**.

In context of reasonably foreseeable environmental trends and due to the lack of need for port modifications or expansions and the small increase in ship traffic, the overall combined port utilization impact on water quality from ongoing and planned actions, including Alternative A, would likely be localized, short-term, and **negligible**.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area and include the five offshore wind turbines associated with Block Island Wind Farm. Dock facilities and other structures are concentrated along the coastline. Using the assumptions in Table A-4, in context of reasonably foreseeable environmental trends and planned actions, there would be up to 475 structures on the OCS that could result in alteration of local water currents (Chakrabarti 1987; COP Volume III, Epsilon 2020b). Alternative A would add up to 102 stationary structures to the WDA during construction, which would remain in place during operations. The proposed Project would contribute 53 acres (0.21 km^2) of impact for foundation and scour protection installation and 35 acres (0.14 km^2) of impact for hard protection for offshore cables to those totals. Future offshore wind activities including Alternative A would result in 69 acres (1.5 km^2) of impact from installation of foundations and scour protection and 348 acres (1.4 km^2) of impact from hard protection for offshore cables and inter-array cables. The proposed Project's contribution to impacts on water quality due to the presence of structures would be additive with the impacts of any and all structures, including those of offshore wind activities, that occur within the water quality geographic analysis area and that would remain in place during the life of the proposed Project. These disturbances would be localized but, depending on the hydrologic conditions, have the potential to impact water quality through altering mixing patterns and the formation of sediment plumes. Significant scour is not expected even without scour protection due to the low current speeds and minimal seabed mobility in the WDA (COP Volume II-A, Section 3.2.2; Epsilon 2018a). The addition of scour protection would further minimize effects on local sediment transport. The impacts from Alternative A alone on water quality due to the presence of structures would be **negligible** during construction and decommissioning, and long-term and **minor** during operations. In context of reasonably foreseeable environmental trends, the combined structure placement impacts on water quality from ongoing and planned actions, including Alternative A, would likely be constant over the lifespans of the reasonably foreseeable activities, localized, and **minor** during operations, but **negligible** during construction and decommissioning.

Discharges: During construction of Alternative A, an average of 25 and a maximum of 46 vessels may be present in the WDA or OECC, leading to potential discharges of uncontaminated water and treated liquid wastes (COP Volume I, Section 4.2.4; Epsilon 2020a). COP Table 4.2-2 lists types of waste potentially produced by the Proposed Action, and COP Table 4.2-3 lists potential chemical products to be used and describes planned treatment, discharge, and disposal options for each (COP Volume I, Sections 4.2.5 and 4.2.6; Epsilon 2020a). Vineyard Wind would only be allowed to discharge uncontaminated water (e.g., uncontaminated ballast water and uncontaminated water used for vessel air conditioning) or treated liquid wastes overboard (e.g., treated deck drainage and sumps). Other waste such as sewage, solid waste or chemicals, solvents, and oils and greases from equipment, vessels, or facilities would be stored and properly disposed of on land or incinerated offshore.

Vineyard Wind expects substantially less vessel use during routine operations/maintenance than during construction. Vessel use would consist of scheduled inspection and maintenance activities (an example schedule is provided in COP Volume I, Figure 4.3-1; Epsilon 2020a), with corrective maintenance as needed. Vineyard Wind would maintain each wind facility component annually, resulting in 401 to 887 round trips per year, or an average of 1 to 3 vessel trips per day (COP Volume I, Table 4.3-2; Epsilon 2020a). The proposed Project would require all vessels to comply with regulatory requirements related to the prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 (including Subpart D, which specifically addresses Ballast Water Management for Control of Nonindigenous Species in Waters of the United States) and 46 CFR Part 162. Furthermore, the proposed Project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151. The bilge water from the proposed Project would 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 could be discharged overboard. In addition, bilge water would not be allowed to 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 3 nautical miles from shore, bilge water regulations under the USEPA's National Pollutant Discharge Elimination System program apply to any vessel of the proposed Project's vessels that are covered by a Vessel General Permit (those that are 79 feet [24 meters] or greater in length). Bilge discharges within 3 nautical miles 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. Vineyard Wind has submitted chemical waste management plans to BOEM for approval, described in COP Section 4.2 (Volume I; Epsilon 2020a) and COP Appendices I-A and I-B (Volume I; Epsilon 2020a). With appropriate self-imposed measures in place by Vineyard Wind (COP Volume III, Section 5.2.2.1.6; Epsilon 2020b) and anticipating that vessels would comply with the discharge measures described above, the temporary impact of routine vessel discharge is expected to be **minor**.

The WTGs and ESPs are self-contained and do not generate discharges under normal operating conditions. Except in the event of a spill related to an allision or other unexpected or low-probability event, impacts on water quality from discharges from the WTGs or ESPs during operation would be temporary and **negligible**. During decommissioning, Vineyard Wind would drain all fluid chemicals from the WTGs and ESPs, and dismantle and remove them. BOEM anticipates decommissioning to have **minor** temporary impacts on water quality, with a return to baseline conditions.

Overall, the impacts on water quality from Alternative A alone would be short-term and **minor** during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in **negligible** impacts.

Impacts on water quality from Alternative A due to discharges would be additive with the impact(s) of any and all discharges, including those of offshore wind activities, that occur within the water quality geographic analysis area during the same timeframe. Vessel traffic (e.g., fisheries use, recreational use, shipping activities, military uses) in the region would overlap with vessel routes and port cities expected to be used for the Proposed Action and vessel traffic would increase under the Proposed Action. Discharge events would mostly be staggered over time and localized, and all vessels would be required to comply with regulatory requirements related to prevention and control of discharges, accidental spills, and nonindigenous species administered by the USEPA, USACE, USCG, and BSEE. Therefore, in context of reasonably foreseeable environmental trends, BOEM expects that the combined discharge impacts on water quality from ongoing and planned actions, including Alternative A, would likely be short-term, localized, and **minor**, primarily during construction and to a lesser extent during decommissioning. During operations, discharge impacts on water quality in context of reasonably foreseeable environmental trends, from ongoing and planned actions, including Alternative A, would likely be localized, short-term, and **negligible**.

Land disturbance: Construction and installation of onshore components would include installation of one or more concrete transition vaults at the selected landfall site, installation of a single buried concrete duct bank through which the onshore export cables would run, and construction of the substation. Ground disturbance associated with these activities could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Vineyard Wind would implement erosion and sedimentation controls during the construction period. Construction of the substation onshore would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. The incremental increases in land disturbance from the Proposed Action would be small and mitigation measures, such as the use of a Spill Prevention, Control, and Countermeasure Plan, would be implemented. As such, impacts from Alternative A alone on water quality from land disturbance would be **negligible** to **minor**.

In context of reasonably foreseeable environmental trends, combined land disturbance impacts on water quality from ongoing and planned actions, including Alternative A, would likely be localized, short-term, and **minor** due to the low likelihood that construction on onshore components would overlap in time or space, and the minimal amount of expected erosion into nearby waterbodies.

In summary, activities associated with construction and installation, operations and maintenance, and decommissioning in the WDA and OECC would impact water quality to varying degrees. Impacts associated with Proposed Action activities would be specific to the scope and location of said activity. Large scopes (i.e., large projects, large volume spills) would result in greater impacts than small scopes and certain locations may be more sensitive than others to various activities. BOEM anticipates the impacts resulting from Alternative A alone would range from **negligible** to **moderate**. Impacts from routine activities, including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying dredging, vessel discharges, sediment contamination, discharges from the WTGs or ESPs during operation, sediment plumes due to scour, and erosion and sedimentation from onshore construction, would be **negligible** to **minor**. Impacts from non-routine activities, such as accidental releases, would be **minor** from small spills, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with Alternative A alone are likely to be temporary and/or small in proportion to the size of the Atlantic Ocean. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section A.8.2.1.2. Vineyard Wind may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario evaluated above, but doing so would not likely result in different impact ratings than those described above.

While the significance level of impacts would remain the same, BOEM could further reduce impacts with the following mitigation measures conditioned as part of the COP approval (Appendix D): BMPs to minimize sediment suspension during pile driving, cable installation, scour protection installation, and offshore facility removal.

In context of reasonably foreseeable environmental trends, combined impacts from individual IPFs on water quality resulting from ongoing and planned actions, including Alternative A, would likely range from **negligible** to **moderate**. Considering all the IPFs together, BOEM anticipates that these impacts from ongoing and planned actions, including Alternative A, would be **minor**. The main drivers for this impact rating are the short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures. BOEM has considered the possibility of a **moderate** impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic, release. While it is an impact that should be considered, it is unlikely to occur. Alternative A would contribute to the overall impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures. Thus, the overall impacts on water quality would qualify as **minor** because adverse and measurable impact is anticipated, but the impact would be small and the resource would recover completely without remedial or mitigating action. Alternative A would contribute to, but does not change, this overall impact rating, primarily through the short-term and localized nature of the impacts.

A.8.2.3. Consequences of Alternatives C, D1, D2, E, and F

Alternative C would exclude six of the northernmost WTG locations and relocate them in the southern portion of the WDA primarily for the purpose of reducing visual impacts and minimizing conflicts with commercial fishing boats. Alternative D1 increases the spacing between WTGs in the WDA to 1 nautical mile to reduce potential conflicts with ocean uses. Alternative D2 would align WTGs in an east-west orientation with 1-nautical-mile spacing between all turbines to allow greater spacing between WTG rows, which would facilitate the established practice of mobile and fixed-gear fishing vessels. New geotechnical and/or engineering surveys necessary to determine the new WTG placements would temporarily affect water quality, which would cease after completion. Except in the event of a spill, the impact of vessel use for the additional surveys would be **negligible** due to the short duration and mitigation measures in place. Alternative E would allow no more than 84 WTGs. Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from Alternative A; instead, the displaced WTGs would be shifted to locations south within the lease area. Under Alternative F, the northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA, depending on whether the Alternative A or Alternative D2 layout is used in combination with Alternative F, and how wide the transit lane is. To accommodate 100 WTGs under Alternative F, the length of inter-array cabling would need to exceed the maximum design parameter in the COP PDE of 171 miles (275 kilometers) due to the need to traverse a 2- or 4-nautical-mile transit lane.

All other design parameters and potential variability in design would be the same as under Alternative A. This assessment analyzes the maximum-case scenario; any potential variances in the proposed-Project build-out as defined in the PDE (i.e., numbers and spacing of WTGs and ESPs, length of inter-array cable) or construction activities would result in similar or lower impacts than described below. For example, if Vineyard Wind were to use fewer, larger WTGs and less total length of cable, impacts resulting from the installation and operation of these elements would be less than the maximum described in this analysis.

Once the WTG and inter-array cable locations are determined, Alternative C would be identical to Alternative A and result in **minor** impacts on water quality. Alternatives D1 and D2 would require additional surveys prior to construction, which may result in a small, temporary increase in vessel use unaccounted for in Alternative A. Upon completion of the surveys, Alternatives D1 and D2 would be the same as Alternative A. Adjusting the spacing between WTGs for Alternatives D1 and D2 to achieve wider spacing between WTGs would reduce the likelihood of collisions and allisions within the WDA, minimizing the potential for spills. Accordingly, the impacts for Alternatives D1 and D2 alone from accidental releases are anticipated to be lower than the predicted impacts from Alternative A alone. However, the impacts of a spill would be the same. Therefore, impacts on water quality from Alternatives D1 and D2 alone would be **minor**. The impacts from Alternative E on water quality would be less than Alternative A, as the reduction in WTGs would reduce the amount of seafloor disturbance, reduce the likelihood of an allision, reduce the amount of chemicals and oils stored offshore, and result in fewer annual maintenance transfers. Therefore, impacts on water quality from Alterative E alone would be **minor**. The impacts of Alternative F alone on water quality would be slightly less than Alternative A because the transit lanes would reduce potential impacts from accidental releases related to collisions or allisions. As a result, Alternative F would have **negligible** to **minor** impacts on water quality.

Alternatives C, D1, D2, E, and F would not result in additional impacts on onshore water resources, such as wetlands or other special aquatic sites and waterbodies, with regard to the proposed substation site similar to Alternative A. Therefore, the impacts of these alternatives on water quality would be the same as, or less than, those of Alternative A.

In context of reasonably foreseeable environmental trends, the combined impacts from individual IPFs on water quality from ongoing and planned actions, including Alternatives C, D1, D2, E, and F, would be very similar to those of Alternative A, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **moderate**; however, there could be an increase in suspended sediment concentration and turbidity under Alternative F as a result of the WTGs shifting farther south, which would require more inter-array cabling to span a 2- or 4-nautical-mile transit lane. The overall impacts in the context of reasonably foreseeable environmental trends from ongoing and planned actions, including Alternatives C, D1, D2, and E, would likely be the same as under Alternative A—**minor**. This impact rating is driven mostly by short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures.

A.8.2.4. Comparison of Alternatives

As discussed, the impacts associated with Alternative A alone do not change substantially under Alternatives C through F. Although the amount of impacts from cabling varies slightly among alternatives, the overall level of impacts would be similar for Alternatives A, C, D1, D2, E, and F for routine activities (**negligible** to **minor**). Ultimately, the same construction, operations and maintenance, and decommissioning activities would still occur, albeit at a reduced scale in some cases. Alternative E would reduce impacts related to the number of WTGs by approximately 16 percent compared to the maximum-case scenario under any other action alternative; however, it is important to note that not all impacts are related to the number of WTGs, thus the total impact would be reduced by less than 16 percent. The impacts of Alternative F alone on water quality would be slightly less than Alternative A because the transit lanes would reduce potential impacts from accidental releases related to collisions or allisions.

BOEM has considered Alternatives C, D1, D2, E, and F in an attempt to reduce visual impacts, and minimize conflicts with commercial fishing boats and other ocean uses. However, none of these alternatives would result in impacts on water quality that would be significant in relation to regional water quality.

In context of reasonably foreseeable environmental trends, combined impacts on water quality from ongoing and planned actions under any action alternative would likely be similar because the majority of the impacts result from ongoing activities and environmental trends and other future offshore wind projects. However, the differences in impacts from each alternative alone should still be considered alongside the impacts of other factors. Therefore, the impacts on water quality would be slightly lower under Alternative E than under the maximum-case scenario in any other action alternative, although under any alternative, the level of impacts from individual IPFs would range from **negligible** to **moderate** and the overall impacts would be **minor**.

A.8.2.5. Summary of Impacts of the Preferred Alternative

The Preferred Alternative would be a combination of Alternatives C, D2, and E with mitigation measures In Appendix D. Overall, the Preferred Alternative would reduce impacts from construction and installation of offshore Project components compared to Alternative A due to the use of fewer WTGs and less inter-array cable required to connect them. New geotechnical and/or engineering surveys necessary to determine the new WTG placements under the Preferred Alternative would temporarily affect water quality, which would cease after completion. Except in the event of a spill, the impact of vessel use for the additional surveys would be **negligible** due to the short duration and mitigation measures in place.

While the significance level of impacts would remain the same as Alternative A, the Preferred Alternative would mitigate potential impacts on water quality by requiring that Vineyard Wind use HDD at the landfall transition site, and BMPs during pile driving cable installation, scour protection installation, HDD operations, and offshore facility removal to minimize sediment suspension (Appendix D).

Impacts on water quality under the Preferred Alternative would be the same as or less than Alternative A: **negligible** from accidental releases of trash and debris and port expansion; **negligible** to **minor** due to anchoring, the presence of structures, and routine vessel discharges; **minor** due onshore erosion and sedimentation, and onshore construction; and **minor** to **moderate** from new cable emplacement/maintenance. Operations and maintenance activities would be the same as or reduced from Alternative A. There is no indication that larger WTGs require more maintenance (and therefore greater vessel use) than the smaller WTGs, so the primary variable is that there are fewer WTGs and less cable to maintain. There would also be reduced potential for sediment plume formation due to scour. Using fewer WTGs would also reduce the total volume of fluid chemicals present in the WDA and OECC. The types and quantities of chemical products used in the WTGs were assessed for Alternative A using the maximum volumes (COP Volume I, Table 4.2-3; Epsilon 2020a). The reduction in WTGs also would also reduce the likelihood of an allision and a resulting chemical spill. Additionally, fewer WTGs would result in fewer annual maintenance transfers, and less opportunity for a maintenance-related spill. The risk posed by spills under the Preferred Alternative would be the same as or less than Alternative A: **negligible** for small-scale spills and **moderate** for low-probability, large-scale spills. Therefore, the overall impacts on water quality from the Preferred Alternative would be the same as, or less than, the predicted impacts from Alternative A: **minor**, localized short-term impacts and **minor** long-term impacts on water quality from routine activities of the Preferred Alternative.

Table A.8.2-1: Summary of Activities and the Associated Impact-Producing Factors for Water Quality

Baseline Conditions: Impacts on water quality in waters of the geographic analysis area for water quality within the Northeastern Atlantic include terrestrial runoff, terrestrial point source discharges, and atmospheric deposition. Additional activities that impact the water quality condition include urbanization; forestry practices; municipal waste discharges; agriculture; marine vessel traffic-related discharges; wastewater; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; military and NASA operations; renewable energy development; natural events; and climate change.

Water temperature, salinity, DO, pH, chlorophyll *a*, turbidity, and nutrient levels are the key parameters characterizing ocean water quality, and contribute to the latter's ability to support and maintain a healthy ecosystem. Some of these parameters are accepted proxies for ecosystem health (e.g., DO, nutrient levels), while others delineate coastal habitats from marine habitats (e.g., temperature, salinity). Northeastern coastal waters are experiencing a long-term warming trend; average temperatures from 1980 to 2005 are 0.5 to 1.3°C warmer than average temperatures from 1890 to 1905. Increased coastal development on Cape Cod is causing increased nutrient pollution in communities, approximately 80 percent of which is due to groundwater contamination by septic systems. Both development and increased boat traffic contribute to other contaminant levels.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/hazmat	Accidental releases of fuels and fluids occur during vessel usage for dredged material ocean disposal, fisheries use, marine transportation, military use, survey activities, and submarine cable, lines, and pipeline laying activities. According to the DOE, 31,000 barrels (4.9 million liters) of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels (6.4 billion liters) of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and into the offshore was <70,000 barrels. Impacts on water quality would be expected to be brief and localized from accidental releases.	Future accidental releases from offshore vessel usage, spills, and consumption will likely continue on a similar trend. Impacts are unlikely to affect water quality.	Using the assumptions in Table A-4, if all leased areas within the water quality geographic analysis area are built out, there is a low risk of leak from any of the approximately 364 WTGs and 9 ESPs. Each WTG would contain approximately 1,717 gallons (6,500 liters) of transformer oil, approximately 2,113 gallons (8,000 liters) of general oil (for hydraulics and gearboxes), and approximately 423 gallons (1,601 liters) of coolants. Each ESP would contain up to approximately 123,559 gallons (467,720 liters) of oil and lubricants and approximately 46 gallons (174 liters) of coolants. The total quantity of diesel fuel for all WTGs and ESPs within the water quality geographic analysis area would be approximately 313,617 gallons (1.2 million liters). Total fuel/fluids/hazmat on Atlantic offshore wind facilities would be approximately 2,398,190 gallons (9.1 million liters). WTGs and ESPs would be equipped with secondary containment sized according to the largest oil chamber. The use of heavy equipment onshore could result in potential spills during use or refueling activities. Onshore construction and installation activities and associated equipment would involve fuel and lubricating and hydraulic oils. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. The impact of accidental releases is anticipated to be short-term, localized, and result in little change to water quality.	The Proposed Action would have a maximum of 5,046 gallons (19,101 liters) of oils, lubricants, diesel fuel, and coolant per turbine (504,600 gallons [1.9 million liters] total), and a maximum of 129,301 gallons (489,458 liters) for 800 MW ESP storage (Volume I; Epsilon 2020a). Modeling near the Proposed Action indicates a low risk of a spill from any structure, and the most likely type of spill (i.e., non-routine event) to occur during the life of the Proposed Action is 90 to 440 gallons (341 to 1,666 liters), which would have brief, localized impacts on water quality. Small releases would have **minor** impacts, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts.	The impacts on water quality from this sub-IPF under the Proposed Action could include potential accidental releases of fuels and fluids primarily during construction, but also throughout operations. Small releases would have **minor** impacts, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action would likely be of a similar nature, spatial, and temporal extent. In context of reasonably foreseeable environmental trends, combined impacts on water quality from ongoing and planned actions through this sub-IPF, including Alternative A, would likely be localized and short-term, resulting in **minor** impacts on water quality, primarily during construction, but also during operation and decommissioning to a lesser degree. In the unlikely event an allision or collision involving Project vessels or components resulted in a large spill, impacts on water quality would be short-term to long-term and **minor** to **moderate** depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, and cables, lines, and pipeline laying. Accidental releases of trash and debris are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. However, there does not appear to be evidence that the volumes and extents anticipated would have any effect on water quality.	Trash and debris may be released by vessels during construction, operations, and decommissioning. An accidental release would be a low probability event in the vicinity of project areas, likely resulting in little change to water quality.	The Proposed Action could result in release of trash and debris by vessels during construction, operations, and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of the Proposed Action activities, likely resulting in little change to water quality; therefore, the impacts would be **negligible**.	Trash and debris may be accidentally discharged as a result of the Proposed Action from vessels supporting the construction, operation, and decommissioning of offshore wind projects. Accidental releases of trash and debris are expected to be low probability events and therefore **negligible** impacts. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions through this sub-IPF, including Alternative A, would likely be localized, short-term, and **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Impacts from anchoring occur due to ongoing military use and survey, commercial, and recreational activities.	Impacts from anchoring may occur semi-regularly over the next 30 years due to offshore military operations or survey activities. These impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be localized, short-term, and temporary.	Under the assumptions in Table A-4, there would be increased anchoring during the construction and installation of offshore components and survey activities. In total, BOEM estimates approximately 86 acres (0.3 km^2) of seabed would be disturbed by anchoring associated with offshore wind activities. In addition, there would be increased anchoring/mooring from met towers or buoys associated with reasonably foreseeable offshore wind projects. Impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be short-term and localized, occurring primarily during construction, but also during operations and decommissioning.	There would be increased vessel anchoring over 4 acres (0.02 km^2) during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components (up to 100 WTGs and 2 ESPs) of the Proposed Action. During construction of the Proposed Action, an average of 25 and a maximum of 46 vessels may be present in the Project area leading to increased turbidity impacts from anchoring. All impacts, including increased turbidity and alteration of water quality, would be short-term and local, with **minor** impacts during construction and **negligible** during operations.	The impacts on water quality from this IPF under the Proposed Action could include increased turbidity levels primarily during construction, but also throughout operations. Impacts on water quality from anchoring would be localized, short-term, and **minor** during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in **negligible** impacts. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but of a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action would likely be of a similar nature, spatial, and temporal extent. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions through this IPF, including Alternative A, would likely be localized, short-term, and **negligible** to **minor**.
New cable emplacement/ maintenance	Suspended sediment concentrations between 45 and 71 mg/L can occur in Nantucket Sound under natural tidal conditions and increase during storms, trawling, and vessel propulsion. Survey activities and new cable and pipeline laying activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would be short-term and either be limited to the emplacement corridor or localized.	Suspension of sediments may continue to occur infrequently over the next 30 years due to survey activities, and submarine cable, lines, and pipeline laying activities. Future new cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would occasionally disturb the seafloor and cause short-term increases in turbidity and minor alterations in localized currents resulting in local short-term impacts. The FCC has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the water quality geographic analysis area, short-term disturbance in the form of increased suspended sediment and turbidity would be expected.	Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited and the water quality would recover following the disturbance. Under the assumptions in Table A-4, there would be 1,015 acres (4.1 km^2) of impact for offshore cable installation and 875 acres (3.5 km^2) of impact for inter-array cable installation. Impacts would occur during construction and would involve a temporary and localized increase in sediment suspension and turbidity for up to 12 hours at a time.	The Proposed Action submarine cable installation would mostly be done by jet or mechanical plow. The modeled resultant plume specific to cable installation is predicted to stay in the lower portion of the water column (bottom 9.8 feet). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet from the route centerline, but could extend up to 1.2 miles. Modeling also showed that sediment concentrations greater than 10 mg/L from pre-cable installation dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours, but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Table 4.2-3, COP Volume I; Epsilon 2020a). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018c). The footprint of potential impacts on water quality from cable installation would be less by using jetting rather than mechanical dredging, due to the amount of material that would be dredged and subsequently placed or disposed of elsewhere (COP Volume III, Section 5.2; Epsilon 2020b). Although turbidity is likely to be high in the affected areas, the sediment would not impact water quality once it has settled. The impacts on water quality from this IPF under the Proposed Action could include accidental suspension of sediments for up to 12 hours at a time throughout construction. However, as there are multiple methods that may be used for new cable	The impacts on water quality from this IPF under the Proposed Action could include accidental suspension of sediments for up to 6 hours at a time throughout construction. The impacts would be short-term and **minor**. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but of a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action would likely be of a similar nature, spatial, and temporal extent; if construction activities were occurring concurrently at two areas, these concentrations are unlikely to be exceeded. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions through this IPF, including Alternative A, would likely be short-term and **minor** to **moderate** during construction. These impacts would not occur during operation or decommissioning.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				emplacement and maintenance, it is difficult to precisely model the sediment plumes that would be caused by these activities and the plumes' resultant impacts on water quality. Based on the parameters used for this modeling effort, the impacts would be short-term and **minor**.	
Port utilization: Expansion	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications, which, along with additional vessel traffic, could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. However, the existing suspended sediment concentrations in Nantucket Sound are already 45 to 71 mg/L; therefore, impacts from vessel traffic are likely to be masked by the natural variability. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly over the next 30 years. Port modifications and channel deepening activities are being undertaken to accommodate the increase in vessel traffic and deeper draft vessels that transit the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. However, the existing suspended sediment concentrations in Nantucket Sound are already 45 to 71 mg/L, so impacts from vessel traffic are likely to be masked by the natural variability. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	Increases in port utilization due to other offshore wind energy projects would lead to an increased potential for an accidental spill and the release of trash and debris. This increase in vessel traffic would be at its peak during construction activities and would decrease during operations, but would increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased sediment suspension and turbidity in coastal waters.	The Proposed Action could result in increased port use during construction and decommissioning, which could affect water quality near ports. The Proposed Action would not result in any port expansion and therefore would not result in any additional effects on water quality near ports from port expansion. The impacts on water quality from this IPF under the Proposed Action could include accidental fuel spills or sedimentation during use of the ports in Vineyard Haven, New Bedford, Montaup, Brayton Point, and Davisville. Impacts would primarily occur during construction and decommissioning and would be **negligible**.	As previously stated, the impacts on water quality from this IPF under the Proposed Action could include accidental fuel spills or sedimentation during the increased use of the ports in Vineyard Haven, New Bedford, Montaup, Brayton Point, and Davisville. Impacts would primarily occur during construction and decommissioning and would be **negligible**. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but of a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action are expected to cause impacts through this sub-IPF on water quality that are less than noticeable. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions through this IPF, including Alternative A, would likely be localized, short-term, and **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures	The installation of onshore and offshore structures leads to alteration of local water currents. These disturbances would be local but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes.	Impacts associated with the presence of structures includes temporary sediment disturbance during maintenance. This sediment suspension would lead to short-term and localized impacts.	Using the assumptions in Table A-4, if all lease areas within the water quality geographic analysis area are built out, there would be approximately 475 structures (WTGs and ESPs). Future offshore wind activities would result in 317 acres (1.3 km^2) of impact from installation of foundations and scour protection and 537 acres (2.2 km^2) of impact from hard protection for both the offshore export cables and inter-array cables within the water quality geographic analysis area. Scour potential would be dependent on current speeds and seabed mobility within the lease area (COP Volume III; Epsilon 2020b). The WTG and ESP foundations would result in localized alterations of water currents, but the low current speeds in the Northeast lease areas and minimal seabed mobility would result in minimal concern over scour. Measures would be in place to minimize scour and therefore any sediment plumes would return to baseline conditions in the area with minimal impact.	The impacts on water quality from this IPF under the Proposed Action could include alteration of local water currents during the life of the Project. The Proposed Action would contribute 53 acres (0.21 km^2) of impact for foundation and scour protection installation and 35 acres (0.14 km^2) of impact for hard protection for offshore cables to those totals. Vineyard Wind would not expect significant scour even without scour protection due to the low current speeds and minimal seabed mobility in the WDA COP Volume II-A, Section 3.2.2; Epsilon 2018a). The impacts on water quality would be long-term and **minor** during operations. The placement and removal of structures during construction and decommissioning, respectively, would result in temporary increases in turbidity, but would ultimately result in **negligible** impacts on water quality.	The impacts on water quality from this IPF under the Proposed Action could include alteration of local water currents during the life of the Project. Vineyard Wind would not expect significant scour even without scour protection due to the low current speeds and minimal seabed mobility in the WDA (COP Volume II-A, Section 3.2.2; Epsilon 2018a). The impacts on water quality would be long-term and **minor** during operations. The placement and removal of structures during construction and decommissioning, respectively, would result in temporary increases in turbidity, but would ultimately result in **negligible** impacts on water quality. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but of a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action would likely be of a similar nature, spatial, and temporal extent. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions through this IPF, including Alternative A, would likely be constant over the lifespans of the projects, localized and **minor** during operations. Placement and removal of the structures during construction and decommissioning, respectively, would result in localized turbidity, but would not affect water currents during the short timeframe of activity, resulting in **negligible** impacts.
Discharges	Discharges impact water quality by introducing nutrients, chemicals, and sediments to the water. There are regulatory requirements related to prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species.	Increased coastal development on Cape Cod is causing increased nutrient pollution in communities, approximately 80% of which is due to groundwater contamination by septic systems. In addition, ocean disposal activity in the North and Mid-Atlantic is expected to gradually decrease or remain stable. Impacts of ocean disposal on water quality are minimized because USEPA has established dredge spoil criteria and regulates the disposal permits issued by USACE. The impact on water quality from sediment suspension during future activities would be short-term and localized.	Offshore wind projects would result in increased potential for discharges from vessels during construction, operations, and decommissioning. Short-term and localized turbidity increases due to bottom disturbance would occur during structure placement. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in these wastes, particularly during construction and decommissioning, but the disposal periods would be staggered over time and localized.	During construction of the Proposed Action, an average of 25 and a maximum of 46 vessels may be present in the WDA leading to potential discharges of uncontaminated water and treated liquid wastes. All vessels would be required to comply with regulatory requirements related to prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species. It is assumed that all vessels would comply with USCG ballast water management requirements and USCG bilge water regulations. Impacts on water quality would be short-term and **minor** during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in **negligible** impacts on water quality.	The impacts on water quality from this sub-IPF under the Proposed Action could include increased potential for discharges from vessels during construction, operations, and decommissioning, and increased turbidity levels due to bottom disturbance for structure placement. Impacts on water quality would be short-term and **minor** during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in **negligible** impacts on water quality. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but of a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action would likely be of a similar nature, spatial, and temporal extent. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions through this sub-IPF, including Alternative A, would likely be localized, short-term, and **minor**, primarily during construction and to a lesser extent during decommissioning. During operation, combined impacts on water quality in context of reasonably foreseeable environmental trends from ongoing and planned actions would likely be localized, short-term, and **negligible**.
Land disturbance: Erosion and sedimentation	Ground disturbance activities may lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity.	Ground disturbance associated with construction and installation of onshore components could lead to unvegetated or unstable soils. Precipitation events could mobilize these soils leading to erosion and sedimentation effects and turbidity. Impacts from future offshore wind through this IPF would be staggered in time and	Erosion and sedimentation can occur from multiple construction and decommissioning activities. The staggered nature of construction activities would limit the total erosion and sedimentation contribution to water quality at any given time.	Additional sediment suspension could occur during construction, outside those that are authorized. The intensity and extent of the effects are geographically constrained such that they are unlikely to have an incremental impact beyond an immediate project vicinity. With staggered construction events, the overall impact on water quality would be short-term, localized, and minimal. The impacts on water quality from this sub-IPF under the Proposed	The impacts on water quality from this sub-IPF under the Proposed Action could include increased potential for erosion and sedimentation effects, and subsequently increased turbidity, due to onshore ground disturbance activities that lead to unvegetated or otherwise unstable soils that could be mobilized by precipitation events. Impacts would be short-term and **minor**. These impacts would occur periodically over the 3-year construction timeframe. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but of a greater spatial and temporal extent. Future offshore wind activities excluding the

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		localized. The impacts would be short-term and localized with an increased likelihood of impacts limited to onshore construction periods.		Action could include increased potential for erosion and sedimentation effects, and subsequent increased turbidity due to onshore ground disturbance activities that lead to unvegetated or otherwise unstable soils that could be mobilized by precipitation events. Impacts would be short-term and **minor**.	Proposed Action are expected to cause impacts on water quality through this sub-IPF that are less than noticeable. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions, including Alternative A, through this sub-IPF would likely be short-term and **minor**.
Land disturbance: Onshore construction	Onshore construction activities may lead to unvegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.	The construction and installation of onshore components would lead to ground disturbance. This could include onshore infrastructure and land use requirements related to an increase in port activity required to meet the demands of future offshore wind. Ground disturbance and precipitation leads to mobilization of soils into nearby waters leading to erosion and sedimentation. Use of heavy equipment onshore could lead to potential spills and result in the inadvertent release of fluids from machinery. Erosion and sedimentation controls should minimize these impacts. The likelihood of these impacts is minimal and localized. They would be focused in areas with onshore construction and often areas where refueling occurs, which would have adequate response abilities.	Ground disturbance associated with onshore construction activities of the Proposed Action could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Vineyard Wind would implement erosion and sedimentation controls during the construction period, making these potential effects temporary and localized. Impacts would be short-term and **minor**.	The impacts on water quality from this sub-IPF under the Proposed Action could include increased turbidity and alteration of water quality following precipitation events due to onshore construction activities that lead to unvegetated or otherwise unstable soils and soil contamination due to leaks or spills from construction equipment. These impacts would occur periodically over the 3-year construction timeframe. Impacts would be short-term and **minor**. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but of a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action are expected to cause impacts on water quality through this sub-IPF that are less than noticeable. In context of reasonably foreseeable environmental trends, the combined impacts on water quality from ongoing and planned actions, including Alternative A, through this sub-IPF would likely be short-term and **minor**.

°C = degrees Celsius; BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; DO = dissolved oxygen; DOE = U.S. Department of Energy; ESP = electrical service platform; FCC = Federal Communications Commission; hazmat = hazardous materials; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meters; met = meteorological; mg/L = milligrams per liter; NASA = National Aeronautics and Space Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; USEPA = Environmental Protection Agency; WDA = Wind Development Area; WTG = wind turbine generator

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A.8.3. Birds

A.8.3.1. No Action Alternative and Affected Environment

This section discusses existing bird resources in the geographic analysis area for birds, as described in Table A-1 and shown on Figure A.7-16. Specifically, the geographic analysis area for birds includes the U.S. East Coast, from Maine to Florida, to capture migratory species, and extends 100 miles (161 kilometers) offshore and 100 miles (161 kilometers) inland to capture the movement range for species in this group. Table A.8.3-1 describes baseline conditions and the impacts, based on IPFs assessed, of ongoing and future activities other than offshore wind, which is discussed below.

This section addresses potential impacts on bird species that use inland, coastal, and offshore habitats, including both resident bird species that use the proposed WDA during all (or portions of) the year and migrating bird species with the potential to pass through the proposed Project area during fall and/or spring migration. Detailed information regarding species potentially present can be found in the COP Volume III, Sections 6.1, 6.2, and Appendix III-C (Epsilon 2020b). Given the differences in life history characteristics and habitat use between offshore and inland/coastal bird species, the sections below provide a separate discussion of each group. This section also discusses migratory birds as well as Bald and Golden Eagles. In addition, this section addresses federally listed threatened and endangered species, but further information is provided in the Vineyard Wind 1 Offshore Wind Energy Project Biological Assessment (BA) prepared for the USFWS (BOEM 2020b).

Threatened and Endangered Species

Three species of birds are listed as threatened or endangered under the Endangered Species Act (ESA) and may occur within the proposed Project area: Roseate Tern (*Sterna dougallii*), Piping Plover (*Charadrius melodus*), and *Rufa* subspecies of Red Knot (*Calidris canutus rufa*) (BOEM 2012; USFWS 1996, 1998, 2014). A fourth species, the Black-capped Petrel (*Pterodroma hasitata*), was proposed for listing as threatened by the USFWS on October 9, 2018 (Threatened Species Status for the Black-capped Petrel with a Section 4(d) Rule, 83 Fed. Reg. 195 [October 9, 2018]). The Vineyard Wind 1 BA provides a detailed discussion of ESA listed species and potential impacts on these species as a result of the proposed Project (BOEM 2020b). The document has also been updated with new information relative to covered species, including the new occurrence of nesting roseate terns on Muskeget Island, and Project design specifications since publication of the DEIS and SEIS. BOEM has requested concurrence on its conclusions of the following: (1) that the impacts of the proposed activities are expected to be discountable and insignificant, and thus may affect but are not likely to adversely affect Piping Plovers, Roseate Terns, *Rufa* Red Knots, or northern long-eared bats (*Myotis septentrionalis*); (2) the determination of no effect to Black-capped Petrel and American chaffseed (*Schwalbea americana*); and (3) that no designated critical habitat for listed species would be adversely affected by the proposed Project activities. In a letter dated October 16, 2020, the USFWS concurred with the findings presented in the 2020 BA (BOEM 2020b); as such, no further consultation pursuant to Section 7 of the ESA is required at this time (USFWS 2020b).

Impacts from reasonably foreseeable offshore wind activities to ESA listed will be discussed in detail in subsequent project-specific analysis documents. As is the case with the proposed Vineyard Wind 1 Project, each proposed project will be required to address ESA listed species at the individual project scale and cumulatively. Additionally, BOEM is currently working on a programmatic ESA consultation with the USFWS to address the potential impacts of the anticipated development of Atlantic offshore wind energy facilities on ESA-listed species.

Bald and Golden Eagles

Bald Eagles (*Haliaeetus leucocephalus*), which are listed as threatened in Massachusetts, are federally protected by the Bald and Golden Eagle Protection Act, 16 USC § 668 et seq., as are Golden Eagles (*Aquila chrysaetos*). Bald Eagles are year-round residents in Massachusetts and occur in a variety of terrestrial environments, typically near water such as coastlines, rivers, and large lakes (BOEM 2012; USFWS 2011). Golden Eagles are rarely seen in the Cape Cod area, but small numbers of individuals migrate through on occasion (eBird 2020). Bald and Golden Eagles typically migrate over land, well inland of all proposed Project facilities (BOEM 2012). More information is available in the COP Section 6.2.1.5.4 (Volume III; Epsilon 2020b). Bald and Golden Eagles are not expected to occur within the WDA, but some potential exists for effects (displacement due to noise, habitat loss/modification, and injury/mortality due to contact with construction equipment) resulting from the construction, operations and maintenance, and decommissioning of the onshore facilities.

Migratory Birds

Many bird species do not normally reside along the Atlantic coast of North America, but pass through during spring and fall migrations. The Atlantic Flyway, which follows the Atlantic coast, is an important migratory route for many bird species moving from breeding grounds in New England and eastern Canada to winter habitats in North, Central, and South America. Bays, beaches, coastal forests, marshes, and wetlands provide important stopover and foraging habitat for migrating birds (MMS 2007). Both the onshore and offshore facilities associated with the Proposed Action are located within the Atlantic Flyway. Bird species using the flyway during spring and fall migration have the potential to encounter proposed Project facilities. Despite the level of human development and activity present, the mid-Atlantic Coast plays an important role in the ecology of many bird species. The Atlantic Flyway is a major route for migratory birds, which are protected under the Migratory Bird Treaty Act of 1918 (MBTA). Chapter 4 of the Atlantic Final Programmatic Environmental Impact Statement (BOEM 2014a) discusses the use of Atlantic Coast habitats by migratory birds. The official list of migratory birds protected under the MBTA, and the international treaties that the MBTA implements, is found at 50 CFR § 10.13. The MBTA makes it illegal to "take" migratory birds, their eggs, feathers, or nests. Under Section 3 of Executive Order 13186, BOEM and USFWS established a Memorandum of Understanding (MOU) on June 4, 2009, which identifies specific areas in which cooperation between the agencies would substantially contribute to the conservation and management of migratory birds and their habitats (MMS-USFWS 2009). The purpose of the MOU is to strengthen migratory bird conservation through enhanced collaboration between the agencies (MOU Section A). One of the underlying tenets identified in the MOU is to evaluate potential impacts to migratory birds and design or implement measures to avoid, minimize, and mitigate such impacts as appropriate (MMS-USFWS 2009, Sections C, D, E(1), F(1-3, 5), G(6); BOEM undated).

BOEM funds scientific studies and partners with USFWS to better understand how migratory birds use the Atlantic OCS and to refine the understanding of the risks from development to migratory species (https://www.boem.gov/environment/environmental-studies/renewable-energy-research). BOEM uses information from these studies, coordination with USFWS, and the scientific literature to avoid leasing areas with high concentrations of migratory birds that are most vulnerable to offshore wind development. For example, BOEM's stakeholder engagement during the delineation of the Massachusetts WEA resulted in the exclusion of 14 OCS blocks that overlapped with high value sea duck habitat (BOEM 2012).

BOEM worked with USFWS to develop standard operating conditions (SOCs) for commercial leases and as terms and conditions of plan approval, and are intended to ensure that the potential for adverse impacts on birds is minimized. The SOCs have been analyzed in recent EAs and consultations for lease issuance and site assessment activities, and BOEM's approval of the Coastal Virginia Offshore Wind Technology Advancement Project (BOEM 2016c). Some of the SOCs originated from Best Management Practices adopted in the Record of Decision for the 2007 *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* (MMS 2007, Section 2.7). Finally, BOEM and USFWS work with the lessees to develop post-construction plans aimed at monitoring the effectiveness of measures considered necessary to minimize impacts to migratory birds with the flexibility to consider the need for modifications or additions to the measures.

Regional Offshore and Inland Birds

Generally, bird species abundance and species diversity decrease as distance from shore increases (Petersen et al. 2006; Paton et al. 2010; Watts 2010). The Proposed Action is located 14.3 miles (23 kilometers) from shore in an area that has been part of a detailed resource assessment, including a review of bird resources (BOEM 2012, 2015b); the Massachusetts Lease Areas exclude areas of important offshore sea duck habitat (BOEM 2012; White and Veit 2020). As such, avian use of offshore habitats in the region is well documented and has been further refined with site-specific surveys (Veit et al. 2015, 2016; Winship et al. 2018; White and Veit 2020). The most likely species to occur within the offshore portions of the Proposed Action include 22 species of gulls and terns, 17 species of sea ducks, 9 species of shearwaters and petrels, 4 species of loons and grebes, and 3 species of gannets and cormorants. Additional species may also occur in lower numbers (BOEM 2012). COP Table 6.2-6 describes each bird species likely to occur offshore of Massachusetts (Volume III; Epsilon 2020b).

Inland and coastal bird species in this region have been catalogued in detail at the Massasoit National Wildlife Refuge, 23 miles (37 kilometers) northeast of the onshore portions of the proposed Project area. At least 74 bird species are known or suspected to occur here (COP Volume III, Table 6.1-2; Epsilon 2020b). Many of these species rely on undisturbed native habitats, including pitch pine-oak forest, white pine-oak forest, as well as open water and shallow emergent marsh, while others use forest edges, grasslands, or even urban habitats (USFWS 2017). The proposed Project's substation site would be located on the eastern portion of a previously developed site within the Independence Park commercial/industrial area in the Town of Barnstable. Construction of the substation site would require the removal of approximately 6.1 acres (24,685.9 m^2) of forested habitat that is potentially suitable for use by nesting and/or foraging birds. Site vegetation is comprised primarily of pitch pine (*Pinus rigida*) and scarlet oak (*Quercus coccinea*) in the tree layer with black huckleberry (*Gaylussacia baccata*) and lowbush blueberry (*Vaccinium angustifolium*) dominant in the understory. Bracken fern (*Pteridium aquilinum*) and teaberry (*Gaultheria procumbens*) are present as ground covers (COP Volume I; Epsilon 2020a). This type of Pitch Pine-Oak forest is very common and widespread throughout southeastern Massachusetts (MDFW 2016). Common bird species such as Rufous-sided Towhee (*Pipilo erythrophthalmus*), Pine Warbler (*Dendroica pinus*), and Ruffed Grouse (*Bonasa ubellus*) are typically associated with this habitat (MDFW 2016). The proposed substation site footprint lacks any available water source, but some small ponds are located within 1,400 feet (427 meters) of the site. Common bird species known to inhabit the onshore portions of the Project area include: Bald Eagle, 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*), Common Loon (*Gavia immer*), Great Blue Heron (*Ardea Herodias*), Black-crowned Night Heron (*Nycticorax nycticorax*), Eastern Phoebe (*Sayornis phoebe*), and Chipping Sparrow (*Spizella passerine*) (COP Volume III; Epsilon 2020b). The proposed substation site is also located adjacent to the Hyannis Ponds Wildlife Management Area (WMA). This WMA contains an important concentration of biodiversity in Massachusetts, and several of the ponds protected by the WMA are among the least disturbed Coastal Plain pond natural communities in Massachusetts (MDFW 1994).

Birds in the geographic analysis area are subject to pressure from ongoing activities, particularly accidental releases, new cable emplacement, interactions with fisheries and fishing gear, and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions of birds within the geographic analysis area. The Northeastern United States is also home to more than one-third of the human population of the nation. As a result, species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including hunting pressure (approximately 86,000 sea ducks harvested annually [Roberts 2019]), commercial fisheries by-catch (approximately 2,600 seabirds killed annually on the Atlantic [Hatch 2017; Sigourney et al. 2019]), and climate change, which have the potential to have adverse impacts on bird species.

According to the North American Bird Conservation Initiative (NABCI), more than half of the offshore bird species (57 percent, 31 species) have been placed on the NABCI watch list as a result of small ranges, small and declining populations, and threats to required habitats. This watch list identified species of high conservation concern based upon high vulnerability to a variety of factors, including population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015) including those that forage, breed, and migrate over the Atlantic OCS. Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch list. Many of these coastal species have small population size and/or restricted distributions, making them especially vulnerable to habitat loss/degradation and other stressors (NABCI 2016). Models of vulnerability to climate change estimate that, throughout Massachusetts, 61 species (43 percent of the 143 species modeled) are highly vulnerable, and 22 species (15 percent) are likely vulnerable (Mass Audubon 2017), some of which occur in the geographic analysis area. These ongoing impacts on birds would continue regardless of the offshore wind industry.

Between 1966 and 2011, 48 percent of breeding bird species surveyed in Massachusetts declined in abundance, whereas 31 percent increased and 21 percent remained stable (Mass Audubon 2011). The list of rare birds in Massachusetts includes 28 state threatened and endangered species, plus 34 more species of conservation concern; many of these species are in greater decline than the other birds in the state. Birds that depend on grasslands, shrublands, and marshes are particularly imperiled. Within these habitats alone, 39 species are "Conservation Action Urgent[10]" species (Mass Audubon 2011). Some of the main drivers of bird population declines include habitat loss, habitat fragmentation, collisions with glass windows and power lines, invasive species, predators, toxic chemicals, and climate change (Mass Audubon 2011, 2013, 2017). Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are additionally vulnerable to sea-level rise and the increasing frequency of strong storms. Models of vulnerability to climate change estimated that 61 species (43 percent of the 143 species modeled) are highly vulnerable, and 22 species (15 percent) are likely vulnerable throughout Massachusetts (Mass Audubon 2017).

Under the No Action Alternative, the proposed Project would not be built. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project (Section A.8.3.2) would not occur as proposed. Impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur (Table A.8.3-1). It is assumed that the energy demand that the Vineyard Wind 1 Project would fill (if approved) would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases (if not approved). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are developed to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action. In other words, future offshore wind facilities capable of generating 9,404 MW could still be built in the RI and MA Lease Areas under the No Action Alternative, although none would be built before 2022. Therefore, the impacts on birds would be similar, but the exact impact would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area and considers the assumptions included in Section 1.7 and here in Appendix A. The No Action Alternative would forgo post-construction avian monitoring for migratory birds and ESA–listed species and annual monitoring reporting that Vineyard Wind has committed to performing, the results of which could provide an understanding of the effects of offshore wind development, benefit the future management of these species, and inform planning of other offshore development; however, ongoing and future surveys and monitoring could still supply similar data.

A.8.3.1.1. Future Offshore Wind Activities (without Proposed Action)

As discussed above, the Atlantic Flyway is an important migratory pathway for as many as 164 species of waterbirds, and a similar number of land birds, with the greatest volume of birds using the Atlantic Flyway during annual migrations between wintering and breeding grounds (Watts 2010). Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). While both groups may occur over land or water within the flyway and may extend considerable distances from shore, the highest

[10] "Conservation Action Urgent" category is a combination of currently listed species and species that have seen drastic declines in their numbers for reasons such as loss of grassland and shrubland habitat.

diversity and density is centered on the shoreline. Building on this information, Robinson Wilmott et al. (2013) evaluated the sensitivity of bird resources to collision and/or displacement due to the future wind development on the Atlantic OCS, and included the 164 species selected by Watts (2010) plus an additional 13 species, for a total of 177 species that may occur on the Atlantic OCS from Maine to Florida during all or some portion of the year. As discussed in Robinson Willmott et al. (2013) and consistent with Garthe and Hűppop (2004), Furness and Wade (2012), and Furness et al. (2013), species with high scores for sensitivity for collision include gulls, jaegers, and the Northern Gannet (*Morus bassanus*). In many cases, high collision sensitivity was driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the Rotor Swept Zone. Many of the species addressed in Robinson Willmott et al. (2013) had low collision sensitivity include passerines that spend very little time on the Atlantic OCS during migration and typically fly above the Rotor Swept Zone. As discussed in BOEM 2012, 55 species may be expected to have some level potential overlap with the WDA and could potentially encounter operating WTGs on the Atlantic OCS. However, generally the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure A.8.3-1). As described above, of the 177 species that may occur along the Atlantic Coast, 55 are likely to encounter WTGs associated with offshore wind development. Of these, a total of 47 marine bird species have sufficient survey data to calculate the modeled percentage of a species population that would overlap with the anticipated offshore wind development on the Atlantic OCS (Winship et al. 2018); the relative seasonal exposure is generally very low, ranging from 0.0 to 5.2 percent (Table A.8.3-2). BOEM assumes that the 47 species (85 percent) with sufficient data to model the relative distribution and abundance on the Atlantic OCS are representative of the 55 species that may overlap with offshore wind development on the Atlantic OCS.

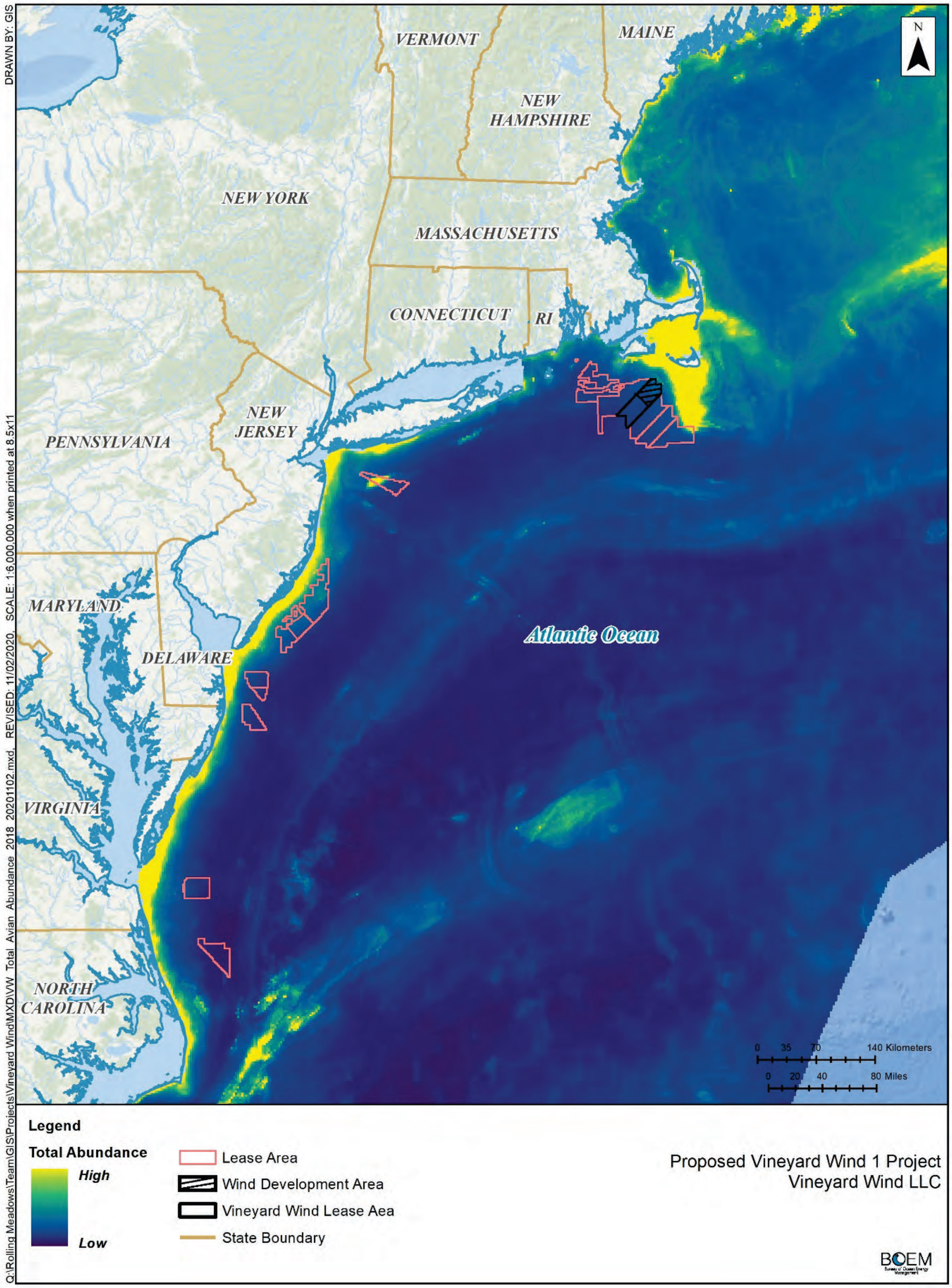
BOEM expects future offshore wind development activities to affect birds through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazmat, sediment, and/or trash and debris may increase as a result of future offshore wind activities. Section A.8.2 discusses the nature of releases anticipated. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities.

In the expanded planned action scenario, there would be a low risk of a leak of fuel/fluids/hazmat from any single 1 of approximately 2,021 WTGs and 45 ESPs, each with approximately 5,000 gallons (18,927 liters) stored. Total fuel/fluids/hazmat on Atlantic offshore wind facilities would be approximately 17.6 million gallons (64.4 million liters) (20 percent of the capacity of a single super tanker). Ingestion of hazmat has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feather can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). Based on the volumes potentially involved, the likely amount of additional releases associated with future offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities.

Trash and debris may be released by vessels during construction, operations, and decommissioning of offshore wind facilities. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the unlikely event of a release, it would be an accidental localized event in the vicinity of WDAs. Accidentally released trash may be ingested by birds that mistake it for prey. Lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019), though BOEM expects accidental trash releases from project vessels to be rare events.

Given that the overall impact of accidental releases on birds is anticipated to be localized and short-term, BOEM expects that accidental releases of trash and debris would not appreciably contribute to overall impacts on birds.



Sources: Curtice et al. 2018; Northeast Ocean Data 2019; Winship et al. 2018

Figure A.8.3-1: Total Avian Relative Abundance Distribution Map

Table A.8.3-2: Percentage of Each Atlantic Seabird Population that Overlaps with Anticipated Offshore Wind Energy Development on the OCS by Season

Species	Spring	Summer	Fall	Winter
Artic Tern (*Sterna paradisaea*)	NA	0.2	NA	NA
Atlantic Puffin (*Fratercula arctica*) [a]	0.2	0.1	0.1	0.2
Audubon Shearwater (*Puffinus lherminieri)*	0.0	0.0	0.0	0.0
Black-capped Petrel (*Pterodroma hasitata)*	0.0	0.0	0.0	0.0
Black Guillemot (*Cepphus grille)*	NA	0.3	NA	NA
Black-legged Kittiwake (*Rissa tridactyla*) [a]	0.7	NA	0.7	0.5
Black Scoter (*Melanitta americana)*	0.2	NA	0.4	0.5
Bonaparte’s Gull (*Chroicocephalus philadelphia*)	0.5	NA	0.4	0.3
Brown Pelican (*Pelecanus occidentalis*)	0.1	0.0	0.0	0.0
Band-rumped Storm-Petrel (*Oceanodroma castro*)	NA	0.0	NA	NA
Bridled Tern (*Onychoprion anaethetus*)	NA	0.1	0.1	NA
Common Eider (*Somateria mollissima*) [a]	0.3	0.1	0.5	0.6
Common Loon (*Gavia immer*)	3.9	1.0	1.3	2.1
Common Murre (*Uria aalge*)	0.4	NA	NA	1.9
Common Tern (*Sterna hirundo*) [a]	2.1	3.0	0.5	NA
Cory’s Shearwater (*Calonectris borealis*)	0.1	0.9	0.3	NA
Double-crested Cormorant (*Halacrocorax auritus*)	0.7	0.6	0.5	0.4
Dovekie (*Alle alle*)	0.1	0.1	0.3	0.2
Great Black-backed Gull (*Larus marinus*) [a]	1.3	0.5	0.7	0.6
Great Shearwater (*Puffinus gravis*)	0.1	0.3	0.3	0.1
Great Skua (*Stercorarius skua*)	NA	NA	0.1	NA
Herring Gull (*Larus argentatus*) [a]	1.0	1.3	0.9	0.5
Horned Grebe (*Podiceps auritus*)	NA	NA	NA	0.3
Laughing Gull (*Leucophaeus atricilla*)	1.0	3.6	0.9	0.1
Leach’s Storm-Petrel (*Oceanodroma leucorhoa*)	0.1	0.0	0.0	NA
Least Tern (*Sternula antillarum*)	NA	0.3	0.0	NA
Long-tailed Ducks (*Clangula hyemalis*)	0.6	0.0	0.4	0.5
Manx Shearwater (*Puffinus puffinus*) [a]	0.0	0.5	0.1	NA
Northern Fulmar (*Fulmarus glacialis*) [a]	0.1	0.2	0.1	0.2
Northern Gannet (*Morus bassanus*) [a]	1.5	0.4	1.4	1.4
Parasitic Jaeger (*Stercorarius parasiticus*)	0.4	0.5	0.4	NA
Pomarine Jaeger (*Stercorarius pomarinus*)	0.1	0.3	0.2	NA
Razorbill (*Alca torda*) [a]	5.2	0.2	0.4	2.1
Ring-billed Gull (*Larus delawarensis*)	0.5	0.5	0.9	0.5
Red-breasted Merganser (*Mergus serrator*)	0.5	NA	NA	0.7
Red Phalarope (*Phalaropus fulicarius*)	0.4	0.4	0.2	NA
Red-necked Phalarope (*Phalaropus lobatus*)	0.3	0.3	0.2	NA
Roseate Tern (*Sterna dougallii*)	0.6	0.0	0.5	NA
Royal Tern (*Thalasseus maximus*)	0.0	0.2	0.1	NA
Red-throated Loon (*Gavia stellate*) [a]	1.6	NA	0.5	1.0
Sooty Shearwater (*Ardenna grisea*)	0.3	0.4	0.2	NA
Sooty Tern (*Onychoprion fuscatus*)	0.0	0.0	NA	NA
South Polar Skua (*Stercorarius maccormicki*)	NA	0.2	0.1	NA
Surf Scoter (*Melanitta perspicillata*)	1.2	NA	0.4	0.5
Thick-billed Murre (*Uria lomvia*)	0.1	NA	NA	0.1
Wilson’s Storm-Petrel (*Oceanites oceanicus*)	0.2	0.9	0.2	NA
White-winged Scoter (*Melanitta deglandi*)	0.7	NA	0.2	1.3

Source: Calculated from Winship et al. 2018; Appendix D

NA = not applicable
[a] species used in collision risk modeling

Light: Offshore wind development at night would result in additional light from vessels and offshore structures. Ocean vessels have an array of lights including navigational lights and deck lights. Such lights can attract some birds, primarily during nighttime construction activities, but also during operations and decommissioning. Attraction to project vessels by birds would not be expected to result in increased risk of collision with vessels. The resulting vessel-related lighting impacts would be localized and temporary. In a maximum-case scenario, lights could be on 24 hours per day during construction. This could attract birds, and/or potential prey species, to construction zones, potentially exposing them to greater harm from other IPFs associated with construction.

Using the assumptions in Table A-4, up to 2,021 WTGs and 45 ESPs that could be constructed would have navigational and Federal Aviation Administration (FAA) hazard lighting in accordance with BOEM's lighting and marking guidelines, and would be placed on the OCS where few lighted structures currently exist. This lighting has some potential to result in long-term impacts and may pose an increased collision risk to migrating birds (Hűppop et al. 2006), though this risk would be minimized through the use of red flashing FAA lighting (BOEM 2019a; Kerlinger et al. 2010). While small due to the use of red flashing FAA lighting, some potential exists for WTG lighting to result in new collision risk, particularly to night flying migrants during low-visibility weather conditions where few lighted structures currently exist on the OCS.

New cable emplacement and maintenance activities: Generally, emplacement of submarine cables would result in increased suspended sediments that may impact diving birds and result in displacement of foraging individuals or decreased foraging success and have impacts on some prey species (Cook and Burton 2010). Using the assumptions in Table A-4, the total area of seafloor disturbed by offshore export and inter-array cables for offshore wind facilities is estimated to be up to 8,153 acres (33 km^2). In addition to cables related to individual offshore wind facilities, two unsolicited proposals for the development of two open access offshore transmission systems have been announced. The routes for these proposed regional cables have not been determined at this time and are not considered reasonably foreseeable, but BOEM assumes that if future offshore wind projects utilize one of these open access transmission systems, the impacts associated with new cable emplacement and maintenance activities would be less than if each individual project installed its own cable. In any case, all impacts associated with cable emplacement would be localized, and turbidity would be present during installation for 1 to 6 hours at a time. Any dredging necessary prior to cable installation could also contribute to additional impacts. New offshore submarine cables associated with the expanded planned action scenario would cause short-term disturbance of seafloor habitats and injury and mortality of bird prey species in the immediate vicinity of the cable emplacement activities. Disturbed seafloor from construction of future offshore wind projects may affect some bird prey species; however, assuming future projects use installation procedures similar to those proposed in the Vineyard Wind COP, the duration and extent of impacts would be limited and short-term, and benthic assemblages would recover from disturbance. FEIS Sections 3.2 and 3.3 provide more information. Given that impacts would be temporary and generally localized to the emplacement corridor, no individual fitness or population-level effects on birds would be expected. Based on the current anticipated construction schedule provided in Table A-4, construction impacts associated with multiple projects could overlap in time and space and could potentially result in greater impacts, though no individual fitness or population-level impacts would be expected to occur because birds would be expected to be able to successfully forage in adjacent areas not affected by increased suspended sediments. Migrating birds that are not actively foraging would not be affected.

Noise: Anthropogenic noise on the OCS associated with future offshore wind development, including noise from aircraft, pile-driving activities, geological and geophysical (G&G) surveys, offshore construction, and vessel traffic, has the potential to result in impacts on birds on the OCS. Additionally, onshore construction noise has the potential to result in impacts on birds. BOEM anticipates that these impacts would be localized and temporary. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

Aircraft may be used to transport construction and maintenance crews and would continue to be used for ongoing wildlife monitoring surveys, though the anticipated level of use would be low and restrictions on low-flying aircraft may be imposed. If flights are at a sufficiently low altitude, birds may flush, resulting in increased energy expenditure. Disturbance, if any, would be temporary and localized, with impacts dissipating once the aircraft has left the area. No individual or population-level effects would be expected.

In the expanded planned action scenario (Table A-4), construction of 2,066 offshore structures would create noise and may temporarily impact diving birds. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures and would be produced during construction for 4 to 6 hours at a time over a 6- to 12-year period. Noise transmitted through water has the potential to result in temporary displacement of diving birds in a limited space around each pile and can cause short-term stress and behavioral changes ranging from mild annoyance to escape behavior (BOEM 2014b, 2016a). Additionally, effects on foraging success may result from impacts on prey species (Table A.8.3-1). The extent of impacts would depend on pile size, hammer energy, and local acoustic conditions. Similar to pile-driving, G&G site characterization surveys for offshore wind facilities would create high-intensity impulsive noise around sites of investigation, leading to similar impacts. The extent depends on equipment used, noise levels, and local acoustic conditions. G&G noise would occur intermittently over an assumed 2- to 10-year period.

Onshore noise associated with intermittent construction of required offshore wind development infrastructure may also result in localized and temporary impacts, including avoidance and displacement, though no individual fitness or population-level effects would be expected to occur.

Noise associated with project vessels could disturb some individual diving birds, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). However, brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level effects would be expected.

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on birds through fish aggregation and associated increase in foraging opportunities, as well as entanglement and gear loss/damage, migration disturbances, and WTG strikes and displacement. These impacts may arise from buoys, met towers, foundations, scour/cable protections, and transmission cable infrastructure. Using the assumptions in Table A-4, the expanded planned action scenario would include up to 2,066 foundations which would entail 2,945 acres (12 km^2) of new scour protection for foundations and hard protection atop cables where few currently exist. In addition, the Southern New England OceanGrid Project allows for an up to 16 GW offshore electrical power transmission system; however, this project is not reasonably foreseeable. Projects may also install more buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until decommissioning of each facility is complete, approximately 30 years following construction.

In the Northeast and mid-Atlantic waters, there are 2,570 seabird fatalities through interaction with commercial fishing gear each year; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2017). Abandoned or lost fishing nets from commercial fishing may get tangled with foundations, reducing the chance that abandoned gear would cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013). In contrast, the presence of structures may also increase recreational fishing and thus expose individual birds to harm from fishing line and hooks; this intermittent impact would persist for the anticipated 30-year life of the proposed Project until decommissioning is complete.

The presence of new structures could result in increased prey items for some marine bird species. WTG and ESP foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, the new structure may also create habitat for structure-oriented and/or hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018). Invertebrate and fish assemblages may develop around these reef-like elements within the first year or two after construction (English et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind energy facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for individuals of some marine bird species. BOEM anticipates that the presence of structures may result in permanent beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs.

Offshore wind development would add up to 2,021 WTGs (Table A-4). Based on the assumption that structures would be spaced 1 nautical mile apart, ample space between WTGs would allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. Course corrections made to avoid a wind energy facility could result in exposure to one or more additional wind energy facilities within the geographic analysis area, but again, the 1-nautical-mile spacing would allow for migrating individuals to make only small course correction, if any, to avoid operating WTGs. Course corrections made by migratory birds to avoid a project or individual WTG would be relatively minor when compared to the distances traveled during seasonal long-distance migrations. Adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of WDAs would not be expected to be biologically significant. Any additional flight distances would be miniscule when compared with the overall migratory distances traveled by migratory birds, and no individual fitness or population-level effects would be expected to occur. The greatest risk to birds associated with future offshore wind development is expected to be fatal interactions with operating WTGs. However, unlike at land-based turbines, it is extremely difficult to record fatality events in the offshore environment; further, in rare events, the victim was rarely identified to species. Siting projects away from areas with high concentrations of birds and vulnerable populations is the best way to minimize impacts to avian resources on the OCS. To this end, several OCS blocks were removed from the Massachusetts call area to avoid high value sea duck habitat and minimize impacts to these species (BOEM 2012, 2014b).

The primary impact to avian resources during operations would be collision with the rotating turbine blades. In the contiguous United States, bird collisions with operating WTGs are a relatively rare event, with an estimated 140,000 to 328,000 (mean = 234,000) birds killed annually by 44,577 onshore turbines (Loss et al. 2013; and others report similar findings [e.g., Erickson et al. 2014]). Of course, the mortality estimate is likely higher because the number of turbines has increased since the studies were conducted; nevertheless, these studies represent the best available science in estimating collision mortality of North American bird species.

Estimating avian (or bat) mortality at a terrestrial wind facility is a relatively simple and straightforward process comprised of conducting ground searches for bodies and statistically adjusting the counts upward to account for the probability of not seeing the body and for the probability that the body was devoured by scavengers. Based on the mean annual mortality rate of 6.9 birds per turbine in the eastern United States (Loss et al. 2013), an estimated 13,945 birds could be killed annually under the anticipated development described in the expanded planned action scenario. However, the actual mortality rate would be expected to be much lower. First, 75 percent of the documented onshore mortality is composed of groups (small passerines, diurnal raptors, doves, pigeons, and upland game birds) that would not be expected to frequently encounter offshore WTGs in large numbers. Second, factors such as landscape features and weather patterns that influence collision risk are different on the OCS compared to onshore wind facilities. Third, empirical studies suggest that bird fatalities due to collision with offshore turbines is low. For instance, unlike the planned development on the U.S. Atlantic OCS, the majority of the offshore wind development in Europe is relatively close to shore, where bird densities tend to be greater in part due to being closer to some nesting colonies. In addition, the European wind energy facilities that are further out are usually between large land masses (e.g., North Sea), thus creating more opportunities for birds to move from the shore of one land mass to another. Using data from radar and thermal imaging to inform a stochastic collision risk model, 47 out of 235,136 migrating sea ducks were predicted to collide with 72 offshore wind turbines each year at the Nysted Wind Farm off Denmark (Desholm 2006)—or 0.7 bird per turbine. After reviewing 20 months of camera footage, six gulls were observed colliding with two turbines at the Thanet Wind Farm off England (Skov et al. 2018),—or 3.6 birds per turbine per year—which is an area that has approximately 3 to 10 times more gulls (Table 5 in Royal Haskoning 2013) compared to the WDA (COP Volume III, Appendix C, Table 4; Epsilon 2020b). Another approach to estimate collision fatalities is to use a collision risk model (e.g., the Band model [2012] or the Avian Stochastic Collision Risk Model [v2.3.2]). Collision modeling is commonly used at the project level to predict the number of fatalities of marine bird species in Europe and in the United

States (e.g., BOEM 2015b, 2019c). Model inputs (e.g., monthly bird densities, flight behavior, avoidance behavior, turbine specifications) are used to determine the estimated number of annual collisions with operating WTGs. Due to inherent data limitations, these models often represent only a subset of species potentially present, and are for a subset of marine bird populations that are vulnerable to collisions (based on Robinson Willmott et al. [2013]). The following modeling analysis estimates the hypothetical number of seabird fatalities from the multiple offshore wind projects described under the expanded planned action scenario. The following analysis is provided herein not to quantify the exact number of fatalities associated with the anticipated development of Atlantic offshore wind energy facilities, but rather to explore the relative number of fatalities using species that have sufficient information to run collision risk models.

The analysis uses the Avian Stochastic Collision Risk Model (CRM) (v 2.3.2) model and is similar to the Band model (Band 2012), except it is a simulation model and each input has an estimate of variation (e.g., standard of deviation [SD]). For example, in addition to entering the monthly mean density of flying birds, the user enters the standard deviation, and the subsequent output includes confidence intervals (or a range of fatalities). To obtain estimated confidence interval, the model was run 1,000 times for each species (see Donovan [2017] and McGregor et al. [2018] for more information on the model). For simplicity, it was assumed that there was one giant wind energy facility on the Atlantic OCS at 41 degrees latitude with 2,021 turbines laid out in 45 x 45 nautical mile grid with 1-nautical-mile spacing. The width of the wind energy facility was 51.6 miles (83 kilometers), and the model was set for a large array correction. The modeled reference turbines were based on a 12 MW WTG with three blades, a rotor radius of 107 meters, and a blade width of 23 feet (7 meters). The air gap between the lowest point of the blade and the water was 131 feet (40 meters), with a tidal offset of 5.9 feet (1.8 meters) (GE 2019). The turbine rotation speed was set at 7.8 revolutions per minute with the pitch of 1. The average wind speed was set at 7.74 (3.2 SD). It was assumed that all turbines would be operating (spinning) 96 percent of the time. It is important to note that the fatality estimates produced by the collision risk models are based upon above described parameters, which are representative of the WTGs expected to be used in future offshore wind development on the OCS. Model outputs would vary slightly based on specifications of actual WTGs selected for each project, but would not be expected to be materially different.

Twelve seabird species were identified as occurring on the Atlantic OCS with modeled flight height distributions from Johnston et al. (2014); they represent a wide range of marine bird species spanning five taxonomic orders: Anseriformes, Charadriiformes, Gaviiformes, Procellariiformes, and Suliformes. These flight height distributions provide enough information to use Option 3 (Extended) model feature in the Avian Stochastic CRM. Other model inputs for each species are provided in Table A.8.3-3. The model requires the monthly density of flying birds (number/km^2) and the monthly standard deviation. This information came from five regional survey efforts: Rhode Island Ocean Special Area Management Plan (Paton et al. 2010), Massachusetts Clean Energy Center avian surveys (Viet et al. 2016), New York State Energy Research and Development Authority New York Bight Surveys (Normandeau 2019), New Jersey Ecological Baseline (GMI 2010), and Mid-Atlantic boat surveys (Goyert et al. 2016). Only observations identified to species were used. The proportions of flying birds by species were calculated from the data from each survey effort in the Northwest Atlantic Seabird Catalog (O'Connell et al. 2009) and summarized in Table A.8.3-4. These proportions were multiplied by the observed monthly density of birds in each region, and then the mean monthly density of flying birds and standard deviation (Table A.8.3-5) was calculated across regions.

Table A.8.3-3: Model Inputs for Each Species [a]

Species	Avoidance Extended	Body Length	Wingspan	Flight Speed (meters/second)	Nocturnal Activity
Black-legged Kittiwake (*Rissa tridactyla*)	0.967 (0.002)	0.39 (0.005)	1.08 (0.04)	7.26 (1.5)	0.033 (0.0045)
Common Eider (*Somateria mollissima*)	0.98	0.605	0.97	19 (1.63)	0
Northern Fulmar (*Fulmarus glacialis*)	0.98	0.45 (0.025)	1.07 (0.025)	13 (2.8)	0.7
Razorbill	0.98	0.38 (0.005)	0.66 (0.0125)	16 (2.5)	0.1

Species	Avoidance Extended	Body Length	Wingspan	Flight Speed (meters/second)	Nocturnal Activity
Red-throated Loon (*Gavia stellate*)	0.98	0.61 (0.04)	1.11 (0.025)	20.6 (1.47)	0.1
Common Tern (*Sterna hirundo*)	0.98	0.33 (0.01)	0.88 (0.0525)	11 (1.85) [b]	0.28 (0.07) [c]
Great Black-backed Gull(*Larus marinus*)	0.996 (0.011) [d]	0.71 (0.035)	1.58 (0.0375)	9.8 (3.63) [d]	0.5 [e]
Herring Gull (*Larus argentatus*)	0.999 (0.005) [d]	0.595 (0.0225)	1.44 (0.03)	9.8 (3.63) [d]	0.5 [e]
Northern Gannet (*Morus bassanus*)	0.999 (0.003) [d]	0.935 (0.0325)	1.73 (0.0375)	13.33 (4.24) [d]	0.03 [f]
Lesser Black-backed Gull (*Larus fuscus*)	99.8 [d]	0.58	1.34 [b]	8.71 [d]	3 [g]
Atlantic Puffin (*Fratercula arctica*)	0.98	0.275 (0.0075)	0.55 (0.04)	17.6 (3.2) [h]	0.10 [e]
Manx Shearwater (*Puffinus puffinus*)	0.98	0.34 (0.02)	0.83 (0.0325)	11.3	0.5 [e]

[a] Mean (1SD) values. Avoidance, body length, and wingspan were set to default values unless otherwise noted. Half of the flights were upwind, and all birds were flapping (except Manx Shearwater).
[b] Pennycuick et al. 2013
[c] Loring et al. 2019
[d] Skov et al. 2018
[e] Robinson Willmott et al. 2013
[f] Furness et al. 2018
[g] Garthe and Hüppop 2004
[h] Pennycuick 1990

For the 2,021 WTGs anticipated under the expanded planned action scenario, the collision models predicted that 75 marine birds across the 12 modeled species would be killed each year. However, due to uncertainty in the data inputs (Table A.8.3-6), the modeled fatalities could be as high as 3,481 birds. Most of the variation in estimated fatalities is likely due to the relatively large amount of variation in monthly bird densities (see standard deviation in Table A.8.3-5). Fatalities of Common Eider (*Somateria mollissima*) were predicted to be relatively greater than Common Tern (*Sterna hirundo*) and Red-throated Loon (*Gavia stellate*) (Table A.8.3-5). For the remaining species, modeled fatalities were predicted to be extremely low. Further, no Atlantic Puffin (*Fratercula arctica*) and Manx Shearwater (*Puffinus puffinus*) fatalities are expected, because they are expected to fly below the rotor swept zone (less than 40 meters). The Avian Stochastic CRM would not run for Lesser Black-backed Gulls (*Larus fuscus*), so the Band model was used instead; no fatalities were predicted for Lesser Black-backed Gulls by the Band model.

Due to inherent data limitations (e.g., species-specific data needed to fill in Tables A.8.3-3, A.8.3-4, and A.8.3-5), it should be no surprise that there is not a fatality estimate for every species that may encounter operating WTGs. As described above, BOEM believes that as many as 55 species of birds may have some potential to encounter operating WTGs associated with the anticipated development of offshore wind facilities on the Atlantic OCS. However, aerial surveys of the Massachusetts WDAs conducted in all seasons from November 2011 to January 2015 identified only 25 species (Viet et al. 2016). Further, as shown in Veit et al. (2016), the mean densities of the 15 most commonly observed species were relatively low, as would be expected based on predicted species occurrence as modeled by the Marine-life Data and Analysis Team (Figure A.8.3-1 and Table A.8.3-2). All 12 species with sufficient data to run the collision risk modeling were included in the 15 most commonly observed species/species groups reported by Viet et al. (2016). Additionally, the 12 species modeled consist of species spanning five taxonomic orders and exhibit a wide range of behaviors and natural history characteristics. As such, these 12 species provide a representative sample of the majority marine bird species that would be expected to encounter operating WTGs based upon past surveys on the OCS. Given the relatively little overlap of the modeled presence of 47 marine bird species with future offshore wind energy development on the Atlantic (Table A.8.3-6), the annual mortality is generally expected to be relatively low.

Table A.8.3-4: Proportion of Birds Flying by Survey Effort Calculated Data in the Northwest Atlantic Seabird Catalog [a]

Species	Rhode Island Ocean Special Area Management Plan Boats Surveys	Massachusetts Clean Energy Center Aerial Surveys	New York State Energy Research and Development Authority Hi-Resolution Aerial Surveys	New Jersey Ecological Baseline Boat Surveys	Mid-Atlantic Boat Surveys
Common Eider (*Somateria mollissima*)	0.759	0.047	-	-	-
Red-throated Loon (*Gavia stellate*)	0.891	-	0.423	0.820	0.876
Northern Fulmar (*Fulmarus glacialis*)	0.000 [b]	0.692	0.667	-	-
Manx Shearwater (*Puffinus puffinus*)	0.200 [b]	-	-	-	0.786
Northern Gannet (*Morus bassanus*)	0.874	0.673	0.297	0.779	0.755
Black-legged Kittiwake (*Rissa tridactyla*)	0.958	0.841	0.770	0.913	-
Lesser Black-backed Gull (*Larus fuscus*)	-	-	0.395	-	-
Herring Gull (*Larus argentatus*)	0.904	-	0.297	0.813	0.840
Great Black-backed Gull (*Larus marinus*)	0.780	-	0.312	0.670	0.696
Common Tern (*Sterna hirundo*)	0.947	-	0.953	0.985	0.918
Razorbill (*Alca torda*)	0.778	0.065	0.010	0.515	0.588
Atlantic Puffin (*Fratercula arctica*)	0.167 [b]	-	0.010	-	-

[a] O'Connell et al. 2009; only observations that were identified to species were used.
[b] Less than ten observations

Table A.8.3-5: Mean Density (1 Standard Deviation) of Flying Birds by Month across Regional Surveys That Were Used as Model Inputs

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Common Eider (*Somateria mollissima*)	0.026 (0.023)	0.026 (0.023)	0.003 (0.005)	0.003 (0.005)	0.003 (0.005)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.047 (0.001)	0.047 (0.001)	0.047 (0.001)	0.026 (0.023)
Red-throated Loon (*Gavia stellate*)	0.299 (0.393)	0.299 (0.393)	0.307 (0.324)	0.299 (0.334)	0.299 (0.334)	0.001 (0.002)	0.001 (0.002)	0.010 (0.016)	0.025 (0.007)	0.025 (0.007)	0.025 (0.007)	0.299 (0.393)
Northern Fulmar (*Fulmarus glacialis*)	0.028 (0.042)	0.028 (0.042)	0.006 (0.004)	0.006 (0.005)	0.006 (0.005)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.046 (0.057)	0.046 (0.057)	0.046 (0.057)	0.028 (0.042)
Manx Shearwater (*Puffinus puffinus*)	0.014 (0.024)	0.014 (0.024)	0.005 (0.006)	0.005 (0.006)	0.005 (0.006)	0.004 (0.006)	0.004 (0.006)	0.004 (0.006)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.014 (0.024)
Northern Gannet (*Morus bassanus*)	1.940 (3.211)	1.940 (3.211)	1.007 (0.994)	0.934 (1.070)	0.934 (1.070)	0.085 (0.151)	0.085 (0.151)	0.165 (0.310)	0.712 (0.797)	0.712 (0.797)	0.712 (0.797)	1.940 (3.211)
Black-legged Kittiwake (*Rissa tridactyla*)	0.117 (0.203)	0.117 (0.203)	0.017 (0.029)	0.017 (0.029)	0.017 (0.029)	0.000 (0.000)	0.000 (0.000)	0.010 (0.018)	0.043 (0.029)	0.043 (0.029)	0.043 (0.029)	0.117 (0.203)
Lesser Black-backed Gull (*Larus fuscus*)	0.002 (-)	0.002 (-)	0.002 (-)	0.001 (-)	0.001 (-)	0.000 (-)	0.000 (-)	0.000 (-)	0.001 (-)	0.001 (-)	0.001 (-)	0.002 (-)
Herring Gull (*Larus argentatus*)	0.232 (0.112)	0.232 (0.112)	0.324 (0.113)	0.253 (0.202)	0.253 (0.202)	0.052 (0.060)	0.052 (0.060)	0.076 (0.090)	0.354 (0.401)	0.354 (0.401)	0.354 (0.401)	0.232 (0.112)
Great Black-backed Gull (*Larus marinus*)	0.160 (0.178)	0.160 (0.178)	0.098 (0.021)	0.081 (0.050)	0.081 (0.050)	0.052 (0.056)	0.052 (0.056)	0.069 (0.066)	0.204 (0.181)	0.204 (0.181)	0.204 (0.181)	0.160 (0.178)
Common Tern (*Sterna hirundo*)	0.000 (0.000)	0.000 (0.000)	0.366 (0.557)	0.418 (0.510)	0.418 (0.510)	0.243 (0.252)	0.243 (0.252)	0.192 (0.211)	0.101 (0.124)	0.101 (0.124)	0.101 (0.124)	0.000 (0.000)
Razorbill (*Alca torda*)	0.203 (0.308)	0.172 (0.321)	0.057 (0.044)	0.056 (0.047)	0.056 (0.047)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.003 (0.005)	0.003 (0.005)	0.003 (0.005)	0.203 (0.308)
Atlantic Puffin (*Fratercula arctica*)	0.003 (0.004)	0.003 (0.004)	0.006 (-)	0.000 (-)	0.000 (-)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.003 (0.004)

Source: O’Connell et al. 2009
“-“= not calculated

Table A.8.3-6: Predicted Annual Number of Hypothetical Collision Fatalities on the Atlantic OCS [a]

Species	Median [b]	95% CI
Atlantic Puffin (*Fratercula arctica*) [c]	0	NA
Black-legged Kittiwake (*Rissa tridactyla*)	0	0–19
Common Eider (*Somateria mollissima*)	56	0–465
Common Tern (*Sterna hirundo*)	11	3–29
Great Black-backed Gull (*Larus marinus*)	2	0–1,006
Herring Gull (*Larus argentatus*)	0	0–349
Lesser Black-backed Gull (*Larus fuscus*) [d]	0	NA
Manx Shearwater (*Puffinus puffinus*) [c]	0	NA
Northern Fulmar (*Fulmarus glacialis*)	0	0–3
Northern Gannet (*Morus bassanus*)	0	0–247
Razorbill (*Alca torda*)	0	0–17
Red-throated Loon (*Gavia stellate*)	6	0–1,346

95% CI = confidence interval; NA = not applicable
[a] Calculated from Avian Stochastic CRM (v2.3.2), using 12-megawatt turbines with 40-meter air gap. Output is from Extended Model (Option 3). Monthly mean densities of flying birds were calculated across regional survey efforts.
[b] Fatality estimates are dependent on presence and density of birds. For example, Common Eiders are known to appear in large numbers clumped together but not always in the same exact place from one year to the next. This, in part, can help explain why it is possible to have zero fatalities; if there are no birds present, then the number of fatalities would be zero.
[c] Flies below Rotor-Swept Zone, and therefore not at risk of collision with rotating turbine blades.
[d] Unable to use the stochastic model, so the traditional Band model was used.

Not all individuals that occur or migrate along the Atlantic coast are expected to encounter the rotor swept area of one or more operating WTGs associated with future offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table A.8.3-2). The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. However, substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas, and no individual fitness or population-level impacts would be expected to occur.

Aircraft traffic: General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Because aircraft flights associated with offshore wind development are expected to be minimal in comparison to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic would not be expected to appreciably contribute to overall impacts on birds.

Onshore construction: Construction activities associated with onshore construction of required offshore wind development infrastructure has the potential to result in some impacts due to habitat loss and/or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities. Further, construction would be expected to generally occur in previously disturbed habitats, and no individual fitness or population-level impacts on birds would be expected to occur. As such, onshore construction associated with future offshore wind development would not be expected to appreciably contribute to overall impacts on birds.

Climate change: Several sub-IPFs related to climate change, including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, and increased erosion and sediment deposition, have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing. Section A.8.1 provides more details on the expected contribution of offshore wind to climate change.

A.8.3.1.2. Conclusions for the No Action Alternative

Under the No Action Alternative, the resource would continue to follow the current general decreasing trends and respond to current and future environmental and societal activities.

While the proposed Project would not be built as proposed under the No Action Alternative, BOEM expects ongoing activities and future offshore wind activities to have continuing temporary to permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on birds primarily through accidental releases, anthropogenic noise, presence of structures, and climate change. BOEM anticipates that ongoing activities, especially interactions with commercial fisheries, anthropogenic light in the coastal environment, and climate change, would be **minor**. In addition to ongoing activities, BOEM anticipates that the impacts of planned actions other than offshore wind development would include new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and the installation of new structures on the OCS (Table A.8.3-1) and would be **minor.** BOEM expects that the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **minor** impacts on birds in the geographic analysis area.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with offshore wind activities in the geographic analysis area would result in **moderate** adverse impacts but could potentially include **moderate beneficial** impacts because of presence of structures. The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind development. Migratory birds that use the offshore WDAs during all or parts of the year would either be exposed to new collision risk, or would have long-term functional habitat loss due to behavioral avoidance and displacement from WDAs on the OCS. The offshore wind development would also be responsible for the majority of impacts related to new cable emplacement and pile-driving noise, but effects on birds resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant.

The No Action Alternative would forgo post-construction avian monitoring for migratory birds and ESA–listed species and annual mortality reporting that Vineyard Wind has committed to performing, the results of which could provide an understanding of the effects of offshore wind development, benefit the future management of these species, and inform planning of other offshore development would not be conducted; however, ongoing and future surveys and monitoring could still supply similar data.

A.8.3.2. Consequences of Alternative A

The following proposed-Project design parameters (Appendix G) would influence the magnitude of the impacts on birds:

- The new onshore substation, which would require the removal of forested habitat;
- The number, size, and location of WTGs;
- The type of lighting to be used; and
- The time of year during which construction occurs.

Since the DEIS was published, the substation area has been expanded, and the total approximate area of ground disturbance would be 7.7 acres (31,161 m^2), or 1.8 acres (7,122 m^2) greater than the 5.9 acres (23,877 m^2) assumed in the DEIS. The majority of ground disturbance would occur in previously disturbed (paved) areas where no tree clearing would be needed (potentially 0.2 acre [809 m^2] may require tree clearing). The southern portion of the expanded substation area is wooded, and an additional 0.2 acre (809 m^2) may need to be cleared, for a total of 6.1 acres (24,686 m^2) of tree clearing. This 6.1 acres (24,686 m^2) of tree clearing is within the estimated 7 acres (28,328 m^2) of tree clearing analyzed in the DEIS. Considering these changes, the impacts of Alternative A and all other action alternatives on birds through land disturbance are still expected to be **negligible**.

This assessment analyzes the maximum-case scenario; any potential variances in the proposed-Project build-out as defined in the PDE (i.e., numbers and spacing of WTGs and ESPs, length of inter-array cable) or construction activities would result in similar or lower impacts than described below. The sections below summarize the potential impacts of Alternative A on birds during the various phases of the proposed Vineyard Wind 1 Project. Routine activities would include construction, operations, maintenance, and decommissioning of the proposed

Project, as described in Chapter 2. The most impactful IPFs are expected to be the presence of structures, which could lead to adverse impacts including injury and mortality or elicit an avoidance response. BOEM prepared a BA for the potential effects to USFWS federally listed species, which found that the Proposed Action was not likely to adversely affect, or would have no effect, on listed species or their critical habitat (BOEM 2020b).

Impacts of Alternative A alone would likely result in both long-term and temporary localized consequences resulting from disturbance, displacement, injury, mortality, and habitat conversion that would not be expected to alter the overall character of birds in the geographic analysis area for birds. Some impacts would be adverse and others could be beneficial; overall the impacts of Alternative A alone on birds would likely be **negligible** to **minor** and may include **minor beneficial** impacts.

Accidental releases: As described in Table A.8.3-1, some potential for mortality, decreased fitness, and health effects exists due to the accidental release of fuel, hazmat, and trash and debris from vessels associated with the Proposed Action. Vessels associated with the Proposed Action may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012). Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Vineyard Wind 1 Project personnel, reducing the likelihood of occurrence to a very low risk. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and temporary **negligible** impacts on birds. Future offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazmat exposure. The contribution from future offshore wind and Alternative A would be a low percentage of the overall spill risk from ongoing activities.

In context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including Alternative A, would be expected to be localized and temporary due to the likely limited extent and duration of a release and result in **negligible** impacts.

Light: The Alternative A incremental contribution of up to 100 WTGs and two ESPs would all be lit with navigational and FAA hazard lighting. Per BOEM guidance (2019a) and outlined in the Vineyard Wind COP (Volume I, Section 3.1.1; Epsilon 2020a) each WTG would be lit with two FAA “L-864” aviation red flashing obstruction lights on top of the nacelle, adding up to 200 new red flashing lights to the offshore environment where none currently exist; these lights have some potential to attract birds and result in increased collision risk (Hűppop et al. 2006). However, red flashing aviation obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010; Orr et al. 2013). Should Alternative A involve the use of taller 14 MW WTGs, there would be 57 WTGs compared to 100, however additional mid-mast lighting would be required, resulting in three additional red flashing FAA aviation obstruction lights per WTG, for a total of 285 (57 x 5 = 285) red flashing lights on the OCS where none currently exist. Additionally, marine navigation lighting would consist of multiple flashing yellow lights on each WTG and on the corners of each ESP. The proposed Vineyard Wind 1 Project is proposing to use an Aircraft Detection Light System (ADLS), which if implemented would only activate WTG lighting when aircraft enter a predefined airspace. For Alternative A, this was estimated to occur 235 times during the year, illuminating less than 0.1 percent of nighttime hours per year (COP Volume III, Appendix III-N; Epsilon 2020b). To further reduce impacts to birds, when practicable Vineyard Wind would (1) reduce the number of lights, (2) use low intensity lights, (3) avoid white lights, (4) use flashing lights where appropriate, and (5) use lights only when necessary for work crews to minimize the potential bird attraction and disorientation and thus collision mortality (Appendix D). As such, BOEM expects impacts, if any, to be long-term but **negligible** from lighting**.** Vessel lights during construction, operations, and decommissioning would be minimal and likely limited to vessels transiting to and from construction areas.

While the significance level of impacts would remain the same, BOEM could further reduce impacts with the following mitigation measures conditioned as part of the COP approval (Appendix D):

- Use of red flashing FAA hazard lighting to decrease the likelihood of attracting migrating birds to the operating WTGs and minimize the risk of bird collisions.

- Use of ADLS to minimize the amount of time that FAA hazard lighting would be visible to reduce potential attraction to WTGs
- Use of Project lighting reductions to minimize the amount of light to reduce potential attraction to project vessels, WTGs, and ESPs.

The expected **negligible** impact of Alternative A alone would not noticeably increase the impacts of light beyond the impacts described under the No Action Alternative. Under the expanded planned action scenario, up to 2,021 turbines and 45 ESPs would have lights, and these would be incrementally added over time beginning in 2022 and continuing through 2030. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2019a) guidance. In context of reasonably foreseeable environmental trends, combined lighting impacts on birds from ongoing and planned actions, including Alternative A, would be expected to have **negligible**, non-measurable impacts on birds. Ongoing and future non-offshore wind activities are expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

New cable emplacement and maintenance: The Alternative A contribution of up to 328 acres (1.3 km^2) of seafloor disturbed by cable installation and up to 69 acres (0.3 km^2) affected by dredging prior to cable installation would result in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species. These impacts are expected to be temporary, lasting up to 12 hours, localized to the emplacement corridor, extending up on 1.2 miles (2 kilometers; Section A.8.2 has further details). However, individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement, and only non-measurable **negligible** impacts, if any, on individuals or populations would be expected given the localized and temporary nature of the potential impacts. Based on the assumptions in Table A-4, only the South Fork Wind Project cable installation would overlap in time with the Proposed Action for a limited time in 2022. However, given the localized nature of these impacts, impacts associated with the emplacement of South Fork Wind's export and inter-array cabling would not overlap spatially with the Proposed Action, and **negligible**, if any, impacts would be expected. Suspended sediment concentrations during activities other than dredging would be within the range of natural variability for this location. Any dredging necessary prior to cable installation could also generate additional impacts.

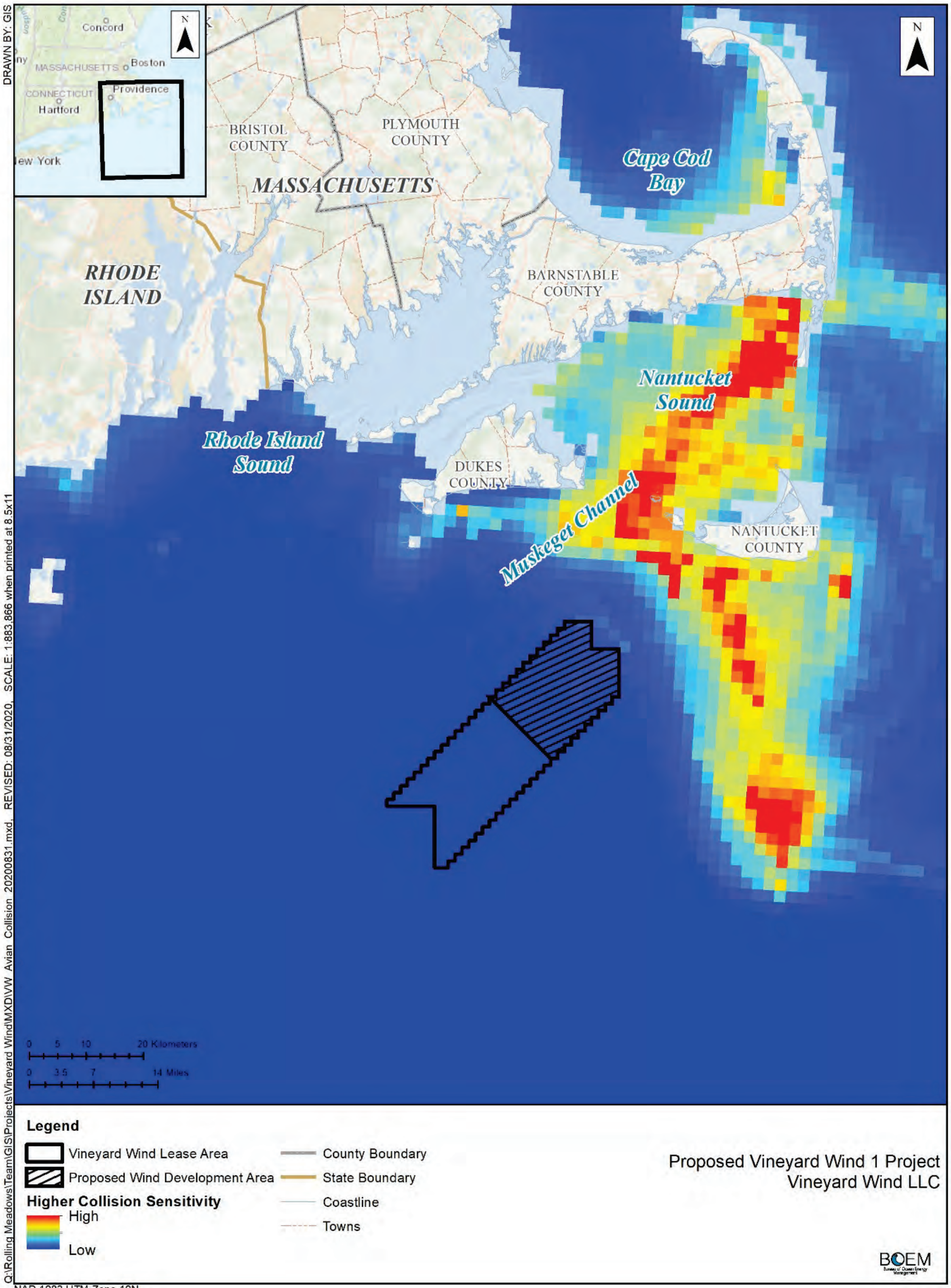
The expected **negligible** incremental impact of Alternative A combined with the planned actions would include up to 8,153 acres (33 km^2) of seafloor disturbed from the offshore export cable and inter-array cables. In context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including Alternative A, could occur if impacts are in close temporal and spatial proximity. However, these impacts from cable emplacement would be expected to be **negligible**, and would not be expected to be biologically significant.

Noise: The expected **negligible** impacts of aircraft, G&G survey, and pile-driving noise associated with Alternative A alone would not increase the impacts of noise beyond the impacts described under the No Action Alternative. Effects on offshore bird species could occur during the construction phase of Alternative A because of equipment noise (including pile-driving noise). The pile-driving noise impacts would be short-term (3 hours per pile with a maximum of two piles per day and not concurrent). Vessel and construction noise could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). As only temporary impacts, if any, are expected to occur, BOEM anticipates impacts to be **negligible** from the construction and installation of the offshore components. Normal operation of the substation would generate continuous noise, but BOEM expects **negligible** associated long-term impacts when considered in the context of the other commercial and industrial noises near the proposed substation.

In context of reasonably foreseeable environmental trends, combined noise impacts on birds from ongoing and planned actions, including Alternative A, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be **negligible**.

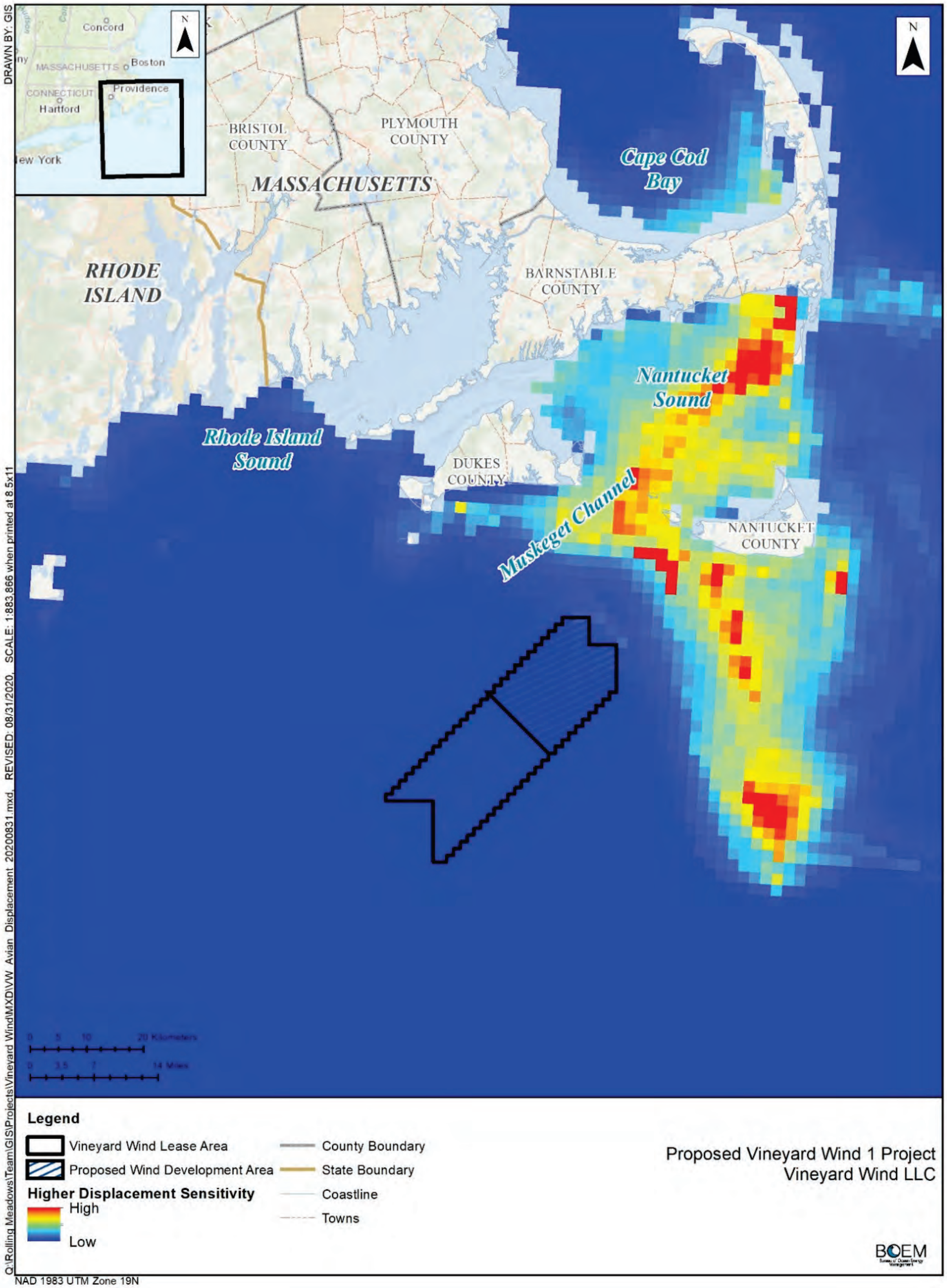
Presence of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, as well as entanglement and fishing gear loss/damage, migration disturbances, and WTG strikes and displacement, are described in detail in Section A.8.3.1.1. The impacts of Alternative A alone as a result of presence of structures would be **minor**, and may include **minor beneficial** impacts. As described in the BA submitted to the USFWS (BOEM 2020b), the Proposed Action would have **no effect** on the Black-capped Petrel as the Proposed Action occurs outside of the known distribution of the species. Due to the anticipated use of flashing red tower lights, the restricted time period of exposure during migration, and a small number of migrants that could cross the WDA, BOEM and USFWS conclude that the effects of the Proposed Action are **negligible** for Roseate Terns, Piping Plovers, and Red Knots. See the Vineyard Wind 1 BA (BOEM 2020b) for a complete discussion of the potential collision risk to ESA-listed species as a result of operation of the proposed Project.

As described above and depicted for the WDA in Figures A.8.3-2 and A.8.3-3, the locations of the OCS WDAs were selected to minimize impacts on all resources, including birds. Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). However, operation of the Proposed Action would result in impacts on some individuals of offshore bird species, and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs and/or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Millman 2016). The predicted activity of bird populations that have a higher sensitivity to collision (as defined by Robinson Willmott et al. [2013]) is relatively low in the WDA during all seasons of the year (Figure A.8.3-2), suggesting that bird fatalities due to collision is likely to be low. Species in the higher collision sensitivity group that are unlikely to be present in the WDA include, but are not limited to, the Black-legged Kittiwake (*Rissa tridactyla*), Double-crested Cormorant (*Phalacrocorax auritus*), Great Black-backed Gull (*Larus marinus*), Herring Gull (*Larus argentatus*), Laughing Gull (*Leucophaeus atricilla*), Northern Gannet, Parasitic Jaeger (*Stercorarius parasiticus*), and Pomarine Jaeger (*Stercorarius pomarinus*). When turbines are present, many birds would avoid the turbine site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid wind turbines by flying above, below, or between them (e.g., Desholm and Kahlert 2005; Plonczkier and Simms 2012; Skov et al. 2018), and others may take extra precautions to avoid turbines when the turbines are moving (e.g., Vlietstra 2008; Johnston et al. 2014). Several species have very high avoidance rates; for example, the Northern Gannet, Black-legged Kittiwake, Herring Gull, and Great Black-backed Gull have measured avoidance rates of at least 99.6 percent (Skov et al. 2018).Vineyard Wind performed an exposure assessment to estimate the risk of various offshore bird species encountering the WDA (COP Volume III, Appendix III-C; Epsilon 2020b). The species with the highest estimated risks were the Herring Gull, Great Black-backed Gull, Razorbill (*Alca torda*), Cory’s Shearwater (*Calonectris borealis*), and Black-legged Kittiwake. The risk for each species may change with the seasons, but at least one species would be at risk during any particular season. Averaged over the year, each species’ estimated risk of exposure was insignificant to low/unlikely, except for the Herring Gull and Great Black-backed Gull, for which the risk was medium/likely due to the attraction of gulls to vessels and offshore structures, upon which they may perch. Based on the results of the exposure assessment (COP Volume III; Epsilon 2020b), only cormorants, jaegers, and gulls would exhibit a significant chance of encountering the WDA. While cormorants’ typical low flight altitudes make them less vulnerable to collision, this is not the case with jaegers and gulls, though jaegers would only be expected to encounter operating WTGs during migration in the winter (COP Volume III; Epsilon 2020b and references in COP Section 6.2.2.2.1). In Massachusetts, jaegers and gulls are not listed as Special Concern species (MNHESP 2020).



Sources: Curtice et al. 2018; Northeast Ocean Data 2019; Winship et al. 2018

Figure A.8.3-2: Total Avian Relative Abundance Distribution Map for the Higher Collision Sensitivity Species Group



Source: Curtice et al. 2018; Northeast Ocean Data 2019; Winship et al. 2018

For more information, see: https://www.northeastoceandata.org/data-explorer/?birds|stressor-groups

Figure A.8.3-3: Total Avian Relative Abundance Distribution Map for the Higher Displacement Sensitivity Species Group

During migration, many bird species, including song birds, likely fly at heights well above the rotor swept zone (89 to 696 feet [27 to 212 meters] above sea level) (COP Volume III; Epsilon 2020b and references in COP Volume III, Section 6.2.2.2.1; Epsilon 2020b). As shown in Robinson Willmott et al. (2013), species with low sensitivity scores include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the Rotor Swept Zone.

It is generally assumed that inclement weather and reduced visibility causes change to migration altitudes (Ainley et al. 2015) and could potentially lead to large-scale mortality events. However, this has not been shown to be the case in studies of offshore wind facilities in Europe, with oversea migration completely, or nearly so, ceasing during inclement weather (Fox et al. 2006; Pettersson 2005; Hüppop et al. 2006), and with migrating birds avoiding flying through fog and low clouds (Panuccio et al. 2019). Further, many of these passerine species, while detected on the OCS during migration as part of BOEM's Acoustic/Thermographic Offshore Monitoring project (Robinson Willmott and Forcey 2014), they were documented in relatively low numbers. In addition, most of the activity (including Blackpoll warblers) was during windspeeds less than 10 kilometers per hour—below the turbine cut in speed (see Figure 109 in Robinson Willmott and Forcey 2014) and thus little risk to migrating passerines. Further, most carcasses of small migratory songbirds found at land-based wind energy facilities in the northeast were within 2 meters of the turbine towers, suggesting that they are colliding with towers rather than moving turbine blades (Choi et al. 2020). Although it is possible that migrating passerines could collide into offshore structures, migrating passerines are also occasionally found dead on boats, presumably from exhaustion (e.g., Stabile et al. 2017).

If Alternative A were implemented with 14 MW turbines, the collision risk to birds that may encounter operating WTGs would be minimized, as there would only be 57 WTGs compared to 100, and the overall project footprint would be smaller. This would allow for greater distances between some individual WTGs and increased distance from sea level to the rotor swept area—which would, in turn, reduce the probability of a fatal interaction with an operating WTG.

Some marine bird species might avoid the WDA during its operation, leading to an effective loss of habitat. For example, loons (Dierschke et al. 2016; Drewitt and Langston 2006; Lindeboom et al. 2011; Percival 2010; Petersen et al. 2006), grebes (Dierschke et al. 2016; Leopold et al. 2011; Leopold et al. 2013), seaducks (Drewitt and Langston 2006; Petersen et al. 2006), and Northern Gannets (Drewitt and Langston 2006; Lindeboom et al. 2011; Petersen et al. 2006) typically avoid offshore wind developments. However, loons, seaducks, grebes, and several gull species were not observed or observed in low densities in the WDA during MASSCEC surveys while Razorbills and Black-legged Kittiwakes were relatively common in winter (see Table 4, in COP Append III-C). The proposed Project would be built in an approximate 118-square-mile portion of the Vineyard Wind lease area. While this area would no longer provide foraging opportunities to those species with high displacement sensitivity, suitable foraging habitat exists in the immediate vicinity of the proposed Project and throughout the region. Potentially suitable foraging habitats located to the northeast, north, and northwest of the proposed Project are located outside of the Massachusetts Lease Areas and would remain available to these species following the anticipated development of the Massachusetts Lease Areas. However, as depicted in Figure A.8.3-3, modeled use of the WDA by bird species with high displacement sensitivity, including but not limited to the Common Loon, Great Black-backed Gull, Northern Gannet, and Red-throated Loon is low. A complete list of species included in the higher displacement sensitivity group can be found in Robinson Willmott et al. (2013). Since the Massachusetts Lease Areas avoid high-value sea duck habitat and is not likely to contain important foraging habitat for the other species susceptible to displacement, BOEM expects this loss of habitat to be insignificant (COP Volume III; Epsilon 2020b and references in COP Volume III, Section 6.2.2.2.2; Epsilon 2020b). Population-level, long-term impacts resulting from habitat loss would likely be **negligible.**

While the significance level of impacts would remain the same, BOEM could further reduce impacts with the following mitigation measures conditioned as part of the COP approval (Appendix D):

- Install bird deterrent devices to minimize bird attraction to operating turbines and the ESPs, where and if appropriate.
- Use ADLS to minimize the amount of time that FAA hazard lighting is visible to reduce potential attraction to WTGs

- The Lessee will coordinate with the Lessor and USFWS to finalize a bird post-construction monitoring plan prior to the commencement of operations. Within the first year of operations, the Lessee will install digital VHF telemetry automated receiving stations and acoustic monitoring devices to estimate the exposure of ESA species and other migratory birds to the operating wind facility. In addition, the Lessee will install acoustic detectors for birds. The monitoring plan will include periodic monitoring progress reports plus comprehensive annual reports followed by a discussion of each year's results with BOEM and USFWS that include the potential need for reasonable revisions to the Monitoring Plan. All data generated as part of pre- and post-construction monitoring will be made available to the public through BOEM's website.
- Provide annual mortality reporting to BOEM and USFWS.

The expected **negligible** to **minor** impacts of Alternative A alone would not increase beyond the impacts described under the No Action Alternative. Using the assumptions in Table A-4, there could be up to approximately 2,021 WTGs within the geographic analysis area. Of these, a maximum of 100 WTGs would result from the proposed Project, and the remainder is the estimated result of other offshore wind projects in the geographic analysis area. The structures associated with Alternative A and the consequential impacts would remain at least until decommissioning of the proposed Project is complete. In context of reasonably foreseeable environmental trends, the combined impacts arising from the presence of structures from ongoing and planned actions, including Alternative A, would be expected to range from **negligible to moderate** based on the sub-IPFs identified in Table A.8.3-1 and may result in **moderate beneficial** impacts due to the large number of structures. A majority (approximately 95 percent) of these impacts would occur as a result of structures associated with other future offshore wind development and not Alternative A, as Alternative A would account for 4.9 percent (100 of 2,021) of the new WTGs on the Atlantic OCS.

Aircraft Traffic: The expected **negligible** impacts of aircraft traffic associated with the Alternative A alone would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative.

In context of reasonably foreseeable environmental trends, the combined aircraft traffic impacts from ongoing and planned actions, including Alternative A, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be **negligible**.

Onshore Construction: The expected impacts of onshore construction associated with Alternative A would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative. Vineyard Wind's commitment to the use of HDD technology at the Covell's beach would avoid beach habitat for nesting shorebirds; as such, temporary impact to birds, particularly nesting shorebirds resulting from the landfall location, would be **negligible**. BOEM could further reduce potential impacts on nesting shorebirds near the Covell's Beach landfall by implementing the mitigation measure of avoiding the installation of export cable conduits between April 1 and August 31 (Appendix D). This would avoid impacts on nesting shorebirds. To further reduce impacts on Piping Plovers, Vineyard Wind would implement a Piping Plover Protection Plan (Appendix D). Given that the closest areas of designated Critical Habitat for Piping Plovers are located in North Carolina, no effects to designated Piping Plover Critical Habitat would be expected to occur as a result of the proposed Project. Implementation of a Piping Plover Protection Plan would also benefit other species of shorebirds.

Collisions between birds and vehicles or construction equipment have some limited potential to cause mortality. However, these temporary impacts, if any, would be **negligible**, as most individuals would avoid the noisy construction areas (Bayne et al. 2008; Goodwin and Shriver 2010; McLaughlin and Kunc 2013). Alternative A would require temporary habitat alteration within existing public utility right-of-way. Clearing, grading, and excavations would temporarily alter existing habitat, which is primarily grassland and small shrubs. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for birds. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on bird species that frequent this forest edge/managed grassland ecosystem are not expected to be measurable, and as such are considered **negligible**.

Long-term habitat loss or alteration may also result from Alternative A. The proposed new substation site would require the clearing of 6.1 acres (24,685.9 m^2) of pitch pine-oak forest habitat that is potentially suitable for use by nesting and/or foraging birds. Common bird species such as Rufous-sided Towhee, Pine Warbler, and Ruffed Grouse are typically associated with this habitat (MDFW 2016). This type of forest is very common throughout southeastern Massachusetts (MDFW 2016). In addition, the proposed substation site would be located on the edge of a previously developed site within the Independence Park commercial/industrial area in the Town of Barnstable. These changes would be expected to have a minimal effect on birds because this type of forest habitat is common across Cape Cod and is available as a high-quality, contiguous block in the nearby Hyannis Ponds WMA, which lies as near as 0.25 mile (0.4 kilometer) from the proposed substation area. As a result, BOEM anticipates temporary **negligible** impacts.

Vineyard Wind would likely leave onshore facilities in place for future use (Chapter 2). There are no plans to disturb the land surface or terrestrial habitat during the course of Proposed Action decommissioning. Therefore, onshore temporary impacts of decommissioning would be **negligible**.

In context of reasonably foreseeable environmental trends, the combined impacts associated with onshore construction from ongoing and planned actions, including Alternative A, would be expected to remain **negligible** and would not be expected to result in noticeable change to the condition of birds in the geographic analysis area.

Other considerations: For temporary impacts, including the effects of accidental releases, anthropogenic noise, new cable emplacement, and onshore construction, it is likely that a portion, possibly a majority, of such impacts from future activities would not overlap temporally or spatially with Alternative A. However, some IPFs that may result in temporary impacts can also result in long-term to permanent impacts.

In summary, activities associated with the construction, installation, operations, maintenance, and eventual decommissioning of Alternative A alone would impact birds to varying degrees, depending on the location, timing, and species affected by an activity. Construction of offshore components is not likely to disturb or displace birds, and would have a **negligible** impact on the resource. Construction of onshore components would result in a small area of permanent habitat loss and conversion, but impacts would be **negligible**. Operation of the onshore components would have **negligible** impacts, while operation of the offshore components, especially the rotating WTGs, could result in habitat loss and in collision-induced mortality, leading to **negligible** to **minor** impacts, with potential **minor beneficial** impacts. Onshore decommissioning would hardly have any effect, but offshore decommissioning would have impacts comparable to the construction phase. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section A.8.3.1.2.

In context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including Alternative A, would range from **negligible** to **moderate,** but could potentially include **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including Alternative A, would result in **moderate** impacts to birds in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and the potential for direct mortality resulting from fatal interactions with operating WTGs associated with the expanded planned action scenario. Alternative A would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures. Therefore, the overall impacts on birds would likely qualify as **moderate** because a notable and measurable impact is anticipated, but the resource would likely recover completely when the WTGs are removed and/or remedial or mitigating actions are taken.

While the significance level of impacts would remain the same, BOEM could further reduce impacts with the following mitigation measures conditioned as part of the COP approval (Appendix D):

- Install bird deterrent devices to minimize bird attraction to operating turbines and on the ESP, where and if appropriate.
- Implement a Piping Plover Protection Plan.
- Implement Project lighting reductions.
- Use ADLS.

- Develop and implement a framework for an avian post-construction monitoring program in coordination with applicable federal and state resource agencies (Appendix F). Use annual monitoring reports to assess the need for reasonable revisions to the monitoring plan.
- Implement a post-construction monitoring program for ESA-listed and migratory bird species that is developed in coordination with BOEM and USFWS.
- Provide annual mortality reporting to BOEM and USFWS.

A.8.3.3. Consequences of Alternatives C, D1, D2, and F

The impacts resulting from individual IPFs associated with Alternatives C, D1, D2, and F would be similar to those described under Alternative A. BOEM does not expect relocation of the six northernmost WTG locations under Alternative C to the southern portion of the WDA to significantly change the potential impacts because the total number of WTGs would remain the same, and the southern portion of the WDA does not include areas with higher densities of birds. Under Alternatives D1, D2, and F, the acreage of the WDA would increase compared to Alternative A, potentially leading to a slightly increased risk of migrating birds encountering the WDA due to the larger Project footprint, though the additional spacing between WTGs would allow for individuals to make only minor, if any, course corrections to avoid operating WTGs. Some additional loss of suitable habitat for bird species with high displacement sensitivity would occur under Alternatives D1, D2, and F. While each of the alternatives would slightly change the potential impacts, the incremental impacts would not be expected to be materially different that those described under Alternative A; they would include **negligible** to **minor** impacts and possibly **minor beneficial** impacts.

In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternatives C, D1, D2, or F, would not be materially different from those described under Alternative A (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and potentially **moderate beneficial** impacts). While Alternatives D1, D2, and F may be slightly more impactful to birds than Alternative A, the impacts of Alternatives C, D1, D2, and F would be similar to impacts described under Alternative A. The overall impacts on birds of ongoing and planned actions, including Alternatives C, D1, D2, or F, would be the same level as described under Alternative A—**moderate**. This impact rating is driven primarily by ongoing activities such as climate change as well as the presence of operating WTGs on the OCS. As described above for Alternative A, Vineyard Wind's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts, but would not change the impact ratings.

A.8.3.4. Consequences of Alternative E

With the exception of the number of WTGs, impacts of the construction and installation, operations and maintenance, non-routine activities, and decommissioning of Alternative E would be practically identical to those described under Alternative A. IPFs associated with the construction and installation of no more than 84 WTGs, including accidental releases, pile-driving noise, temporary avoidance and displacement, turbidity, and sediment deposition, would be reduced by approximately 16 percent compared to the maximum-case scenario under Alternative A, namely 100 WTGs. As demonstrated by Johnston et al. (2014), the use of fewer and taller WTGs may be an effective method of reducing bird collision risk. In addition to reduced collision risk, functional habitat loss to those species populations with higher displacement sensitivity would be slightly smaller due to the reduced Project footprint. Should Alternative A involve the use of taller 14 MW WTGs, an even greater reduction in potential collision risk and functional habitat loss would result. However, the overall expected **negligible** to **minor** impacts and potential **minor beneficial** impacts on birds would not be expected to be materially different than those described under Alternative A.

In context of reasonably foreseeable environmental trends, the combined impacts on birds from ongoing and planned actions, including Alternative E, would not be materially different from those described under Alternative A (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and potentially **moderate beneficial** impacts). While Alternative E may be slightly less impactful to birds than described under Alternative A, the overall impacts of Alternative E on birds within the geographic analysis area would be the same level as under Alternative A–**moderate**. This impact rating is driven primarily by ongoing activities such as climate change as well as the presence of operating WTGs on the OCS. As described above for Alternative A, Vineyard Wind's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts, but would not change the impact ratings.

A.8.3.5. Comparison of Alternatives

As discussed in the above sections, the expected **negligible** to **minor** impacts and potential **minor beneficial** impacts associated with Alternative A alone would not change substantially under Alternatives C through F. While the alternatives have some potential to result in slightly different impacts on birds, the same construction, operations and maintenance, and decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives D1, D2, and F may result in slightly more, but not materially different, **negligible** to **minor** impacts and **minor beneficial** impacts on species with higher collision sensitivity and species with higher displacement sensitivity due to an expanded Project footprint. Alternative E may result in slightly less, but not materially different, **negligible** to **minor** impacts and **minor beneficial** impacts on high-collision sensitive and high-displacement sensitive species due to a reduced number of WTGs and Project footprint. Therefore, the overall **negligible** to **minor** impacts and **minor beneficial** impacts would be very similar across all alternatives. Any action alternative would include monitoring for potential effects on ESA–listed species, annual mortality reporting, and the development of a post-construction monitoring program. Information gained via monitoring could be used to inform Vineyard Wind's decommissioning procedures and could also be used to assist other future offshore wind projects in selecting the least impactful method(s).

In context of reasonably foreseeable environmental trends, impacts from ongoing and planned actions, including any action alternative, would likely be similar because the majority of the impacts of any alternative come from other future offshore wind development, which does not materially change between alternatives. However, the differences in impacts between action alternatives would still apply when considered alongside the impacts of other ongoing and future activities. Therefore, impacts on birds would be slightly higher but not materially different under Alternatives D1, D2, and F, and slightly lower but not materially different under Alternative E. The impacts resulting from individual IPFs associated with the any alternative would range from **negligible** to **moderate** due to behavioral avoidance, temporary or permanent displacement, injury, and mortality, and may include **moderate beneficial** impacts due to the presence of structures.

In conclusion, the overall impacts on birds from any alternative, including ongoing and planned actions, are expected to be **moderate**. The main drivers for this are a result of ongoing activities, the presence of WTGs, and climate change, which are expected to lead to noticeable temporary and permanent impacts across much of the geographic analysis area, of which a small portion is contributed by Alternative A. The presence of new structures could benefit some prey species that depend on hard structure and thereby provide increased foraging opportunities for bird species within the geographic analysis area.

A.8.3.6. Summary of Impacts of the Preferred Alternative

The Preferred Alternative would be a combination of Alternatives C, D2, and E with mitigation measures in Appendix D. Under the Preferred Alternative, the OECR would be located within existing roadway rights-of-way, thus avoiding all habitat and resulting in no impact on terrestrial habitat or any known protected or rare habitats. In addition, the Preferred Alternative would result in the clearing of 6.1 acres (24,685.9 m^2) of pitch pine-oak habitat at the proposed substation site.

Mitigation measures included as part of the Preferred Alternative would reduce potential impacts compared to Alternative A by requiring that Vineyard Wind comply with no installation of the OECC at Covell's Beach landfall between April 1 and August 31 to avoid impacts to nesting shorebirds; the installation of bird deterrent devices, where appropriate, on operating turbines to minimize the potential to attract birds to the WTGs and ESP(s); implementation of an ADLS to reduce amount of light emitted into the environment that may attract migrating birds and reduce risk of bird collisions; development of a framework for a post-construction monitoring program for birds to determine the actual impact and adjust monitoring requirements (Appendix F); annual reporting to BOEM and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning; and post-construction monitoring for ESA-listed and other migratory bird species, including the first year of operations. Vineyard Wind would coordinate with BOEM and

USFWS to install digital very high frequency telemetry automated receiving stations to estimate the exposure of ESA and other migratory birds to the operating wind facility as a condition of COP approval (Appendix D).

Under the Preferred Alternative, the WDA would contain between 57 to 84 WTGs. This alternative would include 43 to16 percent fewer WTGs than the maximum-case scenario under Alternative A. As demonstrated by Johnston et al. (2014), the use of fewer, higher WTGs may be an effective method of reducing collision risk. It is possible that Vineyard Wind could use larger capacity WTGs that are not necessarily taller than smaller capacity WTGs; this would result in fewer turbines than the 100 WTGs in Alternative A. Thus, the Preferred Alternative could be less likely to affect birds (including migratory birds and summer resident seabirds) than Alternative A. Overall, the significance level of impacts for the Preferred Alternative would remain the same as those for Alternative A—

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Table A.8.3-1: Summary of Activities and the Associated Impact-Producing Factors for Birds

Baseline Conditions: More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). The Northeast United States is also home to more than one-third of the human population of the nation. As a result, species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of human-caused stressors that have the potential to have impacts on bird species.

Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015). Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Each year, almost 86,000 sea ducks such as the Long-tailed Duck (27,000), Common Eider (12,500), Black Scoter (19,400), White-winged Scoter (3,300), and Surf Scoter (23,500) are harvested on the Atlantic Flyaway (Roberts 2019). Sea duck mortality due to hunting pressure is expected to continue at the current rate commensurate with the current trend in hunting effort.

In the Northeast and mid-Atlantic waters, there are 2,570 seabird interactions each year with commercial fishing gear; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2017).

In the United States, domestic cats (free ranging and feral) kill 2.4 billion birds a year (Loss et al. 2015). Avian mortality associated with predation by free-ranging cats is expected to continue at the current rate commensurate with the number of free-ranging cats.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms due to global climate change. Models of vulnerability to climate change have estimated that, throughout Massachusetts, 61 species (43 percent of the 143 species modeled) are highly vulnerable, and 22 species (15 percent) are likely vulnerable (Mass Audubon 2017).

The marine bird behavioral response to offshore wind energy development is species-specific (Krijgsveld 2014). Some may be attracted to the structures, while some may entirely avoid the area of development and others may be indifferent or habituate to the presence of new structures. Sea ducks, loons, alcids, and gannets are birds that may avoid areas with structures and consequently could be displaced from foraging areas, while others like cormorants and large gulls are attracted to the structures for roosting.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	Table A.8.2-1 provides a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Ingestion of hydrocarbons can lead to morbidity and mortality due to decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in feather oiling can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). These impacts rarely result in population-level impacts.	Table A.8.2-1 provides a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the potential risk of accidental releases and associated impacts, including mortality, decreased fitness, and health effects on individuals. Impacts are unlikely to affect populations.	Table A.8.2-1 provides a quantitative analysis of these risks. Based on the volumes potentially involved, the additional impact would fall within the range of ongoing activities, primarily during construction, but also during operations and decommissioning.	Table A.8.2-provides a quantitative analysis of these risks. The Proposed Action would increase the risk of releases, which would have localized, temporary **negligible** impacts including individual mortality, decreased fitness, and health effects. Further, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize impacts on offshore bird species resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012).	Table A.8.2-1 provides a quantitative analysis of these risks. The Proposed Action could lead to an increased potential for a release that may result in localized and temporary **negligible** impacts, including individual mortality, decreased individual fitness, and health effects. However, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills, which would minimize impacts on offshore bird species resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012). The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. In context of reasonably foreseeable environmental trends, combined impacts from this IPF on birds from ongoing and planned actions, including Alternative A, are expected to be **negligible** impacts and are expected to be highly localized and temporary due to the likely limited extent and duration of a release.
Accidental releases: Trash and debris	Trash and debris are accidentally discharged through onshore sources; fisheries use; dredged material ocean disposal; marine minerals extraction; marine transportation, navigation, and traffic; survey activities; and cables, lines, and pipeline laying on an ongoing basis. In a study from 2010, students at sea collected more than 520,000 bits of plastic debris per square mile. In addition, many fragments come from consumer products blown out of landfills or tossed out as litter (Law et al. 2010). Birds may accidentally	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. This may result in increased injury or mortality of individuals. However, there does not appear to be evidence that the volumes and extents would have any impact on bird populations.	Trash and debris may be released by vessels during construction, operations, and decommissioning. An accidental release would be a localized event in the vicinity of WDAs, likely resulting in little change to the resource.	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of the WDA, likely resulting in non-measurable **negligible** impacts, if any. Further, BMPs proposed for waste management and mitigation for marine debris training and awareness of Vineyard	The Proposed Action could lead to non-measurable, **negligible** impacts on birds, including individual injury or mortality caused by ingesting trash and debris. Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Vineyard Wind 1 Project personnel, reducing the likelihood of occurrence to a very low risk. The impacts from ongoing activities and future non-offshore wind activities would be similar in nature, but of a greater spatial and temporal extent. Future offshore wind activities would likely result in much more accidental trash and debris releases than the Proposed Action, but the overall risk would still be considered low. In context

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	ingest trash mistaken for prey. Mortality is typically a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019).			Wind 1 Project personnel would be required, reducing the likelihood of occurrence to a very low risk.	of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on birds from ongoing and planned actions, including Alternative A, is expected to be **negligible** impacts and are expected to be short-term and localized, with the Proposed Action having little-to-no influence on impacts through this sub-IPF.
Light: Vessels	Ocean vessels have an array of lights including navigational lights, deck lights, and interior lights. Such lights can attract some birds. The impact is localized and temporary. This attraction would not be expected to result in an increased risk of collision with vessels, but may lead to accidental trash ingestion (see Accidental Releases: Trash and debris row). Population-level impacts would not be expected.	Gradually increasing vessel traffic over the next 30 years would increase the potential for bird and vessel interactions. While birds may be attracted to vessel lights, this attraction would not be expected to result in increased risk of collision with vessels, but may lead to accidental trash ingestion (see Accidental Releases: Trash and debris row). No population-level impacts would be expected.	In a maximum-case scenario, lights could be active 24 hours per day during construction. This could attract birds to construction zones, potentially exposing them to greater harm from other IPFs. If there were no nighttime construction, this would not be a factor. Some vessel lighting could also occur during operations and decommissioning.	The Proposed Action would allow nighttime work on an as-needed basis, in which case the Project would reduce lighting of vessels. These impacts would be highly localized and would exist only as long as the lights were in use. Navigation lights during construction, operations, and decommissioning would be minimal and are expected to cause a **negligible** impact, if any, on birds, with no individual fitness or population-level impacts expected.	The Proposed Action is expected to cause **negligible** impacts on birds from this sub-IPF. The impacts of ongoing activities and future non-offshore wind activities (attraction, exposure to other IPFs) are highly localized, temporary to short-term, and greater than the expected impacts of future offshore wind activities. Future offshore wind activities would likely result in the same type of impacts, but with a smaller spatial and temporal extent than ongoing activities. No impacts of this sub-IPF on birds can be attributed to the Proposed Action, although ongoing activities, including other offshore wind projects, are expected to result in some highly localized and short-term **negligible** impacts.
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including houses and ports, emit a great deal more light on an ongoing basis. Buoys, towers, and onshore structures with lights can attract birds. This attraction has the potential to result in an increased risk of collision with lighted structures (Hűppop et al. 2006). Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in proportion with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	Up to 2,021 turbines and 45 ESPs would have lights, and these would be incrementally added over time. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) in accordance with BOEM guidance (BOEM 2019a). Use of red flashing lights could reduce the potential increase in collision risk (Kerlinger et al. 2010).	Up to 100 WTGs and two ESPs would have aviation hazard navigation lights for 30 years. Red flashing aviation obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010). Vineyard Wind would use red flashing lights as a measure to decrease the likelihood of attracting migrating birds to the operating WTGs and to minimize the risk of bird collisions. The Vineyard Wind 1 Project is also proposing to use ADLS, which would mean that FAA lighting would be used only 10% of the time at night. The proposed use of ADLS would substantially reduce the amount of light emitted into the environment. Given the use of red flashing lights and the ADLS, only non-measurable **negligible** impacts, if any, to individuals or populations would be expected.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on birds through this sub-IPF. The impacts from ongoing activities and future non-offshore wind activities are widespread and permanent near the coast, but minimal offshore. Future offshore wind activities could cause impacts on birds through this sub-IPF if BOEM and FAA lighting guidance is not followed. This sub-IPF would have **negligible**, non-measurable impacts on birds that would be attributed to the Proposed Action, although ongoing and future non-offshore wind activities are expected to cause permanent impacts, primarily driven by light from onshore structures.
New cable emplacement/ maintenance	New cable emplacement and cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be temporary and generally limited to the emplacement corridor. Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances will be temporary and limited to the emplacement corridor. In the geographic analysis area, there are six existing power cables. See BOEM (2019b) for details. Impacts from suspended sediment include reduced foraging success, as vision is an important component of seabird foraging activity (Cook and Burton 2010). Additionally, impacts	Future new cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in localized, short-term impacts. The FCC has two pending submarine telecommunications cable applications in the North Atlantic. Impacts would be temporary and localized, with no biologically significant impacts on individuals or populations.	Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited spatially and temporally. Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term impacts on foraging individuals could occur in the immediate vicinity of installation activities. No biologically significant impacts on individuals or populations would be expected.	The Proposed Action would cause short-term disturbances during construction and possibly during operations and maintenance. The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation, and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term impacts including reduced foraging success and displacement (Cook and Burton 2010). Cable installation would mostly be done by jet or mechanical plow. Dredged material disposal could increase suspended sediment concentrations to more than 1,000 mg/L for a	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term, **negligible** impacts due to reduced foraging success and displacement, although no biologically significant impacts would be expected. Ongoing and future non-offshore wind activities—if any involve this IPF—may cause local, short-term impacts. Future offshore wind activities other than the Proposed Action would disturb up to 7,037 acres (28.5 km^2). No measurable impacts on birds would be attributed to the Proposed Action. Some level of impacts arising from future development, including future offshore wind, could occur if impacts are in close temporal and spatial proximity. Although these impacts would be **negligible**, they would not be expected to be biologically significant.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	may occur as a result of impacts on prey species. However, given the localized nature of the potential impacts, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation, and no biologically significant impacts on individuals or populations would be expected.			duration of less than 2 hours and approximately 3 miles (5 kilometers). However, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation and only non-measurable **negligible** impacts, if any, would be expected on individuals or populations.	
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for birds. With the possible exception of rescue operations and survey aircraft, no ongoing aircraft flights would occur at altitudes that would elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary, and impacts would be expected to dissipate once the aircraft has left the area.	Aircraft noise is likely to continue to increase as commercial air traffic increases; however, very few flights would be expected to be at a sufficiently low altitude to elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary, and impacts would be expected to dissipate once the aircraft has left the area.	Offshore wind projects may use aircraft for crew transport during construction and/or maintenance over the next 30 years. Aircraft would continue to be used for pre-construction surveys and wildlife monitoring. The level of use would be low, and restrictions on low-flying aircraft may be imposed. No individual fitness or population-level impacts would be expected.	Vineyard Wind may use aircraft for crew transport during maintenance over the life of the Proposed Action. Additionally, aircraft would be used to conduct Project-level wildlife surveys, which could amount to as many as 30 flights per year. These flights may result in non-biologically significant increased energy expenditure due to flushing in response to aircraft overflights. Any disturbance would be intermittent, localized, and affect only a few individuals. As such, impacts, if any, would be **negligible**.	The impacts on birds from this sub-IPF under the Proposed Action could include **negligible** non-biologically significant increased energy expenditure due to flushing in response to aircraft overflights. However, flights associated with the Proposed Action would be limited, and only a few individuals would be exposed. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but across a greater spatial and temporal extent. Future offshore wind activities would likely result in many more aircraft flights than the Proposed Action, but the overall impacts on individuals would still be considered low, and no biologically significant impacts would be expected. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on birds from ongoing and planned actions, including Alternative A, are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have little-to-no influence on overall impacts through this sub-IPF.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities could result in impacts on diving birds due to displacement by the use of active acoustic equipment and other active acoustic equipment. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement were to occur in preferred feeding areas during seasonal migration periods.	Same as ongoing activities, with the addition of possible future oil and gas surveys.	Site characterization surveys for offshore wind facilities would create intermittent, high-intensity impulsive noise around investigation sites over a 2- to 10-year period. These activities could result in impacts on diving birds due to displacement by the use of active acoustic equipment and other active acoustic equipment. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement occurred in preferred feeding areas during seasonal migration periods.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys may be less intense than G&G noise from site investigation surveys in WDAs. Impacts, if any, are anticipated to be temporary and **negligible** during non-migratory periods, but impacts could be greater if G&G noise occurs in preferred feeding areas during seasonal migration periods, although impacts would still be **negligible**.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts (displacement of diving birds) along the cable routes during inspections. Impacts could have higher consequences, although still **negligible**, if G&G surveys occur during seasonal migration periods. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent. Future offshore wind development, excluding the proposed Project, would likely affect a much greater area than the Proposed Action would. **Negligible** impacts associated with the Proposed Action with ongoing and planned actions would likely be approximately equal to, or slightly less than, the sum of these impacts.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water could result in intermittent, temporary, localized impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile-driving activity. The extent of these impacts depends on pile size, hammer energy, and local acoustic conditions. No biologically significant impacts on individuals or populations would be expected.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 4 to 6 hours at a time over a 6- to 12-year period. Noise transmitted through water could result in localized, intermittent, temporary impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile-driving activity. No biologically significant impacts on individuals or populations would be expected.	Noise from pile driving would occur during foundation installations for 4 to 6 hours at a time. If birds are present in the vicinity of pile-driving activity, noise transmitted through water could result in localized, intermittent, temporary, **negligible** impacts on diving birds due to displacement from foraging areas. No biologically significant impacts on individuals or populations would be expected.	The Proposed Action is expected to cause non-biologically significant, localized, short-term, **negligible** impacts, resulting in temporary displacement of individual diving birds. Ongoing and future non-offshore wind activities may have similar impacts, perhaps with a smaller extent, with a majority of impacts occurring in nearshore waters. Future offshore wind activities excluding the proposed Project could cause similar impacts, but over a greater temporal and spatial scale. **Negligible** impacts associated with the Proposed Action with ongoing and planned actions, equal to the sum of these impacts, if any, would not be expected to be biologically significant and no noticeable change to the condition of birds in the geographic analysis area are anticipated.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Onshore construction	Onshore construction is routinely used in generic infrastructure projects. Equipment could potentially cause displacement. Any displacement would only be temporary and no individual fitness or population-level impacts would be expected.	Onshore construction will continue at current trends. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.	Onshore construction could take place to install onshore transmission cable and, in the rare occasion, to make repairs. This activity would occur intermittently in the geographic analysis area for birds. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.	All onshore construction required for the Proposed Action would occur in previously disturbed areas. The Proposed Action is expected to cause localized and short-term, **negligible** impacts, resulting in non-biologically significant behavioral responses.	Onshore construction associated with the Proposed Action is expected to cause localized, short-term, **negligible** impacts, resulting in non-biologically significant behavioral responses. Onshore impacts from ongoing and non-offshore activities are expected to result in the same non-biologically significant behavior responses, but across a greater temporal and spatial scale. Future offshore wind, excluding the proposed Project, would also be expected to cause only non-biologically significant behavior responses. **Negligible** impacts associated with the Proposed Action with ongoing and planned actions, equal to the sum of these impacts, are anticipated to result in no noticeable change to the condition of birds in the geographic analysis area.
Noise: Vessels	Section 3.11 discusses noise impacts from vessels. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Sub-surface noise from vessels could disturbed diving birds foraging for prey below the surface. The consequence to birds would be similar to noise from G&G but likely less because noise levels are lower.	Section 3.11 discusses noise impacts from vessels.	Vessel noise associated with future offshore wind development could disturb some individuals, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). However, brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level impacts would be expected.	Vessel noise associated with the Proposed Action could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). Brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. Non-measurable **negligible** impacts, if any, to individuals or populations would be expected.	Vessel noise from the Proposed Action is anticipated to cause small, temporary, localized, non-measurable **negligible** impacts on birds, if any. Vessel noise from ongoing activities and future non-offshore wind activities is also expected to cause small, temporary, localized impacts on birds. Vessel noise from future offshore wind activities excluding the proposed Project is also expected to cause small, temporary, localized impacts birds. **Negligible** impacts associated with the Proposed Action with ongoing and planned actions, equal to the sum of these impacts, are anticipated to result in no noticeable change to the condition of birds in the geographic analysis area.
Presence of structures: Entanglement, gear loss, gear damage	Each year, 2,551 seabirds die from interactions with U.S. commercial fisheries on the Atlantic (Sigourney et al. 2019). Even more die due to abandoned commercial fishing gear (nets); a reduction in derelict fishing gear has a beneficial impact on bird populations (Regular et al. 2013). In addition, recreational fishing gear (hooks and lines) is periodically lost on existing buoys, pilings, hard protection, and other structures and has the potential to entangle birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Development of the projects in the expanded planned action scenario would install more buoys and foundations. The installation of 2,066 foundations increases the chance that drifting derelict gear becomes immobilized, and thus reduces the chance that the abandoned gear would cause additional harm to birds and other wildlife. While debris tangled with foundations may still pose a hazard to marine life including birds, implementation of surveys and gear removal would further reduce potential long-term intermittent risk.	The Proposed Action is expected to add up to 102 foundations, increasing the chance that drifting derelict gear becomes immobilized and thus reducing the chance that the abandoned gear would cause additional harm to birds and other wildlife. While debris tangled with foundations may still pose a hazard to marine life including birds, implementation of surveys and gear removal would further reduce potential long-term intermittent risk. Additionally, impacts due to gear entanglement from recreational fishing near the structures would likely be localized, short-term, and difficult to detect, although the risk of occurrence would persist as long as the structures remain. The proposed measure of annual remotely operated, underwater vehicle surveys, reporting, and monofilament and other fishing-gear cleanup around WTG foundations would minimize the potential for impacts on birds. As such, impacts, if any would be expected to be **negligible**.	The risk of impacts from this sub-IPF is proportional to the amount of structures present. The Proposed Action would add up to 102 foundations, which could lead to **negligible** impacts including injury or mortality due to recreational fishing. Ongoing entanglement and gear loss/damage at existing structures also periodically results in localized, short-term impacts. Future offshore wind activities, not including the Proposed Action, would add approximately 2,737 acres (11 km^2) of scour/cable protection and the vertical surfaces of up to 2,066 new foundations. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on birds from ongoing and planned actions, including Alternative A, up to 2,066 foundations could immobilize drifting derelict fishing gear plus the implementation of surveys and gear removal would further reduce the expected **negligible** potential long-term intermittent risk with **beneficial** impacts.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short-term to permanent. These fish aggregations can provide localized, short-term to permanent,	New cables installed incrementally in the geographic analysis area for birds over the next 20 to 30 years would likely require hard protection atop portions of the cables (see New cable emplacement/ maintenance row). Any new towers, buoys, or piers would also create uncommon relief in a	A total of 2,066 new structures added intermittently over an assumed 6- to 10-year period could attract structure-oriented fishes while the structures remain. Abundance of certain fishes may increase and result in increased foraging opportunities for some bird species. Recreational fishing, both personal and for-hire, may also increase, which could	A total of 102 new structures and 151 acres (0.6 km^2) of scour/cable protection would be added. Foundations would remain for the life of the Proposed Action, and scour/cable protection would permanently remain until decommissioning. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase	The installation of 102 new structures and 151 acres (0.6 km^2) of scour/cable protection associated with the Proposed Action is expected to cause localized impacts on birds that may be either short-term to permanent and may be **beneficial** or **adverse**. Existing structures and future non-offshore wind structures are expected to cause similar localized impacts on birds through this sub-IPF. The estimated 2,066 offshore wind structures other than those associated with the Proposed Action are also expected to cause similar

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	beneficial impacts on some bird species due to increased prey species availability. Likewise, structures may attract recreational fishing.	mostly flat seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local and may be short-term to permanent. These fish aggregations can provide localized, short-term to permanent beneficial impacts on some bird species due to increased prey species availability.	lead to impacts on birds (see Presence of Structures: Entanglement, gear loss/damage row). These impacts are expected to be local and may be short-term to permanent.	and result in increased foraging opportunities for some bird species, leading to **minor beneficial** impacts. Recreational fishing, both personal and for-hire, may also increase, which could lead to **negligible** impacts on birds (see Presence of Structures: Entanglement, gear loss/damage row). These impacts are expected to be local and may be short-term to permanent.	localized impacts on birds through this sub-IPF. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on birds from ongoing and planned actions, including Alternative A, is anticipated to cause many localized, short-term to permanent, **negligible** impacts and may lead to **moderate beneficial** impacts due to the anticipated reef effect. BOEM does not anticipate that this sub-IPF would result in considerable changes in bird distributions across the geographic analysis area for birds.
Presence of structures: Migration disturbances	A few structures are scattered about the offshore geographic analysis area for birds. The area includes an assortment of navigation and weather buoys plus a handful of light towers (NOAA 2020). Migrating birds can easily fly around or over these sparely distributed structures.	The infrequent installation of future new structures in the marine environment over the next 30 years would not be expected to result in migration disturbances.	Offshore wind-related activities would add up to 2,066 structures (turbines and ESPs) plus buoys. Based on the assumption that structures would be spaced 1 nautical mile (1.9 kilometers) apart, ample space between WTGs would allow birds that are not flying above WTGs to fly through without changing course or to make minor course corrections to avoid operating WTGs. Course corrections made by migratory birds to avoid a project or individual WTG would be relatively minor when compared to the distances traveled during seasonal migrations. Impacts, if any, resulting from additional energy expenditure would not be expected to result in individual fitness or population-level impacts.	Up to 100 turbines plus two ESPs could be installed that would remain for the life of the Proposed Action. Most birds that are not flying above the towers would be able to fly between individual towers or make minor course corrections. Course corrections made by migratory birds to avoid individual operating WTGs would be relatively minor when compared to the distances traveled during seasonal migrations. Similarly, some species may avoid the entire WDA during migration; however, impacts, if any, resulting from additional energy expenditure would be expected to result in non-measurable, **negligible** impacts and no individual fitness or population-level impacts would be expected.	The non-measurable, **negligible** impacts on birds from this sub-IPF under the Proposed Action could include non-biologically significant increased energy expenditure due to minor course correction to avoid individual WTGs or the entire WDA. Ongoing activities and future non-offshore wind would not be expected to have any impacts on migrating birds. Offshore structures associated with future offshore wind (excluding the proposed Project) would likely result in multiple and/or larger-scale course corrections, but the overall impacts on individuals would still be considered low, and no biologically significant impacts would be expected. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on birds from ongoing and planned actions, including Alternative A, are expected to be long-term but localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have little to no influence on overall impacts through this sub-IPF.
Presence of structures: Turbine strikes, displacement, and attraction	A few structures are in the offshore geographic analysis area for birds. The area has an assortment of navigation and weather buoys plus a handful of light towers (NOAA 2020). Given the limited number of structures currently in the geographic analysis area, individual- and population-level impacts due to displacement from current foraging habitat would not be expected. Stationary structures in the offshore environment would not be expected to pose a collision risk to birds. Some birds like cormorants and gulls may be attracted to these structures and opportunistically roost on these structures.	The infrequent installation of future new structures in the marine environment over the next 30 years would not be expected to result in an increase in collision risk or to result in displacement. Some potential for attraction and opportunistic roosting exists, but would be expected to be limited given the limited anticipated number of structures.	Offshore wind development would add up to 2,066 structures (turbines and ESPs) plus buoys. Individual WTG and project spacing would allow individuals to avoid individual operating WTGs, individual offshore wind facilities, or all offshore lease areas, resulting in non-biologically significant increased energy expenditure. The greatest risk to birds associated with future offshore wind development is expected to be fatal interactions with operating WTGs. Some level of mortality can be assumed at future operating offshore wind facilities, though migrating and/or foraging individuals would not be exposed to all the proposed projects, and no population-level impacts would be expected. Based on the mortality rate of 6.9 birds per turbine in the Eastern United States (Loss et al. 2013), an estimated 13,945 birds could be killed annually due to the 2,021 WTGs anticipated under the expanded planned action scenario. Collision risk models predict that 75 marine birds would be killed annually. The addition of WTGs to the offshore environment would result in increased functional loss of habitat for those species with higher displacement sensitivity;	Up to 100 turbines and two ESPs could be installed. Birds that are not flying above WTGs would be able to fly between individual towers or make minor course corrections. Course corrections made by migratory birds to avoid individual WTG, or the entire proposed WDA, would be relatively minor when compared to the distances traveled during seasonal migrations. Impacts, if any, resulting from additional energy expenditure would be **negligible** and would not be expected to result in individual fitness or population-level impacts. Given the known annual mortality of 234,000 birds at terrestrial wind facilities, some mortality due to the Proposed Action could occur, though use of the WDA by those species with higher collision sensitivity is expected to be low, resulting in **negligible** to **minor** impacts (Figure A.8.3-2). For those species with higher displacement sensitivity, the WDA would no longer provide suitable foraging habitat; however, foraging habitat exists outside the WDA and would remain available. Some potential for attraction and opportunistic roosting on new structures	Some turbine strikes could occur as a result of the Proposed Action, though the extent to which this mortality would affect resident and migrant populations of birds is unclear at this time. Given the low expected use of the WDA, these impacts would be **negligible** to **minor**. Those species with higher displacement sensitivity would be expected to avoid the Proposed Action, resulting in non-measurable **negligible** impacts. Conversely, the presence of structures may result in **minor beneficial** impacts due to the anticipated reef effect. Ongoing and future non-offshore wind activities would not have any impact on birds. WTGs associated with future offshore wind (excluding the Proposed Action) would be expected to result in a greater number of strikes due to the much larger number of WTGs. Similarly, under the expanded planned action scenario, a much larger area of habitat would be unavailable to foraging individuals of species with higher displacement sensitivity. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on birds from ongoing and planned actions, including Alternative A, are expected to range from **negligible** to **moderate** as most of the assumed WTG strikes would be attributed to future offshore wind development (excluding the Proposed Action) and may also result in long-term **moderate beneficial** impacts due to the large number of structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			however, substantial foraging habitat for resident birds would remain available outside the proposed offshore lease areas, and no individual fitness or population-level impacts would be expected to occur. Some potential for attraction and opportunistic roosting on new structures associated with future offshore wind development exists, and could result in increased exposure to operating WTGs.	associated with future offshore wind development exists, and could result in increased exposure to operating WTGs.	
Traffic: Aircraft	General aviation accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Additionally, aircraft are used for scientific and academic surveys in marine environments.	Bird fatalities associated with general aviation would be expected to increase with the current trend in commercial air travel. Aircraft would continue to be used to conduct scientific research studies as well as wildlife monitoring and pre-construction surveys. These flights would be well below the 100,000 flights and no bird strikes would be expected to occur.	Aircraft would continue to be used to at the same rate to conduct wildlife surveys during the post-construction phase. The amount of flight activity is not expected to change from current levels. Aircraft may be used to transport construction, operations, and maintenance crews. The level of use would be modest and well below 100,000 flights per year; therefore, bird strikes due to flights associated with future offshore wind development are expected to be highly unlikely.	Aircraft would be used to conduct Project-level wildlife surveys, which could amount to a dozen or two flights per year. Additionally, aircraft may be used to transport construction and maintenance crews. The number of flights for transport and surveys would be well below 100,000 flights and bird strikes from Project-related flights are expected to be **negligible** and highly unlikely.	The Proposed Action would lead to **negligible** impacts on birds for this sub-IPF. Ongoing and future non-offshore wind developments are expected to continue at current levels and two bird strikes per 100,000 flights would be expected to continue. Future offshore wind developments would not be expected to lead to any impacts for this sub-IPF. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on birds from ongoing and planned actions, including Alternative A would have little to no influence and **negligible** overall impacts on birds relative to this sub-IPF.
Land disturbance: Onshore construction	Onshore construction activity will continue at current trends. There is some potential for impacts associated with habitat loss and fragmentation. No individual or population-level impacts would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss, but would not be expected to result in injury or mortality of individuals.	A small amount of construction impacts associated with onshore power infrastructure would be required to tie future offshore wind energy projects to the electric grid. Typically, this would require only small amounts of habitat removal, if any. As such, this sub-IPF is not expected to appreciably contribute to impacts on birds.	The Vineyard Wind 1 Project would require temporary habitat alteration within existing public utility ROW. Clearing, grading, and excavations would temporarily alter existing habitat, which is primarily grassland and small shrubs. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for birds. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on bird species that frequent this forest edge/managed grassland ecosystem are expected to be **negligible**.	Onshore construction associated with the Proposed Action is expected to cause localized, short-term, **negligible** impacts, resulting in non-biologically significant behavioral responses. Onshore impacts from ongoing and non-offshore activities are expected to result in the same non-biologically significant behavior responses, but across a greater temporal and spatial scale. Future offshore wind, excluding the proposed Project, would also be expect to cause only non-biologically significant behavioral responses. **Negligible** impacts associated with the Proposed Action and ongoing and planned actions, equal to the sum of these impacts, are anticipated to result in no noticeable change to the condition of birds in the geographic analysis area.
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency and severity during the breeding season can reduce productivity of bird nesting colonies and kill adults, eggs, and chicks.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of bird prey resources. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Section A.8.1 discusses the contribution of these activities to climate change.
Climate change: Ocean acidification	Increasing ocean acidification may affect prey species upon which some birds feed and could lead to shifts in prey distribution and abundance. Intensity of impacts on birds is speculative.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities. Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of bird prey resources and may lead to impacts on prey abundance and distribution. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Section A.8.1 discusses the contribution of these activities to climate change.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the distribution of bird prey resources.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of bird prey resources and may lead to impacts on prey abundance and distribution. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Section A.8.1 discusses the contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered migration patterns	Birds rely on cues from the weather to start migration. Wind direction and speed influence the amount of energy used during migration. For nocturnal migrants, wind assistance is projected to increase across eastern portions of the continent (0.32 m/s; 9.6%) during spring migration by 2091, and wind assistance is projected to decrease within eastern portions of the continent (0.17 m/s; 6.6%) during autumn migration (La Sorte et al. 2019).	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to impacts through changes to cues related to migration timing and the potential for wind assistance during migration periods. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Section A.8.1 discusses the contribution of these activities to climate change.
Climate change: Warming and sea level rise, property/ infrastructure damage	This sub-IPF would have no impacts on birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF would not contribute to impacts on birds.
Climate change: Warming and sea level rise, protective measures (barriers, seawalls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence, impacts on bird nesting habitat.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to impacts through loss or modification of currently suitable nesting habitat. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Section A.8.1 discusses the contribution of these activities to climate change.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the frequencies and distributions of various diseases of birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to changes in the frequency and distribution of bird diseases. Because this sub-IPF is a global phenomenon, impacts on birds through this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Section A.8.1 discusses the contribution of these activities to climate change.

ADLS = Aircraft Detection Light System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; ESP = electrical service platform; FAA = Federal Aviation Administration; FCC = Federal Communications Commission; G&G = Geological and Geophysical; GHG = greenhouse gas; hazmat = hazardous materials; IPF = impact-producing factor; km^2 = square kilometers; mg/L = milligrams per liter; m/s = meter per second; OCS = outer continental shelf; ROW = right-of-way; USCG = U.S. Coast Guard; WDA = wind development area; WTG = wind turbine generator

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A.8.4. Bats

A.8.4.1. No Action Alternative and Affected Environment

This section discusses existing bat resources in the geographic analysis area for bats, as described in Table A-1 and shown on Figure A.7-16. Specifically, the geographic analysis area for bats includes the U.S. East Coast, from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 100 miles (161 kilometers) inland to capture the movement range for species in this group. Table A.8.4-1 describes baseline conditions and impacts, based on IPFs assessed, of ongoing and future activities other than offshore wind, which is discussed below.

Nine species of bats occur within Massachusetts, eight of which may be present in the onshore portions of the proposed Project area (Table A.8.4-2). Bat species consist of two distinct groups based upon their overwintering strategy: cave-hibernating bats (cave bats) and migratory tree bats (tree bats). Bats are terrestrial species that spend almost their entire lives on or over land. On occasion, tree bats may potentially occur offshore during spring and fall migration and under very specific conditions like low wind and high temperatures. Recent studies, combined with historical anecdotal accounts, indicate that migratory tree bats sporadically travel offshore during spring and fall migration, with 80 percent of acoustic detections occurring in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Stantec 2016). However, unlike tree bats, the likelihood of detecting a *Myotis* species or other cave bat is substantially less in offshore areas (Pelletier et al. 2013). Regionally, both resident and migrant tree and cave bat species occur on islands within Nantucket Sound, indicating that over-water crossings do occur (MMS 2008). Dowling et al. (2017) documented little brown bats (*Myotis lucifugus*) and eastern red bats (*Lasiurus borealis*) leaving Nantucket Island and crossing open water in August and September, which is consistent with the migratory chronology of these species. In all cases, these movements were toward shore and away from the WDA. Pre-construction studies at the Block Island Wind Farm indicate that bat use of Block Island is largely limited to the island and nearshore waters, with limited acoustic detections in offshore habitats (TetraTech 2012a). Similarly, no identifiable bat echolocation calls were detected at the Cape Wind Energy Project area or adjacent open water in Nantucket Sound during monthly surveys in 2013 conducted by Cape Wind Associates from April to October (ESS 2014).

Table A.8.4-2: Bat Species Potentially Present in Massachusetts

Common Name	Scientific Name	State Status	Federal Status
Cave Bats			
Big brown bat	*Eptesicus fuscus*		
Eastern small-footed bat	*Myotis leibii*	E	
Little brown bat	*Myotis lucifugus*	E	
Northern long-eared bat	*Myotis septentrionalis*	E	T
Indiana bat [a]	*Myotis sodalis*	E	E
Tri-colored bat	*Perimyotis subflavus*	E	
Tree Bats			
Silver-haired bat	*Lasionycteris noctivagans*		
Eastern red bat	*Lasiurus borealis*		
Hoary bat	*Lasiurus cinereus*		

Source: BOEM 2012; USFWS 2015

E = Endangered; T = Threatened
[a] Does not occur in eastern Massachusetts

Existing data from meteorological buoys provide the best opportunity to further define bat use of open-water habitat far from shore where Vineyard Wind would site the proposed Project WTGs. Despite significant distance from any suitable terrestrial habitat, all five meteorological buoys in the Gulf of Maine detected bats; however, detection rates were the lowest at these sites and use was sporadic when compared to sites located on offshore islands (Stantec 2016). Of the relatively few (372) bat passes recorded at offshore buoys, only 14 (4 percent) were attributed to cave bats (Stantec 2016), confirming the very limited use of open water habitats by cave bats. Given these data, the potential exists for some migratory tree bats to encounter offshore facilities during spring and fall migration. BOEM expects this exposure risk to be limited to very few individual tree bats and to occur, if at all, during migration. Given the distance of the WDA from shore, BOEM does not expect foraging bats to encounter operating WTGs outside spring and fall migration.

The onshore areas in the region of the Proposed Action include forested habitats that provide features suitable for use by roosting and/or foraging bats (COP Volume III; Epsilon 2020b), as well as dense residential, industrial, and commercial development. All eight species of bats with the potential to occur in eastern Massachusetts may be present near the onshore facilities. The federally threatened northern long-eared bat (*Myotis septentrionalis*) occurs throughout Massachusetts, including Cape Cod, Martha's Vineyard, and Nantucket. See the BA for further details on this species (BOEM 2020b). The federally endangered Indiana bat (*Myotis sodalis*) is not known to occur in the greater Cape Cod region and this section therefore does not discuss it further. Several state endangered species—the eastern small-footed bat (*M. leibii*), the little brown bat, and the tri-colored bat (*Perimyotis subflavus*)—may occur within the onshore portions of the proposed Project area and may have been heavily impacted by white nose syndrome (WNS), a fungal bat disease in the United States resulting in mortality as high as 90 percent at some hibernation sites (Blehart et al. 2009; Gargas et al. 2009; Turner et al. 2011). The terrestrial ecology of northern long-eared bats is well understood; these bats forage under closed canopy ridges and hillsides, typically relatively close to occupied roost trees (Brack and Whitaker 2001; Broders et al. 2006; Henderson and Broders 2008; Lacki et al. 2009; Owen et al. 2002). Although the presence of northern long-eared bats on Martha's Vineyard and Nantucket illustrate that the species has the ability to cross open water habitats, there are no records of northern long-eared bats migrating to and from islands to the mainland (BOEM 2015b; Dowling et al. 2017; Pelletier et al. 2013). Therefore, it is extremely unlikely that northern-long eared bats would fly over the open ocean near the WDA. Similarly, it is very unlikely that state-endangered eastern small-footed, little brown, or tri-colored bats would encounter offshore facilities during migration (BOEM 2015b; Pelletier et al. 2013). On May 24, 2019, BOEM used the Information for Planning and Consultation tool to determine what conservation measures, if any, would be required to minimize potential impacts on the northern long-eared bat during tree-clearing activities for the onshore substation. USFWS confirmed that the proposed tree-clearing activities would comply with the USFWS's January 5, 2016, Programmatic Biological Opinion, which satisfies USFWS responsibilities relative to the northern long-eared bat for this action under ESA Section 7(a)(2) (USFWS 2020a). Specifically, there are no known occupied hibernacula sites within 0.25 mile (0.4 kilometer) or maternal roost sites within 150 feet (45.7 meters) of the proposed substation site; in fact, the closest known hibernacula and maternal roost sites are 65 miles (104.6 kilometers) and 11.3 miles (18.2 kilometers) away, respectively (Mass Wildlife 2020).

Bats within the geographic analysis area are subject to pressure from ongoing activities, generally associated with onshore impacts, including onshore construction and climate change. Onshore construction activities, and associated impacts, are expected to continue at current trends and have the potential to result in impacts on bat species. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence. Additionally, cave bat species, including the northern long-eared bat, are experiencing drastic declines due to WNS. In Massachusetts, the eastern small-footed bat's population status is unknown, but WNS and human disturbances during hibernation threaten it (Mass Wildlife 2015a). The little brown bat was once the most abundant bat species in this region, but has suffered greatly from WNS (Mass Wildlife 2015b). Likewise, WNS has devastated the tri-colored bat in the last ten years (Mass Wildlife 2015c). Proposed Project-related impacts have the potential to result in impacts on cave bat populations already affected by WNS. The unprecedented mortality of more than 5.5 million bats in northeastern North America as of 2015 reduces the likelihood of many individuals being present within the onshore portions of the proposed Project area (USFWS 2015). However, given the drastic reduction in cave bat populations in the region, the biological significance of mortality resulting from the Proposed Action, if any, may be increased.

Under the No Action Alternative, the proposed Project would not be built. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project (Section A.8.4.2) would not occur as proposed. Impacts from ongoing, future non-offshore wind, and future offshore wind activities would likely still occur (Table A.8.4-1). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are developed to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action. In other words, future offshore wind facilities capable of generating 9,404 MW could still be built in the RI and MA Lease Areas under the No Action

Alternative, although none would be built before 2022. Therefore, the impacts on bats would be similar, but the exact impact would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area and considers the assumptions included in Section 1.7 and here in Appendix A. The No Action Alternative would forgo post-construction acoustic monitoring for bats and annual mortality reporting that Vineyard Wind has committed to performing, the results of which could provide an understanding of the effects of offshore wind development, benefit the future management of these species, and inform planning of other offshore development; however, ongoing and future surveys and monitoring could still supply similar data.

A.8.4.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects future offshore wind activities to affect bats through the following primary IPFs.

Noise: Anthropogenic noise on the OCS associated with future offshore wind development, including noise from pile-driving and construction activities, has the potential to impact bats on the OCS. Additionally, onshore construction noise has the potential to impact bats. BOEM anticipates that these impacts would be temporary and highly localized.

In the expanded planned action scenario, the construction of 2,066 offshore structures would create noise and may temporarily impact some migrating tree bats, if conducted at night during spring or fall migration. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 4 to 6 hours at a time over a 6- to 10-year period. Construction activity would be short-term, temporary, and highly localized. Auditory impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Habitat- related impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would likely be limited to behavioral avoidance of pile-driving and/or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur, as little use of the OCS is expected, and only during spring and fall migration.

Some potential for short-term, temporary, localized habitat impacts arising from onshore construction noise exists; however, no auditory impacts on bats would be expected to occur. Recent literature suggests that bats are less susceptible to temporary or permanent hearing loss due to exposure to intense sounds (Simmons et al. 2016). Impacts are expected to be limited to individuals roosting adjacent to onshore construction locations. Nighttime work may be required on an as-needed basis. Some temporary displacement and/or avoidance of potentially suitable foraging habitat could occur, but these impacts would not be expected to be biologically significant. Some bats roosting in the vicinity of construction activities may be disturbed during construction, but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts, as frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998).

Non-routine activities associated with the offshore wind facilities would generally require intense, temporary activity to address emergency conditions. The noise made by onshore construction equipment or offshore repair vessels could temporarily deter bats from approaching the site of a given non-routine event. Impacts on bats, if any, would be temporary and last only as long as repair or remediation activities were necessary to address these non-routine events.

Given the temporary and localized nature of potential impacts and the expected biologically insignificant response to those impacts, no individual fitness or population-level impacts would be expected to occur as a result of onshore or offshore noise associated with future offshore wind development.

Presence of structures: Using the assumptions in Table A-4, the expanded planned action scenario would include up to 2,066 WTGs and ESPs on the OCS that could result in potential impacts on bats. Cave bats (including the federally threatened northern long-eared bat and the state-endangered small-footed bat, little brown bat, and tri-colored bat), do not tend to fly offshore (even during fall migration) and, therefore, exposure to construction vessels during construction or maintenance activities, or the rotor-swept area of operating WTGs in the lease areas is expected to be negligible, if exposure occurs at all (BOEM 2015b; Pelletier et al. 2013).

Tree bats, however, may pass through the offshore WDAs during the fall migration, with limited potential for migrating bats to encounter vessels during construction and decommissioning of WTGs, ESPs, and OECCs, although structure and vessel lights may attract bats due to increased prey abundance. As discussed above, while bats have been documented at offshore islands, relatively little bat activity has been documented in open water habitat similar to the conditions in the WDA. Several authors, such as Cryan and Barclay (2009), Cryan et al. (2014) and Kunz et al. (2007), discuss several hypotheses as to why bats may be attracted to WTGs. Many of these, including the creation of linear corridors, altered habitat conditions, or thermal inversions, would not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007). Other hypotheses associated with the Atlantic OCS regarding bat attraction to WTGs include bats perceiving the WTGs as potential roosts, potentially increased prey base, visual attraction, disorientation due to electromagnetic fields or decompression, or attraction due to mating strategies (Arnett et al. 2008; Cryan 2007; Kunz et al. 2007). However, no definitive answer as to why, if at all, bats are attracted to WTGs has been postulated, despite intensive studies at onshore wind facilities. As such, it is possible that some bats may encounter, or perhaps be attracted to, the expected 2,066 structures (ESPs and non-operational WTG towers) to opportunistically roost or forage. However, bats echolocation abilities and agility make it unlikely that these stationary objects (ESPs and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the base of onshore turbine towers (Choi et al. 2020).

Tree bat species that may encounter the operating WTGs in the offshore lease areas include the eastern red bat, the hoary bat (*L. cinereus*), and the silver-haired bat (*Lasionycteris noctivagans*). Offshore operations and maintenance would present a seasonal risk factor to migratory tree bats that may utilize the offshore habitats during fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during fall migration, the overall occurrence of bats on the OCS is relatively very low (Stantec 2016), and unlike terrestrial migration routes, there are no landscape features that would concentrate bats and thereby increase exposure to the WDAs. Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with future offshore wind development. With the proposed 1-nautical-mile (1.9-kilometer) spacing between structures associated with future offshore wind development and the distribution of anticipated projects, individual bats migrating over the OCS within the rotor-swept area of project WTGs would likely pass through projects with only slight course corrections, if any, to avoid operating WTGs due to the fact that unlike terrestrial migration routes, there are no landscape features that would concentrate migrating tree bats and increase exposure to WDAs on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016). Additionally, the potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity is associated with relatively low wind speeds and warm temperatures (Arnett et al. 2008; Cryan and Brown 2007; Fiedler 2004; Kerns et al. 2005). Given the rarity of tree bats in the offshore environment, the turbines being widely spaced, and the patchiness of projects, the likelihood of collisions is expected to be low. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats have been shown to suppress activity during periods of strong winds, low temperatures, and rain (Arnett et al. 2008; Erickson et al. 2002).

Land disturbance: A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 6 to 10 years to tie future offshore wind energy projects to the electric grid. Typically, this would require only small amounts of habitat removal, if any, and would occur in previously disturbed areas. Short-term, temporary impacts associated with habitat loss or avoidance during construction may occur, but no injury or mortality of individuals would be expected. As such, onshore construction activities associated with future offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

In addition to electrical infrastructure, some amount of habitat conversion may result from port expansion activities required to meet the demands for fabrication, construction, transportation, and installation of wind energy structures. The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in permanent habitat loss for local bat populations. However, the incremental increase from future offshore wind development would be a minimal contribution in the port expansion required to meet increased commercial, industrial, and recreational demand (BOEM 2019b). The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014).

Climate change: IPFs related to climate change, including increased storm severity/frequency and increased disease frequency, have some potential to result in impacts on bats, although the intensity and extent of these potential impacts are speculative at this time. A discussion of activities that contribute to climate change IPFs is provided in Section A.8.1.

Other Considerations: The federally threatened northern long-eared bat is the only bat species listed under the ESA that may be affected by the proposed Project. Ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the proposed Project may also affect the northern long-eared bat. As described above and discussed further in the BA (BOEM 2020b), the possibility of impacts to the northern long-eared bat would be limited to onshore impacts, generally during onshore facilities construction.

A.8.4.1.2. Conclusions for the No Action Alternative

Under the No Action Alternative, bats would continue to follow current regional trends and respond to current and future environmental and societal activities.

While the proposed Project would not be built as proposed under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind development, and future offshore wind development to have continuing temporary to permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on bats primarily through the onshore construction impacts, the presence of structures, and climate change. BOEM anticipates that the potential impacts of ongoing activities would be **negligible**. In addition to ongoing activities, BOEM anticipates that the impacts of planned actions other than offshore wind development may also contribute to impacts on bats, including increasing onshore construction (Table A.8.4-1), but that these impacts would be **negligible**. BOEM expects the combination of ongoing and planned actions other than offshore wind development to result in **negligible** impacts on bats.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area would result in **negligible** adverse impacts because of ongoing climate change, interactions with operating WTGs on the OCS, and onshore habitat loss. Future offshore wind activities are not expected to materially contribute to the IPFs discussed above. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, none of the IPFs associated with future offshore wind activities that occur offshore would be expected to appreciably contribute to overall impacts on bats. Some potential for temporary disturbance and permanent loss of onshore habitat may occur as a result of future offshore wind development. However, habitat removal is anticipated to be minimal when compared with other past, present, and reasonably foreseeable activities, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area.

A.8.4.2. Consequences of Alternative A

The following proposed-Project design parameters (Appendix G) would influence the magnitude of the impacts on bats:

- The new onshore substation, which would require the removal of forested habitat that is potentially suitable for roosting and foraging;
- The number, size, and location of WTGs; and
- The time of year during which construction occurs.

Changes to the design capacity of the turbines would not alter the maximum-case scenario of potential impacts on bats for Alternative A and all other action alternatives because the maximum-case scenario involves the maximum number of WTGs (100) in the PDE. Changes to the proposed onshore substation site could modify the impacts of Alternative A and all other action alternatives on bats. Since the DEIS was published, the substation area has been expanded, and the total approximate area of ground disturbance would be 7.7 acres (31,161 m^2), or 1.8 acres (7,122 m^2) greater than the 5.9 acres (23,877 m^2) assumed in the DEIS. The majority of ground disturbance would occur in previously disturbed (paved) areas where no tree clearing would be needed (potentially 0.2 acre [809 m^2] may require tree clearing). The southern portion of the expanded substation area is wooded, and an additional 0.2 acre [809 m^2] may need to be cleared, for a total of 6.1 acres (24,686 m^2) of tree clearing. This 6.1 acres (24,686 m^2) of tree clearing is within the estimated 7 acres (28,328 m^2) of tree clearing analyzed in the DEIS.

This assessment analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE (i.e., number and size of WTGs and construction timing) would result in similar or lesser impacts than described below. The sections below summarize the potential impacts of Alternative A on bats during the various phases of the proposed Vineyard Wind 1 Project. Routine activities would include construction, operations, maintenance, and decommissioning of the proposed Project, as described in Chapter 2. BOEM prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action was not likely to adversely affect, or had no effect, on listed species and/or their critical habitat (BOEM 2020b).

Noise: Pile-driving noise and onshore and offshore construction noise associated with Alternative A alone is expected to result in **negligible** impacts, Construction activity would be short-term, temporary, and highly localized. Auditory impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile driving and/or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

In context of reasonably foreseeable environmental trends, combined noise impacts on bats from ongoing and planned actions, including Alternative A, would likely be **negligible**.

Presence of Structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes, are described in detail in Section A.8.4.1.1. Using the assumptions in Table A-4, there could be up to 2,021 new WTGs on the OCS where few currently exist, of which up to 100 would result from the proposed Project. The structures associated with Alternative A, and the consequential **negligible** impacts would remain at least until decommissioning of the proposed Project is complete. At this time, there is some uncertainty regarding the level of bat use of the OCS, and the ultimate consequences of mortality, if any, associated with operating WTGs. However, as described above, existing data from meteorological buoys provide the best opportunity to further define bat use of open-water habitat far from shore where Vineyard Wind would site the proposed Project WTGs. Relatively few (372) bat passes were detected at meteorological buoy sites and use was sporadic when compared to sites on offshore islands (Stantec 2016). While the significance level of impacts would remain the same, BOEM could further reduce potential impacts by the following mitigation measures conditioned as part of the COP approval (see Appendix D):

- Deployment of acoustic bat detectors on a subset of WTGs and/or ESPs to refine our understanding of bat use of the OCS and WDA. Deployment configuration and number of detectors would be determined in consultation with applicable stakeholders.

In context of reasonably foreseeable environmental trends, combined impacts on bats arising from the presence of structures from ongoing and planned actions, including Alternative A, would likely be **negligible** given the expected limited use of the OCS by migrating tree bats. A majority (approximately 95 percent) of these impacts would occur as a result of structures associated with other future offshore wind development and not Alternative A, as Alternative A would account for about 4.9 percent (100 of 2,021) of the new WTGs on the OCS.

Land disturbance: Impacts associated with construction of onshore elements of Alternative A could occur if construction activities occur during the active season (generally April through October), and may result in injury or mortality of individuals, particularly juveniles who are unable to flush from a roost, if occupied by bats at the time of removal. According to the BA prepared for the USFWS (BOEM 2020b), tree clearing activities would comply with the northern long-eared bat 4(d) rule, and no tree clearing would occur when juveniles are unable to fly (June 1 through July 30), limiting the potential for direct injury or mortality from the removal of occupied roost trees. There would be some potential for habitat impacts on bats as a result of the loss of potentially suitable roosting and/or foraging habitat. However, Alternative A would only remove 6.1 acres (24,686 m^2) of marginal quality habitat that is characterized by a cluttered understory, which limits its suitability. Further, a high-quality contiguous block of potentially suitable habitat within the Hyannis Ponds WMA is located as near as 0.25 mile (0.4 kilometer) from the site where forested habitat would be removed. BOEM anticipates that **negligible** impacts, if any, would occur due to adherence to USFWS northern long-eared bat conservation measures and that negligible habitat impacts would not result in individual fitness or population-level effects given the limited amount of habitat removal and the presence of high-quality habitat within the Hyannis Ponds WMA in the vicinity.

In context of the reasonably foreseeable environmental trends, the combined land disturbance impacts from ongoing and planned actions, including Alternative A, would likely be **negligible**, as only a small amount of habitat loss, if any, would be expected.

Other considerations: For temporary impacts, including the effects of onshore construction, it is likely that a portion, possibly a majority, of such impacts from future activities would not overlap temporally or spatially with Alternative A. However, some IPFs that may result in temporary impacts can also result in long-term to permanent impacts that would likely be **negligible**. Vineyard Wind would likely leave onshore facilities in place for future use (Chapter 2). There are no plans to disturb the land surface or terrestrial habitat during the course of Proposed Action decommissioning. Therefore, onshore temporary impacts of decommissioning would be **negligible**. However, Vineyard Wind would remove the offshore WTGs and ESPs. This impact would likely be similar in nature, extent, and intensity to the impacts of WTG and ESP installation and would be **negligible.**

In summary, construction, installation, and decommissioning of Alternative A alone would have **negligible** impacts on bats, especially if conducted outside the active season. The main significant risk would be from operation of the offshore WTGs, which could lead to **negligible** long-term impacts in the form of mortality, although BOEM anticipates this to be rare. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section A.8.4.1.2.

In context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including Alternative A, would be **negligible**. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including Alternative A, would result in **negligible** impacts on bats in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and onshore habitat loss. Alternative A would contribute to the overall impact rating primarily through the permanent impacts due to onshore habitat loss. Thus, the overall impacts on bats would likely be **negligible** because no measurable impacts are expected due to the absence of bats within the WDA.

While the significance level of impacts would remain the same, BOEM could further reduce impacts with the following mitigation measures conditioned as part of the COP approval (see Appendix D):

- Require that trees (greater than 3-inch [7.6-centimeter] diameter at breast height) not be cleared from June 1 to July 31. Should presence/probable absence surveys be conducted pursuant to current USFWS protocols and no northern long-eared bats are documented, this measure may not be necessary for ESA compliance relative to the species.
- Deploy acoustic bat detectors on a subset of WTGs and/or ESPs to refine our understanding of bat use of the OCS and WDA. Deployment configuration and number of detectors would be determined in consultation with applicable stakeholders.

A.8.4.3. Consequences of Alternatives C, D1, D2 and F

The impacts resulting from individual IPFs associated with Alternatives C, D1, D2, and F would be similar to those described under Alternative A. BOEM does not expect relocation of the six northernmost WTG locations under Alternative C to the southern portion of the WDA to significantly change the potential impacts because the total number of WTGs would remain the same, and the southern portion of the WDA does not include areas with higher densities of bats. Under Alternatives D1, D2, and F, the WDA acreage would increase compared to Alternative A. This could potentially lead to a slightly increased risk of individual migrating tree bats encountering the WDA due to the larger Project footprint. However, given the infrequent and limited use of the

OCS by bats during spring and fall migration, BOEM does not anticipate impacts to be different than those described under Alternative A. While each of the alternatives would slightly change the potential impacts, the impacts would not be expected to be materially different that those described under Alternative A—**negligible.**

The impacts of the construction and installation, operations and maintenance, non-routine activities, and decommissioning of Alternative C would be practically identical to those of Alternative A. Based on the analysis above, and under regular circumstances, Alternative C would have **negligible** temporary and long-term impacts on bats. Under Alternatives D1, D2, and F, the WDA acreage would increase compared to Alternative A. This could potentially lead to a slightly increased risk of migrating bats encountering the WDA due to the larger Project footprint. While Alternatives D1, D2, and F would increase the acreage of the WDA, the long-term impacts from this factor would likely remain **negligible**. While these alternatives may result in differing numbers of WTGs and/or differing Project footprints, no significant increase in collision risk would be expected given the presumed lack of use by migratory tree bat species.

In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternatives C, D1, D2, or F, would be similar to those described under Alternative A (with individual IPFs leading to **negligible** impacts). While Alternatives D1, D2, and F may be slightly more impactful than Alternative A, the impacts under Alternatives C, D1, D2, and F would be practically identical to those under Alternative A. The overall impacts on bats of ongoing and planned actions, including Alternatives C, D1, D2, or F, would be the same level as under Alternative A—**negligible**. This impact rating is driven primarily by ongoing activities such as climate change as well as limited disturbance and habitat removal associated with onshore construction. As described above, Vineyard Wind's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts, but would not change the impact ratings.

A.8.4.4. Consequences of Alternative E

With the exception of the number of WTGs, impacts of the construction and installation, operations and maintenance, non-routine activities, and decommissioning of Alternative E would be practically identical to those described under Alternative A. IPFs associated with the construction and installation of no more than 84 WTGs, including pile-driving noise and temporary avoidance and displacement, would be reduced by approximately 16 percent compared to the maximum-case scenario under Alternative A, namely 100 WTGs. Should Alternative A involve the use of taller 14 MW WTGs, an even greater reduction in the number of WTGs would result. Although there is some correlative evidence from inland studies that bat mortality increases with tower height (Barclay et al. 2007; Georgiakakis et al. 2012), fewer WTGs and wider space between WTGs may allow greater opportunity for migrating tree bats (if present) to avoid WTGs. Overall, the expected negligible impacts on bats would not be materially different than those described under Alternative A. The use of taller 14 MW WTGs may have some potential to increase collision risk based on studies of terrestrial wind facilities (Barclay et al. 2007; Georgiakakis et al. 2012). However, uncertainly exists around the degree to which bat mortality may increase with increasing WTG tower height. Given the expected limited use of the OCS by migrating tree bats, impacts would be expected to remain **negligible**.

In context of reasonably foreseeable environmental trends, the combined impacts on bats from ongoing and planned actions, including Alternative E, would be similar to those described under Alternative A, with individual IPFs leading to **negligible** impacts. While Alternative E may be slightly less impactful to bats than described under Alternative A, the overall impacts of Alternative E on bats would be the same level as under the Alternative A–**negligible**. This impact rating is driven primarily by ongoing activities such as climate change as well as disturbance and habitat removal associated with onshore construction. As described above for Alternative A, Vineyard Wind's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts, but would not change the impact ratings.

A.8.4.5. Comparison of Alternatives

As discussed in the above sections, the anticipated **negligible** impacts associated with Alternative A alone do not change substantially under Alternatives C through F. While the alternatives could slightly change the impacts on bats within the WDA, ultimately the same construction, operations, and decommissioning impacts would still occur. Alternative C would be expected to result in **negligible** impacts identical to those described under

Alternative A with respect to bats. Alternatives D1, D2, and F have some potential to result in slightly more impacts, but not materially different, **negligible** impacts than those described under Alternative A. Alternative E may result in slightly fewer, but not materially different, **negligible** impacts than those described under Alternative A.

In context of reasonably foreseeable environmental trends, impacts from ongoing and planned actions, including any alternative, would likely be similar because the majority of impacts result from ongoing activities, environmental trends, and other future offshore wind development. However, the differences in impacts among the action alternatives should still be considered alongside the impacts of other factors. Therefore, impacts on bats would be slightly greater, but not materially different, under Alternatives D1, D2, and F, and slightly lower, but not materially different under Alternative E. The impacts resulting from individual IPFs associated with any alternative would likely be **negligible**.

In conclusion, the overall impacts on bats from any alternative, including ongoing and planned actions, are expected to be **negligible**. The main driver for this is the result of ongoing activities, disturbance and habitat removal associated with onshore construction, and climate change, which are expected to lead to noticeable temporary and permanent impacts across much of the geographic analysis area for bats, of which a small portion is contributed by Alternative A.

A.8.4.6. Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C, D2, and E with certain mitigation measures. Under the Preferred Alternative, the OECR would be located within existing roadways, thus avoiding all habitat and resulting in no impact on terrestrial habitat or any known protected or rare habitats. In addition, the Preferred Alternative would result in the clearing of 6.1 acres (24,685.9 m^2) of pitch pine–oak habitat at the proposed substation site. The Preferred Alternative would comply with no tree clearing (greater than 3-inch [7.6-centimeter] diameter at breast height) from June 1 through July 31 (Appendix D). This could reduce impacts on bats, birds, and other terrestrial wildlife. Should tree clearing need to be completed outside this window, species-specific presence/probable absence surveys must be completed to address ESA-listed species concerns relative to the northern long-eared bat. Construction, installation, and decommissioning of the Preferred Alternative would have **negligible** impacts on bats, especially if conducted outside the active season.

Under the Preferred Alternative, the WDA would contain between 57 to 84 WTGs. This alternative would include at least 16 percent fewer WTGs than the maximum-case scenario under Alternative A. The Preferred Alternative would result in fewer WTGs, and the potential for wider space between WTGs may allow greater opportunity for migrating tree bats (if present) to avoid WTGs. Although there is some evidence from inland studies that increased blade height may result in increased mortality (Barclay et al. 2007; Georgiakakis et al. 2012), it is also possible that Vineyard Wind could use higher capacity WTGs that are not necessarily taller than lower capacity

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Table A.8.4-1: Summary of Activities and the Associated Impact-Producing Factors for Bats

Baseline Conditions: Bats are terrestrial species that spend almost their entire lives on or over land. On occasion, tree bats may potentially occur offshore during spring and fall migration and under very specific conditions like low wind and high temperatures. All eight species of bats that occur in coastal Massachusetts, including the northern long-eared bat, may be present near the onshore facilities. Cave bat species are experiencing drastic declines due to WNS, a fungal bat disease in the United States resulting in mortality as high as 90 percent at some hibernation sites (Blehart et al. 2009; Gargas et al. 2009; Turner et al. 2011).

Use of the OCS by migrating tree bats is expected to be very low and limited to spring and fall migration periods.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded and would result in high-intensity, low-exposure level, long-term, but localized intermittent risk to bats in nearshore waters. Auditory impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Habitat impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized.	Similar to ongoing activities, noise associated with pile driving activities would be limited to nearshore waters, and these high-intensity, but low-exposure risks would likely not result in auditory impacts. Some habitat impacts (i.e., displacement from potentially suitable foraging habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized and no population-level effects would be expected.	Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 4 to 6 hours at a time over a 6- to 12-year period. Under a maximum-case scenario, construction would occur 24 hours per day. Construction activity would be short-term, temporary, and highly localized. Impacts on migrating tree bats are possible. No auditory impacts would be expected to occur (Simmons et al. 2016). Pile driving activities have some potential to result in habitat-related impacts on individual migrating tree bats. However, these impacts are highly unlikely to occur, as little use of the OCS is expected, and only during spring and fall migration.	The Vineyard 1 Project has agreed to avoid nighttime pile driving. Therefore, there would be no contribution to this sub-IPF during construction, operations, and decommissioning, and non-measurable **negligible** impacts, if any, would be expected.	The Proposed Action is expected to result in non-measurable **negligible** impacts on bats through this sub-IPF. The impacts of ongoing activities and future non-offshore wind activities that occur in nearshore waters would be greater than the expected impacts from future offshore wind development, but would not be expected to result in individual fitness or population-level effects. No impacts would be expected to result through this sub-IPF from the incremental impacts of the Proposed Action or other future offshore wind development, given the limited expected use of the OCS by migrating bats. In context of reasonably foreseeable environmental trends, combined impacts from this IPF on bats from ongoing and planned actions, including Alternative A, would likely be short-term, intermittent, highly localized, and **negligible**. Impacts would be primarily driven by construction activities in nearshore habitats.
Noise: Construction	Onshore construction occurs regularly for generic infrastructure projects in the bats geographic analysis area. There is a potential for displacement caused by equipment if construction occurs at night (Schaub et al. 2008). Any displacement would only be temporary. No individual or population-level impacts would be expected. Some bats roosting in the vicinity of construction activities may be disturbed during construction, but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts, as frequent roost switching is a common component of a bat’s life history (Hann et al. 2017; Whitaker 1998).	Onshore construction is expected to continue at current trends. Some behavioral responses and avoidance of construction areas may occur (Schaub et al. 2008). However, no injury or mortality would be expected.	Onshore construction could take place to lay onshore transmission cable and rarely to make repairs. This activity would occur intermittently in the bats geographic analysis area. Some behavior responses and avoidance of construction areas may occur (Schaub et al. 2008) if construction occurs at night, but no injury or mortality would be expected. Some bats roosting in the vicinity of construction activities may be disturbed during construction, but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts, as frequent roost switching is a common component of a bat’s life history (Hann et al. 2017; Whitaker 1998).	All onshore construction activities are expected to occur during daylight hours, and as such, no displacement would occur. Bats roosting in the vicinity may be disturbed, but would be expected to move to an alternate roost. Non-measurable **negligible** impacts, if any, would be expected (Hann et al. 2017; Whitaker 1998). While there is some potential for onshore construction to occur at night on an as-needed basis, impacts on foraging bats arising from temporary displacement in the vicinity of the construction activities would be expected to remain **negligible**.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on bats through this sub-IPF. The impacts of ongoing and future non-offshore wind activities would be expected to result in highly localized, temporary, and short-term impacts only if construction occurs at night. Similarly, onshore construction associated with future offshore wind development would result in temporary and localized impacts only if construction occurs at night. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on bats from ongoing and planned actions, including Alternative A, would be expected to result in **negligible** impacts, if any, given the limited amount of habitat conversion that would be required.
Presence of structures: Migration disturbances	Few structures are scattered throughout the offshore bats geographic analysis area. There is an assortment of navigation and weather buoys and a handful of light towers (NOAA 2020). Migrating bats can easily fly around or over these sparsely distributed structures, and no migration disturbance would be expected. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter	The infrequent installation of future new structures in the marine environment of the next 30 years is expected to continue. As described under Ongoing Activities, These structures would not be expected to cause disturbance to migrating tree bats in the marine environment.	Offshore wind-related activities will add up to 2,066 towers (turbines and ESPs) plus buoys. The structures will be patchily distributed and spaced 1 nautical mile (1.9 kilometers) apart allowing bats that are not flying above the WTGs to fly through individual projects without changing course or to make only minor course corrections to avoid operating WTGs. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS	Up to 100 turbines could be installed plus 2 ESPs. Each could be spaced approximately 1 nautical mile (1.9 kilometers) apart allowing for most bats that are not flying above the towers to fly between individual towers or make minor course corrections. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures associated with the Vineyard Wind 1 Project and no population-level effects would be expected. Given the limited anticipated use of the OCS, the Proposed Action is expected to	Given the limited anticipated use of the OCS, the Proposed Action is expected to result in non-measurable, **negligible** impacts, if any, on bats through this sub-IPF. Similarly, ongoing, future non-offshore wind, and future offshore wind activities would not be expected to appreciably contribute to this sub-IPF. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on bats from ongoing and planned actions, including Alternative A, would be **negligible**. Impacts, if any, would be primarily driven by nearshore structures associated with ongoing activities and non-offshore wind development.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	structures on the OCS and no population-level effects would be expected.		and no population level effects would be expected.	result in non-measurable, **negligible** impacts, if any, on bats.	
Presence of structures: Turbine strikes	Few structures are in the offshore bats geographic analysis area. There is an assortment of navigation and weather buoys plus a handful of light towers (NOAA 2020). Migrating tree bats can easily fly around or over these sparsely distributed structures, and no strikes would be expected.	The infrequent installation of future new structures in the marine environment of the next 30 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to result in increased collision risk to migrating tree bats in the marine environment.	Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Bats are very rare in the offshore environment where future offshore wind development may occur. Some tree bats may pass through project areas during spring and fall migration, and some bats may use the structures (ESPs and turbine towers) to opportunistically roost. However, due to the rarity of bats in the offshore environment, the turbines being widely spaced, and the patchiness of projects, the likelihood of collisions is low.	Up to 100 turbines could be installed plus 2 ESPs. Each could be spaced approximately 1 nautical mile (1.9 kilometers) apart allowing for most bats that are not flying above the towers to fly between individual structures or make minor course corrections. However, due to the rarity of bats in the offshore environment, and the turbines being widely spaced, the likelihood of collisions is low. Given the limited anticipated use of the OCS, the Proposed Action is expected to result in non-measurable **negligible** impacts.	Given the limited anticipated use of the OCS, the Proposed Action is expected to result in non-measurable, **negligible** impacts through this sub-IPF. Impacts from ongoing and future non-offshore wind activities would not be expected to result in impacts on bats, as bats would avoid these stationary structures. Given the number of potential structures associated with the full build-out scenario, long-term impacts on migrating individuals may occur as a result of future offshore wind development. Population-level effects are unlikely due to the rarity of bats in the offshore environment. The incremental impacts of the Proposed Action are not expected to contribute to impacts on bats. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on bats from ongoing and planned actions, including Alternative A, would be **negligible** impacts. Impacts, if any, would primarily be driven by future offshore wind development.
Land disturbance: Onshore construction	Onshore construction activities are expected to continue at current trends. Potential effects on individuals may occur if construction activities include tree removal when bats are potentially present. Injury or mortality may occur if trees being removed are occupied by bats at the time of removal. Of particular sensitivity are juveniles that are unable to flush from the roost. While there is some potential for habitat impacts associated with habitat loss, no individual or population-level effects would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss, but would not be expected to result in injury or mortality of individuals.	A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 6 to 12 years to tie future offshore wind energy projects to the electric grid. Typically, this would require only small amounts of habitat removal, if any. Impacts associated with habitat loss or avoidance during construction may occur (Schaub et al. 2008), but no injury or mortality of individuals would be expected.	The Project would require temporary habitat alteration within an existing public utility ROW. Clearing, grading, and excavations would temporarily alter existing habitat, which is primarily grassland and small shrubs. Onshore construction associated with the Proposed Action is expected to result in impacts ranging from **negligible**, short-term, localized, non-biologically significant behavioral responses to limited impacts due to habitat loss and fragmentation. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for bats. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on bats species that frequent this forest edge/managed grassland ecosystem are not expected to be measurable.	Onshore construction associated with the Proposed Action is expected to result in **negligible** impacts due to habitat loss and fragmentation. Onshore impacts from ongoing and non-offshore activities are expected to result in the same non-biologically significant behavior responses, but across a greater temporal and spatial scale. Future offshore wind, excluding the proposed Project, would also be expected to cause only non-biologically significant behavior responses. In context of reasonably foreseeable environmental trends, combined impacts from this IPF on bats from ongoing and planned actions, including Alternative A, would be **negligible**, equal to the sum of all these impacts. Impacts are anticipated to result in no noticeable change to the condition of bats in the geographic analysis area for bats.
Climate change: Warming and sea level rise, storm severity/frequency	Storms during breeding and roosting season can reduce productivity and increase mortality. Intensity of this impact is speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on bats from ongoing and planned actions, including Alternative A, would contribute to impacts on bats through reduced productivity and potentially increased mortality. Because this sub-IPF is a global phenomenon, impacts on bats would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the contribution of these activities to climate change.
Climate change: Ocean acidification; Warming and sea level rise, altered habitat/ecology; Warming and sea level rise, altered migration patterns;	These sub-IPFs would have no impacts on bats.	No future activities were identified within the bats geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	These sub-IPFs would not contribute to impacts on bats.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Warming and sea level rise, property/ infrastructure damage; Warming and sea level rise, protective measures (barriers, sea walls); Warming and sea level rise, storm severity/frequency, sediment erosion, deposition					
Climate change: Warming and sea level rise, increased disease frequency	Disease can weaken, lower reproductive output, and/or kill individuals. Some tropical diseases will move northward. Extent and intensity of this impact is highly speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	This IPF may contribute to changes in the frequency and distribution of bat diseases. Impacts are the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the contribution of these activities to climate change.

ESP = electrical service platform; IPF = impact-producing factors; NOAA = National Oceanic and Atmospheric Administration; OCS = outer continental shelf; ROW = right-of-way; WNS = white nose syndrome; WTG = wind turbine generator

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A.8.5. Terrestrial and Coastal Fauna

A.8.5.1. No Action Alternative and Affected Environment

This section discusses existing conditions in the geographic analysis area for terrestrial and coastal fauna as described in Table A-1 in Appendix A and shown on Figure A.7-1, namely, all land areas that would be disturbed by the Proposed Action, plus a 0.5-mile (0.8-kilometer) buffer. BOEM expects the faunal resources in this area to have small home ranges and impacts outside their home ranges to be unlikely to affect them. See Appendix A for a discussion on birds and bats, and Section 3.1 for coastal habitats. Table A.8.5-1 describes baseline conditions and the impacts, based on the IPFs assessed, of ongoing and future activities other than offshore wind, which is discussed below.

The geographic analysis area for terrestrial and coastal fauna is within the Long Island-Cape Cod Coastal Lowland Major Land Resource Area. Much of this area exhibits sandy soils, mixed hardwood-softwood forests, and scrublands subject to periodic fires (USDA 2006). The geographic analysis area for terrestrial and coastal fauna is dominated by developed land and pine-oak forest. Pine-oak forest is one of the most common habitat types on Cape Cod. This habitat also predominates in the 365-acre (1.5 km^2) Hyannis Ponds WMA, which is managed for wildlife habitat and other non-consumptive uses. Therefore, terrestrial fauna have access to high quality, unfragmented habitat in a portion of the analysis area. Much of the other habitat in the geographic analysis area is already fragmented and/or developed for human uses, including roads, utility right-of-way (ROW), an airport, and commercial and light industrial operations. Because the geographic analysis area has been heavily developed for decades, habitat quality in the vicinity, and therefore the potential suitability for use by native fauna, has been degraded. Past activities have been taken into consideration in defining the baseline conditions of the resource (Table A.8.5-1).

COP Tables 6.1-1, 6.1-3, and 6.1-4 (Volume III; Epsilon 2020b) list terrestrial and coastal faunal resources that are known to occur near the geographic analysis area. Common species known to inhabit pine-oak forests that can be found within the geographic analysis area are discussed in Appendix E, Section E.5.2. The proposed Project would not encounter any known populations or habitats of terrestrial wildlife listed as threatened or endangered by the Commonwealth of Massachusetts or the U.S. Fish and Wildlife Service. The northern red-bellied cooter (*Pseudemys rubriventris*) is listed as a federal and state endangered species. This population is more than 13 miles (21 kilometers) from the geographic analysis area and is unlikely to be present in the geographic analysis area (MNHESP 2016). Partially due to extensive management efforts by the Massachusetts Division of Fisheries and Wildlife and its partners, the population appears likely to be slowly growing (MNHESP 2016).

The OECR and the proposed substation site would not contain and/or cross any freshwater or wetland resources; however, several wetlands and freshwater ponds lie within the 0.5-mile (0.8-kilometer) buffer. Of the approximately 48,000 acres (194.2 km^2) of wetlands in Massachusetts, approximately 1,250 acres (5.1 km^2) were changed to other land cover types between 1991 and 2005 (Commonwealth of Massachusetts 2016). The geographic analysis area for terrestrial and coastal fauna is in a densely developed part of the state with several nearby wetlands. In the area within approximately 1.5 miles (2.4 km^2) from the geographic analysis area, the Massachusetts Department of Environmental Protection has identified 0.13 acre (526.1 m^2) of wetland loss from 2001 to 2012, the most recent year for which wetland maps are available, and no wetland loss within the geographic analysis area itself (MassDEP 2017).

Ongoing activities related to land disturbance periodically affect terrestrial and coastal fauna in the geographic analysis area. For example, ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but not to a degree that affects terrestrial and coastal fauna. Periodic clearing of shrubs and tree saplings along existing utility ROW causes disturbance and temporary displacement of mobile species and may cause injury or mortality of less-mobile species, although this is not known to be a concern at a population level. Periodically, undeveloped parcels are cleared and developed for human uses, permanently changing the condition of those parcels as habitat for terrestrial fauna. Maintenance of existing roads and public utilities will continue indefinitely. Outside currently protected areas, the conversion of natural areas to developed residential, commercial, and industrial uses is likely to continue. Climate change, influenced in part by greenhouse gas (GHG) emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent changes of unknown intensity. Climate change, sea-level rise, and other ongoing activities and planned actions could also affect the land-sea interface, including beaches that provide habitat for several species. Because the offshore components of the proposed Project have no potential impacts on terrestrial and coastal fauna other than certain avian species, this section does not discuss offshore activities.

Under the No Action Alternative, the proposed Project would not be built. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project (Section A.8.5.2) would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the southern New England region, some of which may intersect the geographic analysis area for terrestrial and coastal fauna. Impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur (Table A.8.5-1). Therefore, impacts on terrestrial and coastal fauna may still occur and may even be similar to those that would occur if the proposed Project were built, but the exact impacts would not be the same due to temporal and geographical differences.

A.8.5.1.1. Future Offshore Wind Activities (without Proposed Action)

Vineyard Wind has proposed a future project that would likely overlap the geographic analysis area for terrestrial and coastal fauna. The impacts of this future offshore wind activity on terrestrial and coastal fauna would be of the same type as those of the Proposed Action discussed below.

A.8.5.1.2. Conclusions for the No Action Alternative

Under the No Action Alternative, terrestrial and coastal fauna would continue to follow current regional trends and respond to current and future environmental and societal activities. The current state of local terrestrial and coastal fauna resources is generally stable, although fauna are subject to disturbance from ongoing activities in the geographic analysis area for terrestrial and coastal fauna. Land disturbance from onshore construction periodically causes temporary and permanent habitat loss, temporary displacement, injury, and mortality, resulting in small short-term impacts on terrestrial and coastal fauna. Climate change, influenced in part by GHG emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent impacts of unknown intensity. Considering current conditions and the modest pace of development in the geographic analysis area, terrestrial fauna resources are expected to remain generally stable under the No Action Alternative.

BOEM anticipates that the impacts of ongoing activities, especially land disturbance and climate change, would be **minor** to **moderate**. In addition to ongoing activities, planned actions other than offshore wind may also contribute to impacts on terrestrial and coastal fauna. Planned actions other than offshore wind primarily include increasing onshore construction, although no particular future construction projects were identified within the geographic analysis area for terrestrial and coastal fauna; BOEM anticipates that the impacts of planned actions other than offshore wind would be **negligible** to **minor**. BOEM expects the combination of ongoing activities and planned actions other than offshore wind to result in **minor** to **moderate** impacts on terrestrial and coastal fauna, primarily driven by land disturbance and climate change.

Future offshore wind activities—if any enter the geographic analysis area for terrestrial and coastal fauna—could cause impacts (e.g., displacement, mortality, habitat loss) that would be similar to the impacts of the proposed Project alone. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities combined with ongoing activities, reasonably foreseeable environmental trends, and planned actions other than offshore wind in the geographic analysis area would result in **moderate** impacts, primarily through land disturbance and climate change. Future offshore wind activities—if any enter the geographic analysis area for terrestrial and coastal fauna—are expected to contribute to the impacts through land disturbance, although the majority of this IPF would be attributable to ongoing activities.

A.8.5.2. Consequences of Alternative A

The following proposed-Project design parameters (Appendix G) would influence the magnitude of the impacts on terrestrial and coastal fauna:

- The routing variants within the OECR

- The time of year during which construction occurs

Changes to the design capacity of the turbine to be used would not alter the maximum potential impacts on terrestrial and coastal fauna for Alternative A, nor any other action alternative, because such changes would not alter the onshore activities and the proposed offshore activities have no potential impacts on terrestrial and coastal fauna. Changes to the proposed onshore substation site could modify the impacts of Alternative A and all other action alternatives on terrestrial and coastal fauna, as described below regarding land disturbance.

This assessment analyzes the maximum-case scenario; any potential variances in construction activities or in the parameters listed above would result in similar or lesser impacts than described below. For instance, summer and fall months (May through October) constitute the most active season for terrestrial fauna in this area, especially for reptiles and amphibians. Therefore, construction during months in which terrestrial and coastal fauna are not present, not breeding, or less active would have lesser impacts on terrestrial and coastal fauna than construction during more active times.

Alternative A has one landfall site and associated OECR connecting the underground vault at the landfall site to the new proposed substation site (Figure 2.1-1). The OECR is colocated with existing, previously disturbed linear corridors (e.g., public road ROW), allowing the export cable to be buried below grade (COP Volume I, Section 3; Epsilon 2020a). The proposed OECR would be located under existing paved roadway in residential and commercial areas with sufficiently wide shoulders that has little to no terrestrial wildlife habitat. The proposed OECR, which runs from the Covell's Beach landfall site to the Barnstable Switching Station for approximately 5.3 miles (8.5 kilometers), would be located entirely within existing roadways until entering the proposed substation site (Epsilon 2018c). The OECR would include crossing a parcel subject to Article 97 of the Constitution of the Commonwealth of Massachusetts, and land acquired by the Town of Barnstable for conservation/open space purposes. Covell's Beach is also subject to Article 97, requiring approval of the legislature for any disposition of parkland; such legislation was approved by the legislature and signed into law on July 31, 2019 (2019 Mass. Acts 44). The proposed Project's substation site would be located on the eastern portion of a partially developed site within the Independence Park commercial/industrial area in the Town of Barnstable. In addition to existing buildings and parking areas, the site includes locally common pine-oak forest habitat. The proposed Project would not encounter wetlands, freshwater bodies, or the Hyannis Ponds WMA, so there would be no impact on these habitats.

Impacts on terrestrial and coastal fauna from Alternative A alone would include temporary consequences resulting from habitat alteration, increased noise and vibration, and possibly physical contact resulting in injury or mortality to individuals.

Alternative A could affect terrestrial and coastal fauna through the following primary IPFs.

Land disturbance: Onshore construction of the proposed Project would disturb up to 15.5 acres (62,726 m^2), possibly resulting in small temporary impacts on terrestrial and coastal fauna during construction such as disturbance, displacement, and potential injury and/or mortality of individuals.

Collisions between animals and vehicles or construction equipment might cause mortality. BOEM expects this to be rare, as most individuals would likely avoid the noise and vibration of the construction areas. However, animals with limited mobility, especially reptiles and amphibians (COP Volume III, Table 6.1-1, Section 6.1.1.2; Epsilon 2020b), may be vulnerable to this type of impact, and BOEM anticipates little to no impact on populations in light of the limited construction footprint.

The proposed OECR lies within existing roadways until entering the proposed substation site (Epsilon 2018c), thus avoiding all habitat in the OECR resulting in no impact on terrestrial habitat or any known protected or rare habitats. Vineyard Wind would consult with local officials to develop and implement procedures to restore any previously undeveloped areas disturbed by construction (COP Volume III, Section 6.1.2.1.5; Epsilon 2020b).

The proposed Project would not involve permanent habitat alteration in the OECR, but construction of the substation site would permanently convert 6.1 acres (24,686 m^2) of forested habitat into developed land. The DEIS assessed the potential impacts of building a substation of up to 7 acres (28,328 m^2) in size within a completely forested site. Vineyard Wind has increased the substation site area to 8.6 acres (34,601 m^2), of which only 7.7 acres (30,999 m^2) would involve ground disturbance that could result in a slight increase in temporary displacement and potential injury or mortality of terrestrial fauna during construction. Of the 7.7 acres (30,999 m^2) of ground disturbance, 6.1 acres (24,686 m^2) would involve permanent habitat conversion, in this case from forested habitat to developed land. These changes would be expected to have a minimal effect on terrestrial fauna, because this type of forest habitat is common across Cape Cod and is available as a high quality, contiguous block in the nearby Hyannis Ponds WMA, which lies as near as 0.25 mile (0.4 kilometer) from the proposed substation area.

BOEM would not expect normal operations and maintenance activities to involve further habitat alteration or otherwise impact terrestrial fauna. Vineyard Wind would typically accomplish maintenance and any necessary repairs through manholes at the splice vaults for the transmission line, within the fenced area of the substation site, or well within the existing public utility ROW. Management of the existing utility ROW would continue to involve periodic removal of tree saplings, possibly through mowing and/or prescribed fire. Vineyard Wind would likely leave onshore facilities in place for future use (Chapter 2); there are no plans to disturb the land surface or terrestrial habitat during decommissioning. The presence of onshore construction equipment could temporarily prevent or deter animals from approaching or crossing the site of a given non-routine event. Impacts on terrestrial and coastal fauna would be temporary, lasting only as long as repair or remediation activities necessary to address these non-routine events, and BOEM expects them to be **negligible**.

The land disturbance involved in Alternative A alone would result in **minor** habitat alteration, mortality, and temporary displacement of terrestrial and coastal fauna from the proposed substation site.

In context of reasonably foreseeable environmental trends, the impacts on terrestrial and coastal fauna of Alternative A alone may add to the impacts of ongoing and future land disturbance. Impacts due to onshore land use changes are expected to include a gradually increasing amount of habitat alteration and habitat loss, likely changing the composition of local faunal assemblages and possibly reducing the local abundance of terrestrial fauna. The future extent of land disturbance from ongoing activities and future non-offshore wind activities over the next 30 years is not known with as much certainty as the extent of land disturbance that would be caused by Alternative A, but, based on regional trends, is anticipated to be similar to or greater than that of Alternative A. If a future project were to cross the geographic analysis area or even be collocated (partly or completely) within the same terrestrial ROW corridor that Alternative A would use, then the impacts of those future projects on terrestrial and coastal fauna would of the same type as those of Alternative A alone; the degree of impacts may increase, although the location and timing of future activities would influence this. For example, repeated construction in a single ROW corridor would be expected to have less impact (e.g., displacement, mortality, habitat loss) on terrestrial and coastal fauna than construction in an equivalent area of undisturbed habitat. In context of reasonably foreseeable environmental trends, combined land disturbance impacts on terrestrial and coastal fauna from ongoing and planned actions, including Alternative A, would likely be **minor** to **moderate**.

Noise: Construction noise and vibration could lead to the disturbance and temporary displacement of mobile species. Displaced individuals would likely return to the affected areas once the noise and vibration has ended (COP Volume III, Section 6.1.2.1.2; Epsilon 2020b). It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. BOEM expects these impacts to be limited and temporary in nature, and therefore **minor**. Normal operation of the substation would generate continuous noise, but BOEM expects negligible associated impacts in the context of existing commercial and industrial noises near the proposed substation.

The impacts on terrestrial and coastal fauna of noise from Alternative A alone may or may not add to the impacts of other anthropogenic noise. Terrestrial fauna may habituate to noise so that it has little to no effect on their behavior or biology (Kight and Swaddle 2011). Considering that the geographic analysis area for terrestrial and coastal fauna is mostly developed and contains many roads, terrestrial fauna in this area are likely to be already subject to anthropogenic noise. Overall, the impacts on terrestrial and coastal fauna from noise from ongoing and planned actions, including Alternative A, are anticipated to be **minor**.

Climate change: Climate change would contribute to impacts on terrestrial and coastal fauna, primarily due to existing global and regional climate trends. Although sources of GHG emissions contributing to regional and global climate change mostly occur outside the geographic analysis area for terrestrial and coastal fauna, terrestrial and coastal fauna may be affected by warming, sea level rise, and altered habitat/ecology. Climate change is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent impacts of unknown intensity (Friggens et al. 2018). See Section A.8.1 for details on the expected contribution of offshore wind activities to climate change. BOEM anticipates that Alternative A alone would have no measurable influence on this IPF. Because this IPF is a global phenomenon, the impacts through this IPF would be the same as those under the No Action Alternative. The intensity of impacts on terrestrial and coastal fauna resulting from climate change are uncertain, but are anticipated to be **minor** to **moderate**.

In summary, the activities associated with the proposed Project may affect terrestrial and coastal fauna through temporary disturbance and injury or mortality and permanent conversion of a small proportion of the overall habitat available regionally. Considering the avoidance, minimization, and mitigation measures proposed, construction of Alternative A alone would likely have **minor** impacts on terrestrial and coastal fauna. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section A.8.5.1.2.

In the context of other reasonably foreseeable environmental trends and planned actions in the area, impacts resulting from individual IPFs would range from **minor** to **moderate**. Considering all the IPFs together, BOEM anticipates that the combined impacts from ongoing and planned actions, including Alternative A would likely be **moderate** impacts on terrestrial and coastal fauna in the geographic analysis area. The main drivers for this impact rating are ongoing and future land disturbance, ongoing climate change, and the land disturbance attributable to Alternative A. Alternative A would contribute to the overall impact rating primarily through the temporary displacement, mortality, and temporary to permanent habitat loss due to construction of the onshore export cable and substation. Thus, the overall impacts on terrestrial and coastal fauna would likely be **moderate** because the measurable impacts expected would be small and/or the resource would likely recover completely when the impacting agent is gone and remedial or mitigating action is taken.

A.8.5.3. Consequences of Alternatives C, D1, D2, E, and F

The impacts on terrestrial and coastal fauna of Alternatives C, D1, D2, E, or F alone would be practically identical to those under Alternative A alone because these alternatives differ only with respect to offshore components, and offshore components of the proposed Project have no potential impacts on terrestrial and coastal fauna. The impacts resulting from individual IPFs associated with Alternatives C, D1, D2, E, and F alone on terrestrial and coastal fauna through land disturbance are expected to be **minor**. For the same reason, the overall combined impacts on terrestrial and coastal fauna from ongoing and planned actions, including Alternatives C, D1, D2, E, and F, would be practically identical to those under Alternative A and would likely be **moderate**.

A.8.5.4. Comparison of Alternatives

With respect to terrestrial and coastal fauna, the impacts associated with all action alternatives alone are identical (**minor**) because the alternatives only differ in offshore components, and offshore components of the proposed Project have no potential impact on terrestrial and coastal fauna. Under the No Action Alternative, the proposed Project would not be built and the impacts from the proposed Project would not occur as proposed. However, the demand for offshore wind power that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the southern New England region, some of which may intersect the geographic analysis area for terrestrial and coastal fauna and cause impacts similar to those described above.

In context of reasonably foreseeable environmental trends and planned actions, impacts on terrestrial and coastal fauna under any action alternative would be practically identical. Ongoing climate change will also contribute to impacts on terrestrial and coastal fauna. In this context, the overall impacts of any action alternative would likely be slightly greater than the incremental impacts of any alternative alone, and would likely be **moderate**.

A.8.5.5. Summary of Impacts of the Preferred Alternative

The Preferred Alternative would be a combination of Alternatives C, D2, and E with mitigation measures in Appendix D. The Preferred Alternative would be located within existing roadway ROWs, thus resulting in no habitat alteration or disruption to quality habitat and would not pass through any known protected or rare habitats. The Preferred Alternative would result in the permanent habitat conversion of 6.1 acres (24,686 m^2) of pitch pine-oak habitat for the proposed substation site. The Preferred Alternative would not pass near wetlands and streams, so there would be no risk of sedimentation or other impacts on these types of resources. Overall, considering the avoidance, minimization, and mitigation measures included in the Preferred Alternative (including Vineyard Wind’s voluntary measures), construction under the Preferred Alternative would likely have **minor** impacts on terrestrial and coastal fauna. BOEM expects **negligible** impacts on terrestrial fauna from operations and maintenance. Vineyard Wind would likely leave onshore facilities in place for future use (Chapter 2). There are no plans to disturb the land surface or terrestrial habitat during the course of decommissioning; therefore, impacts of decommissioning would be **negligible**.

Table A.8.5-1: Summary of Activities and the Associated Impact-Producing Factors for Terrestrial and Coastal Fauna

BOEM expects the faunal resources in this area to have small home ranges and therefore impacts outside their home ranges are unlikely to affect them.

The geographic analysis area for terrestrial and coastal fauna is located within the Long Island-Cape Cod Coastal Lowland Major Land Resource Area. Much of this area exhibits sandy soils, mixed hardwood-softwood forests, and scrublands subject to periodic fires.

Pine-oak forest is one of the most common habitat types on Cape Cod. This habitat also predominates in the 365-acre (1.5 km^2) Hyannis Ponds WMA, which is managed for wildlife habitat and other non-consumptive uses. Therefore, terrestrial fauna have access to high quality, unfragmented habitat. Much of the other habitat in the geographic analysis area is already fragmented and/or developed for human uses, including roads, utility ROW, an airport, and commercial and light industrial operations. Because the geographic analysis area has been heavily developed for decades, habitat quality in the vicinity, and therefore the potential suitability for use by native fauna, has been degraded.

Of the approximately 48,000 acres (194.2 km2) of wetlands in Massachusetts, approximately 1,250 acres (5.1 km2) were changed to other land cover types from 1991 to 2005 (Commonwealth of Massachusetts 2018). The geographic analysis area is in a densely developed part of the state with several nearby wetlands. Within approximately 1.5 miles (2.4 kilometers) from the geographic analysis area, the Massachusetts Department of Environmental Protection has identified 0.13 acres (526.1 m2) of wetland loss from 2001 to 2012, the most recent year for which wetland maps are available, and no wetland loss within the geographic analysis area itself (MassDEP 2017).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Land disturbance: Erosion and sedimentation	Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but usually not to a degree that affects terrestrial and coastal fauna, assuming that industry standard BMPs are implemented.	No future activities were identified within the geographic analysis area other than ongoing activities.	Vineyard Wind has proposed a future project that likely would overlap the geographic analysis area for terrestrial and coastal fauna. The impacts of this future offshore wind activity on terrestrial and coastal fauna would be similar to the impacts of the Proposed Action alone.	The Proposed Action would not encounter habitats sensitive to erosion and sedimentation. With BMPs, BOEM anticipates the Proposed Action would cause a **negligible** impact on terrestrial and coastal fauna through erosion and sedimentation.	The Proposed Action would lead to a **negligible** impact on terrestrial and coastal fauna through erosion and sedimentation. Ongoing activities typically do not cause impacts on terrestrial and coastal fauna through this sub-IPF. Other offshore wind activities within the geographic analysis area may cause impacts similar to those of the Proposed Action. In context of reasonably foreseeable environmental trends, combined erosion and sedimentation impacts on terrestrial and coastal fauna from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.
Land disturbance: Onshore construction	Periodic clearing of shrubs and tree saplings along existing utility ROWs causes disturbance and temporary displacement of mobile species and may cause direct injury or mortality of less-mobile species, resulting in short-term impacts that are less than noticeable. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, and cell tower projects also causes disturbance, displacement, and potential injury and/or mortality of fauna, resulting in small temporary impacts.	See above.	See above.	During onshore construction, the Proposed Action would cause disturbance, temporary displacement, and potential injury and/or mortality of fauna up to 15.5 acres (62,726 m^2), resulting in **minor** temporary impacts. During operations and maintenance, similar impacts could occur in parts of this area where maintenance activities are needed.	The Proposed Action would lead to **minor** impacts of disturbance, displacement, and potential injury and/or mortality on terrestrial and coastal fauna as a result of onshore construction. Ongoing activities periodically cause similar **minor** impacts on terrestrial and coastal fauna. Other offshore wind activities within the geographic analysis area may cause impacts similar to those of the Proposed Action. In context of reasonably foreseeable environmental trends, combined onshore construction impacts (disturbance, displacement, injury, mortality) on terrestrial and coastal fauna from ongoing and planned actions, including the Proposed Action, would likely be **minor**. Repeated construction in any particular area would be expected to have less impact (e.g., displacement, mortality, habitat loss) on terrestrial and coastal fauna than construction in an equivalent area of undisturbed habitat.
Land disturbance: Onshore, land use changes	Periodically, undeveloped parcels are cleared and developed for human uses, permanently changing the condition of those parcels as habitat for terrestrial fauna. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, transportation infrastructure, sewer infrastructure, and cell tower projects could permanently convert various areas.	See above.	See above.	In the course of construction, the Proposed Action would convert approximately 6.1 acres (24,686 m^2) of forest to developed land, resulting in a **minor** permanent impact of habitat loss.	The Proposed Action would lead to a **minor** permanent impact on terrestrial and coastal fauna through converting up to approximately 6.1 acres (24,686 m^2) of forest to developed land. Ongoing activities periodically add to permanent impacts on terrestrial and coastal fauna through land use changes. Other offshore wind activities within the geographic analysis area may cause impacts similar to those of the Proposed Action. In context of reasonably foreseeable environmental trends, combined land use change impacts on terrestrial and coastal fauna from ongoing and planned actions, including the Proposed Action, are expected to include a gradually increasing amount of habitat loss, resulting in **minor** to **moderate** impacts on terrestrial and coastal fauna. Collocation of multiple uses in any particular developed area would be expected to have less impact on terrestrial and coastal fauna than developing an equivalent area of undisturbed habitat.
Noise: Onshore construction	Periodically, construction noise and vibration associated with new development and maintenance occurs, potentially leading to the disturbance and temporary displacement of mobile species. These impacts are likely small in the context of existing vehicle, commercial, and industrial noises in the analysis area.	See above.	See above.	Construction noise and vibration could lead to the disturbance and temporary displacement of mobile species. BOEM expects these impacts to be limited and temporary in nature, and therefore **minor**.	The Proposed Action would lead to **minor** temporary impacts of disturbance and displacement of terrestrial and coastal fauna as a result of noise from onshore construction. Ongoing activities periodically cause similar impacts. Other offshore wind activities within the geographic analysis area may cause impacts similar to those of the Proposed Action. In context of reasonably foreseeable environmental trends, combined noise impacts (disturbance, displacement) on terrestrial and coastal fauna from ongoing and planned actions, including the Proposed Action, would likely be **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by greenhouse gas emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 30 years.	See above.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of future offshore wind activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of the Proposed Action to climate change.	This sub-IPF is altering the seasonal timing and patterns of species distributions and ecological relationships of terrestrial and coastal fauna. The intensity of impacts resulting from climate change is uncertain, but would likely be **minor** to **moderate**. Because this sub-IPF is a global phenomenon, impacts on terrestrial and coastal fauna though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the combined contribution of these activities to climate change.

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; IPF = impact-producing factor; km^2 = square kilometer; m^2 = square meter; ROW = right-of-way; WMA = Wildlife Management Area

A.8.6. Land Use

A.8.6.1. No Action Alternative and Affected Environment

This section discusses baseline conditions in the geographic analysis area for land use and coastal infrastructure as described in Table A-1 in Appendix A and shown on Figure A.7-11, namely, the Town of Barnstable, areas surrounding the ports of New Bedford and Vineyard Haven Harbor, and areas surrounding other ports potentially used for the proposed Project. Table A.8.6-1 describes baseline conditions and the impacts, based on the IPFs assessed, of ongoing and future activities other than offshore wind, which is discussed below.

Land use and coastal infrastructure are diverse within the geographic analysis area due to the presence of large coastal population centers, as well as recreational, tourism, residential, commercial, and industrial development (NOAA 2010). The amount of developed land in the National Oceanic and Atmospheric Administration’s (NOAA’s) Northeast Coastal Region (which includes the geographic analysis area) increased from 1996 to 2010. Approximately 9 percent of this land area is developed, with development highly concentrated around densely developed urban areas (NOAA 2010).

The towns of Barnstable and Tisbury (where Vineyard Haven Harbor is located) are long-established communities with a mix of low- to medium-density residential development, business areas, extensive recreation or tourist-oriented commercial and public uses, open space, and smaller areas of industrial use. Challenges facing the Cape Cod region include an inadequate housing supply for the region’s low and moderate income residents; limited infrastructure; loss of forest cover; use of on-site septic systems that do not adequately protect water quality; climate change; and lack of protection for historic buildings (Cape Cod Commission 2018).

The Town of Barnstable is the largest community on Cape Cod in both land area and population and serves as the county seat. Most of the town’s residential development has occurred in the last 40 years. The town’s Hyannis area contains important regional assets, including two ferry terminals, the region’s largest commercial airport, and the Cape Cod Hospital. Barnstable has large areas of wetlands, forest, and freshwater ponds (Town of Barnstable 2010). Of the town’s 38,500 acres (155.8 km2), 28 percent (10,799 acres [43.7 km2]) is protected open space and 11 percent (4,070 acres [16.5 km2]) is committed to recreation, public use (including the airport), or private agriculture/forest lands (Ridley 2010). Low- to medium-density residential development surrounds commercial and industrial uses along major roads. Working waterfronts are a long-established feature of Barnstable County’s deep-water harbors, which support traditional fishing activities and recreational boating (COP Volume III; Epsilon 2020b).

Vineyard Haven Harbor in the Town of Tisbury is a year-round working port, home to most of the boatyards on Martha’s Vineyard. Small coastal tankers and ferries regularly use Vineyard Haven Harbor to transport freight, vehicles, and passengers (COP Volume III; Epsilon 2020b). The areas of Tisbury near the Vineyard Haven Harbor are a mix of marine-related, commercial, and residential uses. About 2 percent of the island of Martha’s Vineyard is zoned for commercial or industrial use, 40 percent is preserved from development, and nearly all of the remaining land area is developed for residential uses (Martha’s Vineyard Commission 2010). Commercial activity centers on the traditional village centers, while residential development is more dispersed. Waterfront communities focus on tourism-oriented businesses, seasonal residences, and fishing. Industrial activities cluster at the Airport Business Park alongside other commercial activities (COP Volume III; Epsilon 2020b).

The community plans for Barnstable and Martha’s Vineyard place priority on protection of community character and conservation of natural resources, and recommend no substantial changes in land uses near proposed Project onshore facilities (Town of Barnstable 2010; Martha’s Vineyard Commission 2010). The Martha’s Vineyard plan notes a decline in the commercial fishing industry and calls for protecting harbor facilities for commercial fishing, including harbors in Tisbury and other towns on the island (Martha’s Vineyard Commission 2010). The 2018 Cape Cod Regional Policy Plan (which covers Barnstable) calls for fostering a diverse mix of business and industry, encouraging industries that provide living wage jobs, expanding economic activity and promoting year-round, diverse housing stock while preserving the region’s natural, cultural, and historic resources (Cape Cod Commission 2018).

The City of New Bedford is a densely developed, historic, manufacturing center and port within Bristol County. The city's Master Plan establishes numerous goals, which include developing emerging technology industry sectors, linking brownfields and historic mills with new development opportunities, diversifying the industries in the Port of New Bedford while supporting traditional harbor industries, and promoting sustainable, mixed-use development in neighborhoods (Vanasse Hangen Brustlin, Inc. 2010). The Port of New Bedford is within New Bedford's extensive industrial waterfront, adjacent to the Acushnet River estuary, which empties into Buzzard Bay. The port contains the MCT, a facility developed with support from the Commonwealth of Massachusetts to serve the offshore wind energy industry (Sasaki et al. 2016).

Under the No Action Alternative, the proposed Project would not be built. If the Vineyard Wind 1 Project is not approved, impacts from the proposed Project (Section A.8.6.2) would not occur. However, the state demand that the Vineyard Wind 1 Project would have filled could be met by other offshore wind projects that would affect the same geographic analysis area for land use and coastal infrastructure. Therefore, impacts from ongoing, future offshore wind activities, as well as future non-offshore wind activities, would still occur (Table A.8.6-1). The impacts on land use and coastal infrastructure would be similar, but the exact impact would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area and considers the assumptions included in Section 1.7 and Appendix A.

A.8.6.1.1. Future Offshore Wind Activities (without Proposed Action)

Only a small subset of potential offshore wind activities may occur in or near the geographic activity area: activities associated with Vineyard Wind 2 (OCS-A 0501 [southern portion]), Mayflower Wind (OCS-A 0521), Empire Wind (OCS-A-0512), possibly a development by Equinor Wind US (OCS-A 0520), and Bay State Wind (OCS-A 0500). The exact extent of impacts would depend on landfall locations, cable route length, nearby land uses, and environmental features (e.g., residences, beaches, coastal habitats), and ports utilized to support the future offshore wind activities.

BOEM expects future offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/ hazardous materials (hazmat) may increase as a result of future offshore wind activities. See Section A.8.2 for a discussion of the nature of anticipated releases. The risk of accidental releases would be increased primarily during construction, but also during operation and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. The overall impact of accidental releases on land use and coastal infrastructure is anticipated to be localized and short-term, and could result in temporary restrictions on use of adjacent properties and coastal infrastructure during the cleanup process. The exact extent of impacts would depend on the locations of landfall, substations, and cable routes, as well as the ports that support future offshore wind energy projects. Based on the discussion in Section A.8.2, the impacts of accidental releases on land use and coastal infrastructure would be localized and short-term (except in the case of very large spills that affect a large land or coastal area).

Light: The permanent aviation warning lighting required for offshore wind WTGs would be visible from some beaches and coastlines and could have effects on land use through impacts on recreation, tourism, and property values in certain locations if the lighting influences visitors in selecting coastal locations to visit or buy. As stated in Section 3.9, aviation hazard lighting from approximately 709 WTGs (out of 775) could potentially be visible from beaches and coastal areas in and near the geographic analysis area for land use and coastal infrastructure. Visibility would depend upon distance from shore, topography, and atmospheric conditions, but would generally be localized, constant, and long-term. If implemented, ADLS would activate the aviation warning lighting when aircraft approach WTGs. For the Proposed Action, this is expected to occur less than 0.1 percent of annual nighttime hours. Similar analyses have not been prepared for other offshore wind projects; however, this FEIS assumes that activation of ADLS for other projects (if used) would be comparably rare. This would reduce the land use impacts already associated with WTG lighting.

Nighttime lighting from onshore electrical substations could affect the ability to use nearby properties or decisions about where to establish permanent or temporary residences. It is likely that other projects, similar to the proposed Vineyard Wind 1 Project, would expand or construct new substations near existing substations, or would construct new substations in areas where land development regulations (i.e., zoning and land use plan designations) allow such uses. For new or expanded substations in business or industrial areas, lighting would have no adverse impacts on land uses. The extent of lighting impacts would depend on the proposed substation locations, but would generally be localized, constant, and long-term.

Port utilization: Future offshore wind activity could necessitate port expansion in Massachusetts and Rhode Island. Offshore wind energy projects would make productive use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning, including use of the MCT at the Port of New Bedford, which was developed as a result of state investment to support the offshore wind industry. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts such as greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind. The MassCEC has identified 18 waterfront sites in Massachusetts—which include Montaup, Brayton Point, and 8 sites in the New Bedford area, with the remaining 8 being outside the geographic analysis area—that may be available and suitable for use by the offshore wind energy industry, including retired waterfront power plant sites (MassCEC 2017).

Port improvements in the geographic analysis area are planned or underway in concert with plans for offshore wind development. Brayton Port in Massachusetts has completed upgrades to support heavy-lift port operations and receive deep-draft vessels for offshore wind development (Brayton Point Commerce Center 2020). The retired power plant was demolished in early 2020 and grading activities have commenced to prepare laydown and manufacturing areas for future tenants. The grading plan is designed to support industry requirements for manufacturing of offshore wind components. Expansions are planned at the Port of Providence (ProvPort) to service offshore wind (Offshore Source 2020), and dredging, as well as bulkhead and pier extensions, is underway at the Port of Davisville (King 2020).

If multiple future offshore wind energy projects are constructed at the same time and rely on the same ports, this simultaneous use could stress port resources and could potentially increase the marine and road traffic, noise, and air pollution in the area. Overall, the No Action Alternative would have constant, long-term, beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity, as well as localized, short-term, adverse impacts in cases where individual ports are stressed due to simultaneous project activity.

Presence of structures: During operations, the views of offshore wind WTGs from coastal locations on Martha's Vineyard, Nantucket, and mainland Cape Cod could have effects on land use through impacts on recreation, tourism, and property values, if the views influence visitors in selecting coastal locations to visit or buy. Based upon the currently available studies, portions of all 775 WTGs associated with the No Action Alternative could be visible from some shorelines (depending on vegetation, topography, and atmospheric conditions), of which up to 34 (fewer than 5 percent) would be within 15 miles (24.1 kilometers) of shore. As stated in Section 3.9, while WTGs could be visible from some shoreline locations in the geographic analysis area, WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. Visibility would vary with distance from shore, topography, and atmospheric conditions and would generally be localized, constant, and long-term.

The presence of onshore transmission cable infrastructure is anticipated to have minimal long-term impacts on land use. As stated above, this analysis assumes that new substations for future offshore wind projects would be within or near existing substations, or in locations designated for such uses. This analysis further assumes that cable conduits would primarily be underground and collocated with roads and/or other utilities. As a result, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Land disturbance: Future offshore wind installation would require installation of onshore transmission cable infrastructure, which would cause temporary traffic delays and could temporarily affect access to adjacent properties. These impacts would only last through construction and occasionally during maintenance events. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts during construction or maintenance and no long-term impacts on land use.

A.8.6.1.2. Conclusions for the No Action Alternative

Under the No Action Alternative, land use and coastal infrastructure in the geographic analysis area would continue to be affected by ongoing activities, especially onshore and coastal regional trends, development projects, and port expansion. The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and regulations. The ports would continue to serve marine traffic and industries, without the new activity that the proposed Project would generate.

While the proposed Project would not be built as proposed under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, land disturbance from construction, and land use changes. BOEM anticipates that the impacts of ongoing activities, especially onshore and coastal commerce, industry, and construction projects, would have both **minor beneficial** and **minor** impacts on the geographic analysis area (the port areas and Barnstable). Accidental releases and land disturbance could have temporary adverse impacts on local land uses, but as a whole, ongoing use and development undergirds the region’s diverse mix of land uses and provides support for continued maintenance and improvement of the coastal infrastructure essential to the ports and Town of Barnstable. Reasonably foreseeable activities other than offshore wind, primarily increased port maintenance and expansion and construction activity (Table 3.3-1), would have impacts similar to ongoing activities, with **minor beneficial** and **minor** impacts. BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **minor beneficial** and **minor** impacts on the IPFs affecting land use and coastal infrastructure.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities near the geographic analysis area, combined with ongoing activities and reasonably foreseeable activities other than offshore wind, would result in **minor** impacts and **minor beneficial** impacts. Future offshore wind would adversely affect land use through land disturbance (during installation of onshore cable and substations) and accidental releases during onshore construction, as well as through the presence of offshore lighting on wind energy structures, and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind (excluding the Project) would support the productive use of ports and related infrastructure designed or appropriate for future offshore wind activity (including construction and installation, operations and maintenance, and decommissioning).

A.8.6.2. Consequences of Alternative A

The following proposed-Project design parameters (Appendix G) would influence the magnitude of the impacts on land use and coastal infrastructure:

- The time of year during which construction occurs. Vineyard Wind would schedule onshore construction to occur after Labor Day and before Memorial Day, outside of the busiest tourist season, with installation of cables continuing through June 15 with permission from the Town of Barnstable (COP Volume III; Epsilon 2020b). If Project delays were to change this schedule, the impacts on roads and land uses during the busy tourist season would be exacerbated.
- The port facilities chosen for construction support in addition to the MCT and Vineyard Haven Harbor, and improvements (if any) needed at those ports specifically to support the Project.

Changes to the turbine design capacity would not alter the maximum potential impacts on land use and coastal infrastructure for Alternative A and other alternatives because the capacity or number of turbines would not affect onshore infrastructure or port utilization. Increasing the size of the proposed substation by 2.2 acres (less than

0.1 km^2), as described in Chapter 2, would not change the analysis of impacts on land use and coastal infrastructure for Alternative A and other alternatives because the additional affected area would be adjacent to an existing substation and within industrially zoned land.

Alternative A alone would likely result in local impacts that would not alter the overall character of land use and coastal infrastructure in the geographic analysis area. The most impactful IPFs would likely include land disturbance during cable installation, which could cause temporary traffic delays and public beach disturbance during onshore cable installation lasting a few days to weeks, and the utilization of ports, which would lead to a beneficial impact. (The Proposed Action would not itself require port upgrades, but would make productive use of ports that have been upgraded or are planned for upgrade for the offshore wind industry overall). Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction, but also during operations and decommissioning.

Accidental releases: Accidental releases from Alternative A could include release of fuel/fluids/hazmat as a result of port usage, installation of the onshore cables and substation, and substation operation. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. The impact of accidental releases on land use and coastal infrastructure could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. The proposed substation site would be above the sole-source aquifer that services the town's public water supply wells, within an area mapped by both the Town of Barnstable and the Cape Cod Commission as a Wellhead Protection Area. The Host Community Agreement (HCA) between Vineyard Wind and the Town of Barnstable commits Vineyard Wind to protecting the aquifer through provision of containment for dielectric fluids (Town of Barnstable 2018a). Accordingly, accidental releases from Alternative A alone would have localized, short-term, **negligible** to **minor** impacts on land use. In context of reasonably foreseeable environmental trends, combined accidental release impacts on land use and coastal infrastructure from ongoing and planned actions, including Alternative A, would increase the risk of (and thus the potential impacts from) accidental releases of fuel/fluids/hazmat in the geographic analysis area and would result in localized, short-term, **negligible** to **minor** impacts on.

Light: Construction of Alternative A alone could require temporary nighttime lighting during construction and decommissioning of the WTGs in the WDA, and during cable installation along the OECC. In addition, Alternative A would include the installation and continuous nighttime use of aviation hazard avoidance lighting on WTGs and ESPs. Visibility of nighttime lighting during construction and decommissioning would be limited to the southern coasts and some elevated areas of Martha's Vineyard, Nantucket, and adjacent islands, and would depend on vegetation, topography, weather, and atmospheric conditions. As described in Section 3.9, during operations, lighting from all Alternative A's WTGs could potentially be visible from certain coastal and elevated locations on Martha's Vineyard and Nantucket. Vineyard Wind has committed to voluntarily implement ADLS, which would activate Alternative A's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. As a result, WTG lighting of Alternative A alone would have a long-term, continuous, **negligible** impact on land use and coastal infrastructure in the geographic analysis area, due to potential effects on property use and value. The proposed substation would include new lighting, which could affect the ability to use existing properties within sight of this lighting, as well as decisions about where to establish permanent or temporary residences. Because the proposed substation would be constructed adjacent to an existing substation in an industrially zoned area of Barnstable, the substation lighting impacts on land use and coastal infrastructure are expected to be *de minimis*.

As stated in Section 3.6.1, offshore nighttime construction lighting and operational aviation hazard lighting for up to 709 WTGs (out of 775) associated with Alternative A and No Action Alternative projects could be visible from shore (depending on vegetation, topography, weather, and atmospheric conditions). The land use impacts from Alternative A in the context of planned activities (i.e., other offshore wind development) would be similar to, but more extensive than, the impacts for Alternative A alone. Nevertheless, in context of reasonably foreseeable environmental trends, combined WTG lighting impacts on land use and coastal infrastructure from ongoing and planned actions, including Alternative A, would have continuous, long-term, **negligible** impacts. If implemented for future offshore wind projects similar to the Proposed Action, ADLS would reduce the already **negligible** land use impacts associated with WTG lighting.

Port utilization: The Proposed Action includes no port expansion activities, but would use ports that have expanded or would expand to support the wind energy industry generally, including the MCT in New Bedford (for construction and installation) and the Vineyard Haven Harbor on Martha's Vineyard (for the proposed Operations and Maintenance Facility). Other Rhode Island and Massachusetts ports identified as possibly supporting Project construction are the ports of New Bedford, Montaup, and Brayton Point in Bristol County, ProvPort in Providence County, and the Port of Davisville (Quonset Point) in Washington County.

Land uses and coastal infrastructure impacted by construction of offshore components would include the MCT and other port facilities used for shipping, storing, and fabricating Proposed Action components. Vineyard Wind would use the MCT to offload shipments of components, prepare them for installation, and load components onto vessels for delivery to the WDA for installation. The Proposed Action would support the City of New Bedford's land use planning goals (as stated in the Waterfront Framework Plan [Sasaki et al. 2016]) and the state's investment in the MCT by enabling the MCT to better fulfill its purpose of supporting the wind energy industry. The other ports in Massachusetts and Rhode Island[11] that may be used for offloading, storage, and staging of Proposed Action components for delivery to the WDA are industrial in character, designated by local zoning and land use plans for heavy industrial activity, and typically adjacent to other industrial or commercial land uses or major transportation corridors.

Activities associated with Proposed Action construction would generate noise, vibration, and vehicular traffic at the MCT and, to a lesser extent, any of the other ports described above. These impacts are typical for industrial ports; the Proposed Action would not increase above the levels typically experienced or expected at these facilities, and would not hinder other nearby land uses or use of coastal infrastructure.

Vineyard Wind would locate the Project's Operations and Maintenance Facilities at Vineyard Haven Harbor in Tisbury. Vineyard Wind anticipates that the Operations and Maintenance land-based facilities would use an existing industrial marina facility, owned and operated by others. This facility provides marine vessel services and houses multiple businesses. Regardless of the presence of Vineyard Wind, the marina owner plans to upgrade marina facilities to accommodate additional marine industrial uses, as well as to increase the existing facility's protection from storms. The site's owner would be responsible for design, permitting, and construction of these improvements, pursuant to local, state, and federal regulations (COP Addendum, Section 1.4; Epsilon 2019a).

Operations and maintenance of the Proposed Action's offshore components would require daily activity at the Operations and Maintenance Facilities and periodic activity at the MCT and other ports, if needed. The facilities would include offices, a warehouse, training, repair facilities, and docks, all of which are consistent with the range of land uses permitted by the Town of Tisbury in this area. The increased activity within the town's port and nearby areas zoned for business and industrial uses is consistent with the land use character of Tisbury's harbor, town center, and business areas, and would provide a source of investment in the coastal infrastructure.

Overall, the construction and installation of offshore components, operation and maintenance, and decommissioning for Alternative A alone would have **minor beneficial** impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

Future offshore wind development would support investment and employment related to use and expansion of ports and supporting industries through the ongoing investment described in Section A.8.6.1.1. The Proposed Action includes no port expansion activities, but would use ports that have expanded or would expand to support the wind energy industry generally, including the MCT in New Bedford (for construction and installation) and the Vineyard Haven Harbor on Martha's Vineyard (for the proposed Operations and Maintenance Facility). In addition, construction of the Proposed Action would also use the following ports: New Bedford, Montaup, and Brayton Point in Bristol County; ProvPort in Providence County; and the Port of Davisville (Quonset Point) in Washington County. As a result, in context of reasonably foreseeable environmental trends, combined impacts on land use and coastal infrastructure from ongoing and planned actions, including Alternative A, would have **minor beneficial** impacts.

[11] Potential ports in Canada, identified in Section 2.1.1, are outside of the scope of this analysis.

Presence of structures: Portions of all Alternative A WTGs could be visible from southern coasts and elevated areas of Martha's Vineyard, Nantucket, adjacent islands, and the Cape Cod mainland, depending upon vegetation, topography, and atmospheric conditions. As stated in Section 3.9, most WTGs would be more than 15 miles (24.1 kilometers) from the coastal viewers and the WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. Alternative A alone would have a long-term, continuous, **negligible** impact on land use and coastal infrastructure in the geographic analysis area due to views of WTGs and the potential effects on property use and value.

The visual impacts of the WTGs from Alternative A as well as other future offshore wind development, visible from southern coastlines and elevated inland locations, could have long-term impacts on land use if the views influence visitor decisions on locations or properties to visit or purchase. Portions of up to 775 WTGs from Alternative A and other offshore wind development could potentially be visible from coastal and elevated locations near the geographic analysis area. As noted in Section 3.9, impacts on recreation and tourism activities would be moderate. Accordingly, in context of reasonably foreseeable environmental trends, combined visual impacts on land use and coastal infrastructure from ongoing and planned actions, including Alternative A, is anticipated to be localized, long-term, and **minor.**

Alternative A's proposed cable landfall site, cable route, and substation would be within the Town of Barnstable. At the landfall site, the proposed Project would make the physical connection between the OECC and the proposed onshore export cables in one or more underground concrete transition vaults. From the surface, the only visible components of the cable system would be the manhole covers (COP Volume I; Epsilon 2020a). Vineyard Wind would install the onshore cables entirely underground, with access points via manholes every 1,500 to 2,000 feet (457.2 to 609.6 meters) (COP Volume I; Epsilon 2020a). The proposed cable route would follow or be under or adjacent to existing roads (COP Volume I; Epsilon 2020a). Table A.8.6-2 summarizes the land uses along the onshore cable route connecting the landfall site to the proposed substation.

Table A.8.6-2: Onshore Cable Route

Road or ROW Used	Distance	Primary Adjoining Land Uses
Craigville Beach Road	0.6 mile (1 kilometer)	Residential
Strawberry Hill Road	1.4 miles (2.3 kilometers)	Residential; commercial and institutional near major roads
Wequaquet Lane	0.4 mile (0.6 kilometer)	Residential; commercial and institutional near major roads
Phinneys Lane	1.3 miles (2.1 kilometers)	Residential; institutional and industrial near major roads
Attucks Lane, Independence Drive and Communication Way	0.7 mile (1.1 kilometers)	Industrial

Source: COP Volume I; Epsilon 2020a

ROW = right-of-way

The Covell's Beach landfall site is located on Craigville Beach Road near the paved parking lot entrance to a public beach owned by the Town of Barnstable. Residences and a building associated with the public beach are west of the potential landfall site, between Craigville Beach Road and the beach. Residential neighborhoods (single-family homes and one multifamily community) are located on both sides of the road to the north and northeast. The proposed Project substation would be within an industrial area, adjacent to the existing Barnstable Switching Station. The property is zoned by the Town of Barnstable for industrial use, and is within the town's Groundwater Protection Overlay District.

The substation would utilize a 6.4-acre site (25,899.9 m^2) on Independence Park Drive, approximately 2,000 feet (610 meters) south and west of existing and planned multifamily dwellings (COP Volume I; Epsilon 2020a, Epsilon 2019b). The substation layout would include a 50-foot (15.2-meter) vegetated buffer on the south side of the site, along Independence Drive, and a 30-foot (9.1-meter) vegetated buffer on the east side of the site, which would completely screen the proposed substation from view from the multifamily buildings (Epsilon 2019b).

Vineyard Wind would construct sound barrier walls and would implement other noise control design features to limit noise impacts on the residential communities to the east and northeast (Epsilon 2019b). With the visual and sound barriers, the substation operation would not discourage continued residential use.

The presence during operations of Alternative A's onshore transmission cable infrastructure would have no impacts on land use except during occasional repairs; the cable conduits would be underground and located within existing ROW, and the substation would be within an industrial area adjacent to an existing substation. Impacts on land use of Alternative A alone would be long-term and **negligible**.

In context of reasonably foreseeable environmental trends, combined presence of onshore transmission cable infrastructure impacts on land use and coastal infrastructure from ongoing and planned actions, including Alternative A, is anticipated to have **negligible** impacts. Assuming that new substations for future offshore wind projects would be in locations designated for industrial or utility uses, and underground cable conduits would primarily be collocated with roads or other utilities, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Land disturbance: Alternative A's onshore transmission cable infrastructure would be installed entirely underground in a ductbank, generally along, under, or adjacent to existing roads or utility ROW. Installation of the cable landfall sites and underground cable routes would temporarily disturb neighboring land uses through construction noise, vibration, dust, and travel delays along the impacted roads. Construction would also require staging in parking lots adjacent to or near the landfall sites, reducing the public parking available for Covell's Beach. These disturbances would be temporary, lasting up to 1 year (excluding the June through August peak tourist season). Vineyard Wind would complete construction at any one location along a public road in a matter of days or weeks. This IPF would not change adjacent land uses or affect coastal infrastructure, but construction or maintenance activity would cause temporary traffic delays and temporarily impact access to properties adjacent to active construction and occasional maintenance sites. The cable route from the Covell's Beach landfall to the substation would be approximately 5.3 miles (8.5 kilometers). The HCA between Vineyard Wind and the Town of Barnstable commits Vineyard Wind to coordinating construction schedules and plans with the requisite Town departments in accordance with Town policies and procedures, and restoring roadways disrupted by construction to "like new" condition or a mutually acceptable alternative consistent with town policies (Town of Barnstable 2018a).

Substation construction would produce noise and vibration, leading to possible short-term impacts on industrial, commercial, and residential land uses near the substation site. Overall, land disturbance during construction and installation of Alternative A's landfall site, OECR, and substation would have localized, short-term, **minor** impacts on land use and coastal infrastructure due to noise, vibration, travel delays and temporary access restrictions to portions of Covell's Beach and the parking lot.

The short-term impacts on land use and coastal infrastructure would be additive only if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity. In context of reasonably foreseeable environmental trends, combined land disturbance impacts on land use and coastal infrastructure from ongoing and planned actions, including Alternative A, is anticipated to have localized, short-term, **minor** to **moderate** impacts due to construction-related disturbance and access limitations along the OECR route.

In summary, BOEM anticipates that Alternative A alone would have **minor beneficial** impacts resulting from port utilization, **minor** impacts resulting from land disturbance during onshore installation of the cable route and substation, and **negligible to minor** impacts resulting from accidental spills. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section A.8.6.1.2. In the context of other reasonably foreseeable environmental trends in the area, impacts resulting from individual IPFs associated would range from **negligible** to **minor** impacts and **negligible** to **minor beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the impacts associated with ongoing and planned actions including Alternative A would result in **minor** impacts and **minor beneficial** impacts on land use and coastal infrastructure in the geographic analysis area. The main drivers for this impact rating are the beneficial impacts of port utilization and minor impacts of land disturbance. Alternative A would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable, and substation installation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

A.8.6.3. Consequences of Alternatives C, D1, D2, E, and F

The impacts of Alternatives C, D1, D2, E, and F on land use and coastal infrastructure would be the same as Alternative A alone: **minor beneficial** impacts resulting from port utilization, **minor** impacts resulting from land disturbance during onshore installation of the cable route and substation, and **negligible to minor** impacts resulting from accidental spills. Furthermore, in the context of reasonably foreseeable environmental trends, the impacts resulting from individual IPFs associated with ongoing and planned actions including Alternatives C, D1, D2, E, and F would be the same as Alternative A, ranging from **negligible** to **minor** impacts for onshore land use and infrastructure and **minor beneficial** impacts. The overall impacts of Alternatives C, D1, D2, E, and F combined with ongoing and planned actions on land use would be very similar to those of Alternative A—**minor** impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change between alternatives.

A.8.6.4. Comparison of Alternatives

The same land-based and port-related activities would occur for each of the action alternatives. Therefore, the overall level of impacts would be the same across all alternatives—**negligible** to **minor** impacts on land use and coastal infrastructure along with **negligible** to **minor** beneficial impacts due to active use of port facilities.

In context of reasonably foreseeable environmental trends, impacts of ongoing and planned actions including any action alternative would be the same because the majority of the impacts on land use and coastal infrastructure come from future offshore wind development, which does not change between action alternatives. BOEM anticipates the combined impacts from ongoing and planned actions and any action alternative to result in **negligible** to **minor beneficial** impacts at ports and **negligible** to **minor** impacts for onshore land uses and coastal infrastructure. The IPFs for accidental releases, port utilization, and land disturbance could result in **minor** impacts if land use and coastal infrastructure is stressed by overlapping construction of future offshore wind project development. The overall impacts on land use from any action alternative when combined with ongoing and planned actions would be **minor** and **minor beneficial**, primarily driven by land disturbance and port utilization.

A.8.6.5. Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C, D2, and E with mitigation measures in Appendix D. Construction and installation of the Preferred Alternative would make landfall at Covell’s Beach through the use of HDD and continue underground along existing road ROWs to the proposed substation site within an industrial area. Construction, operations and maintenance, and decommissioning impacts of the Preferred Alternative would be identical to Alternative A. Accordingly, construction of the Preferred Alternative alone would have **minor** impacts on land use and coastal infrastructure as a result of land disturbance during construction only and **minor**.

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Table A.8.6-1: Summary of Activities and the Associated Impact-Producing Factors for Land Use and Coastal Infrastructure

Baseline Conditions: Land use in the study area is diverse, encompassing many distinct environments, including wetlands, developed areas, forests, and agricultural land. Developed coastal areas are common, due to the presence of large coastal population centers, including recreational, tourism, residential, commercial, and industrial infrastructures (NOAA 2010). NOAA estimates that 9 percent of the Northeast Coastal Region (which includes the study area) is developed; however, this is highly concentrated around high intensity development urban areas. From 1996 to 2010, developed land has increased (NOAA 2010). The developed areas of the Northeast are primarily along the coast, including major metropolitan areas like Boston and New York. The USACE identifies 15 principal ports along the North Atlantic coast (USACE 2018). For offshore wind energy development, New Bedford, Massachusetts, has a purpose-built terminal for offshore wind that was completed in 2015 (MassCEC 2017b). The towns of Barnstable and Tisbury are long-established communities with a mix of low- to medium-density residential development, business areas, extensive recreation or tourist-oriented commercial and public uses, open space, and smaller areas of industrial use. The City of New Bedford is a densely developed, historic manufacturing town and port. The city's Master Plan establishes numerous goals, which include developing emerging technology industry sectors, linking brownfields and historic mills with new development opportunities, diversifying the industries in the Port of New Bedford while supporting traditional harbor industries, and promoting sustainable, mixed-use development in neighborhoods (Vanasse Hangen Brustlin, Inc. 2010).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	Various ongoing onshore and coastal construction projects include the use of vehicles and equipment that contain fuel, fluids, and hazardous materials that could be released.	Ongoing onshore construction projects involve vehicles and equipment that use fuel, fluids, or hazardous materials could result in an accidental release. Intensity and extent would vary, depending on the size, location, and materials involved in the release.	Accidental releases from onshore components (i.e., transformers) could affect nearby wetlands, developed areas, forests, agricultural lands, and any other adjacent land use. Nearshore accidental releases could affect the ability to use coastal infrastructure. The potential for accidental releases would continue during construction and decommissioning of offshore wind projects, and would remain lower and constant during operations.	Accidental releases from onshore construction could affect adjacent land uses (primarily developed areas). Nearshore accidental releases could affect the ability to use coastal infrastructure, such as docks. The potential for accidental releases would continue during construction and decommissioning of the Proposed Action, and would remain lower and constant during operations. This would have localized, short-term, **negligible** to **minor** impacts on land use and coastal infrastructure.	The impacts on land use and coastal infrastructure from this sub-IPF under the Proposed Action would include increased potential for accidental releases, which would have localized, short-term, **negligible** to **minor** impacts on land use and coastal infrastructure, including restriction in use of adjacent properties and coastal infrastructure during cleanup. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts near construction sites. Future offshore wind activities would have similar contributions as the Proposed Action. In context of reasonably foreseeable trends, combined accidental release impacts on land use and coastal infrastructure from ongoing and planned actions, including the Proposed Action, would occur if accidental releases affect the same or nearby properties or coastal areas simultaneously, and would be localized, short-term, **negligible** to **minor**.
Light: Structures	Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would use nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary, depending on the location, type, direction, and duration of nighttime lighting.	Lighting from nighttime nearshore or onshore construction or operation WTGs could affect adjacent land uses if the lighting influences decisions of visitors in selecting coastal locations to visit or buy. WTG lighting would be visible from an increasing number of locations as each facility is installed, and then would be constant during operations.	Offshore nighttime construction of the Proposed Action, as well as lighting on all of the Proposed Action's WTGs could potentially be visible from higher elevations and some locations along the coastline of Martha's Vineyard and Nantucket, depending on vegetation, topography, weather, and atmospheric conditions. Vineyard Wind has committed to implementing ADLS as a voluntary measure, which would activate WTG lighting less than 0.1 percent of annual nighttime hours. Minimal new lighting associated with the proposed substation could affect the ability to use existing properties, including affecting visitor and residential recreation and tourism decisions, as well as decisions about where to establish permanent or temporary residences. However, the proposed substation would be constructed adjacent to an existing substation, in an industrially zoned area of Barnstable. Therefore, the substation lighting impacts on land use and coastal infrastructure are expected to be *de minimis*. Visible lighting from WTGs would have long-term, continuous, **negligible** impacts on land use and coastal infrastructure.	The impacts on land use and coastal infrastructure from this sub-IPF under the Proposed Action would result from offshore nighttime construction and the potential visibility of lighting on the Proposed Action's WTGs from some beaches, coastlines, and elevated locations on Martha's Vineyard and Nantucket. The presence of these structures could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have long-term, continuous, **negligible** impacts on land use. The Proposed Action's nighttime lighting on the substation within an industrially zoned location is expected to be *de minimis*. Ongoing activities and future non-offshore wind activities would add widespread lighting on onshore structures, along with minimal offshore lighting. Onshore lighting from ongoing activities would be closer to onshore viewers (who would thus perceive onshore lighting as more intense). Onshore lighting would generally contribute the largest part of the impact of lighting on structures, except in cases where minimal onshore lighting is present. Impacts from future offshore wind activities would be similar to those of the Proposed Action but more extensive, due to lighting from up to 709 WTGs potentially visible from the same locations as the Proposed Action, as well as additional coastal locations in Massachusetts and Rhode Island. In context of reasonably foreseeable trends, combined lighting impacts on land use and coastal infrastructure from ongoing and planned actions, including the Proposed Action, would be localized, long-term, constant, and **negligible**. Use of ADLS by offshore wind projects other than the Proposed Action would further reduce the **negligible** impacts of this sub-IPF on land use and coastal infrastructure.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT at the Port of New Bedford is a	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size.	Offshore wind installation would require port facilities for shipping, berthing, and staging. Development activities would support ongoing or new activity at authorized ports, making productive use of these facilities throughout construction,	The Proposed Action would use the MCT at the Port of New Bedford for staging and shipping and facilities at Vineyard Haven Harbor on Martha's Vineyard for the Operations and Maintenance Facility. Improvements for both of these facilities have been or would be completed to support the offshore wind industry as a whole, and not the	The Proposed Action would not cause any port expansion but would use the MCT at the Port of New Bedford and facilities at Vineyard Haven harbor constructed to support the offshore wind industry as a whole. This would make productive use of ports designated or appropriate for offshore wind activity and would have localized, short-term (at the MCT) or long-term (at Vineyard Haven) **minor beneficial** impacts on land use and coastal infrastructure. Ongoing and future non-offshore wind activities would include port upgrades and expansion to support overall changes and increases in shipping and maritime commerce, which could also make

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	completed facility developed by the port specifically to support the construction of offshore wind facilities.		operations, and decommissioning of offshore wind projects.	Proposed Action specifically. The Proposed Action would make active use of these facilities as well as other ports in the geographic analysis area for land use and coastal infrastructure designated or appropriate for offshore wind activity. This would have localized, short-term (at the MCT) or long-term (at Vineyard Haven), **minor beneficial** impacts on land use and coastal infrastructure.	productive use of designated ports. Future offshore wind activities would also have similar contributions as the Proposed Action, at the Port of New Bedford, which was upgraded specifically to support the offshore wind energy industry, and also at other ports in the geographic analysis area for land use and coastal infrastructure. In context of reasonably foreseeable trends, combined port utilization and expansion impacts on land use and coastal infrastructure from ongoing and planned actions, including the Proposed Action, would be localized, short-term and long-term, and **minor beneficial**.
Presence of structures: Viewshed	The only existing offshore structures within the offshore viewshed of the Vineyard Wind are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components would be limited to meteorological towers. Marine activity would also occur within the marine viewshed.	See FEIS Section 3.9. The potential 775 offshore WTGs would be visible from south-facing coastlines and elevated locations on Nantucket, Martha's Vineyard, neighboring islands, and coastal Cape Cod. More than 95 percent of the WTGs would be over 15 miles (24 kilometers) from the closest shoreline. Impacts on land use would be related to impacts on recreation, tourism, and property values, if the views influence visitors in selecting coastal locations to visit or buy. The impact of onshore views of substations would depend upon the specific location, site design, and nature of neighboring land uses.	See FEIS Section 3.9. All of the Proposed Action's WTGs would be visible from south-facing coastlines and elevated locations on Nantucket, Martha's Vineyard, neighboring islands, and Cape Cod, depending upon vegetation, topography, and atmospheric conditions. Most WTGs would be more than 15 miles (24 kilometers) from the coastal viewers and the WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. Views of WTGs would have a long-term, continuous, **negligible** impact on land use due to potential effects on property use and value. The views of the Proposed Action's substation would have long-term, continuous, **negligible** impacts on land use due to its location within an industrial area.	Impacts on land use and coastal infrastructure from the Proposed Action would result from views of the Proposed Action's WTGs from some beaches, coastlines, and elevated locations on Martha's Vineyard, Nantucket, and coastal Cape Cod. The presence of these structures could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have long-term, continuous, **negligible** impacts on land use. Ongoing activities and future non-offshore wind activities would not add visible offshore structures. Impacts from future offshore wind activities would be similar to those of the Proposed Action but more extensive, due to the visibility of up to 775 WTGs potentially visible from the same locations within the geographic analysis area. In context of reasonably foreseeable trends, combined impacts from this sub-IPF on land use and coastal infrastructure from ongoing and planned actions, including the Proposed Action, would be localized, long-term, constant, and **minor**. The impacts would result from potential impacts on property use and value.
Presence of structures: Transmission cable infrastructure	Onshore buried transmission cables are present in the area near the Vineyard Wind 1 Project onshore and offshore improvements. Onshore activities would only occur where permitted by local land use authorities, which would avoid long-term land use conflicts.	No known proposed structures are reasonably foreseeable and proposed to be located in the geographic analysis area for land use and coastal infrastructure.	See Land disturbance: Onshore land use changes.	See Land disturbance: Onshore land use changes.	See Land disturbance: Onshore land use changes.
Land disturbance: Onshore construction	Onshore construction supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.	Installation of onshore cable infrastructure would have localized, short-term impacts during construction or maintenance. Onshore construction of cables is likely to disrupt road traffic for a few days and produce noise and dust, typical of other utility construction projects. Occasional, temporary traffic delays would result from repairs/maintenance. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.	Onshore cable installation would result in temporary traffic delays and temporary disturbance of public beaches, roads, and adjacent uses. Construction at any single location along a public road would be completed in a few days or weeks. Cable routes would generally follow or be under or adjacent to existing roads or utility ROW (COP Volume I; Epsilon 2020a), and therefore would not change adjacent land uses or affect coastal infrastructure. Occasional, temporary traffic delays would result from repairs/maintenance. This would have localized, short-term, **minor** impacts on land use and coastal infrastructure.	The Proposed Action would cause temporary noise and dust, disruptions to beach and road use, and disrupted access to properties adjacent to work areas during construction of onshore transmission cable infrastructure and occasionally during operations. This would result in localized, short-term, **minor** impacts on land use and coastal infrastructure. Ongoing and future non-offshore wind activities would contribute similar types of impacts as the Proposed Action, although there are no known reasonably foreseeable projects proposed in the geographic analysis area for land use and coastal infrastructure. Future offshore wind activities would also have similar contributions as the Proposed Action, but in a wider range of cable routes. In context of reasonably foreseeable trends, combined impacts from this sub-IPF on land use and coastal infrastructure from ongoing and planned actions, including the Proposed Action, would be localized, short-term, and **minor** to **moderate**, and only occur where installation or maintenance/repair occurs simultaneously for multiple projects.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Land disturbance: Onshore land use changes	New development or redevelopment would result in changes in land use in accordance with local government land use plans and regulations.	Ongoing and future development and redevelopment is anticipated to reinforce existing land use patterns, based on local government planning documents.	No long-term changes to land use are anticipated due to the presence of underground cable conduits and substations.	The Proposed Action would not result in changed land use. Cable conduits would be installed within roads and utility ROW; the substation would be installed within an industrial area.	The Proposed Action would result in **no** changes to land use. Ongoing and future non-offshore wind activities are anticipated to reinforce existing land use patterns in the geographic analysis area. Future offshore wind activities would not change land uses if onshore cables are underground within ROWs and substations are within areas designated for industrial or utility uses; the actual impacts would depend on the specific locations proposed for onshore infrastructure. In context of reasonably foreseeable trends, combined impacts from this sub-IPF on land use and coastal infrastructure from ongoing and planned actions, including the Proposed Action, are anticipated to be **negligible**.

ADLS = Aircraft Detection Light System; FEIS = Final Environmental Impact Statement; hazmat = hazardous materials; IPF = impact-producing factors; MCT = New Bedford Marine Commerce Terminal; met = meteorological; NOAA = National Oceanic and Atmospheric Administration; ROW = right-of-way; USACE = U.S. Army Corps of Engineers; WTG = wind turbine generator

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ATTACHMENT A: STATE-BY-STATE SUMMARY OF AWARDS AND MANDATES/GOALS

Maine: New England Aqua Ventus I is a 12 megawatt (MW) floating offshore wind pilot project in the state of Maine waters. The project is currently under review by the Maine Public Utilities Commission.

http://maineaquaventus.com/index.php/the-project/

New Hampshire: New Hampshire does not currently have a renewable energy target for offshore wind.

Massachusetts: Massachusetts passed a law in August 2016 requiring utilities to procure 1,600 MW of offshore wind power by 2027. New legislation in August 2018 was passed that doubles the offshore wind target to 3,200 MW by 2035. Vineyard Wind was awarded a Power Purchase Agreement for 800 MW and Mayflower Wind was awarded a Power Purchase Agreement for 800 MW. The remaining 1,600 MW of the larger 3,200 MW goal by 2035 has not been scheduled and the timing in *Table 1* is an estimate.

https://www.mass.gov/news/department-of-public-utilities-approves-offshore-wind-energy-contracts

https://www.mass.gov/news/project-selected-to-increase-offshore-wind-energy-in-the-commonwealth

Rhode Island: Revolution Wind's 700 MW project would deliver 400 MW to Rhode Island and 304 MW to Connecticut. In addition to the 400 MW from Revolution Wind the Block Island wind farm contributes 30 MW to Rhode Island's renewable energy goals for a total commitment of 430 MW. The state has a clean energy goal of 1,000 MW sourced from clean, renewable energy by 2020, but this 1,000 MW does not necessarily need to be generated solely from offshore wind energy sources.

https://www.ri.gov/press/view/35210

https://www.ecori.org/renewable-energy/2019/6/2/revolution-wind-farm-power-contract-approved-but-without-extra-fund-for-national-grid

Connecticut announced on August 19, 2019, a Request for Proposal for up to the maximum authorized procurement level of 2,000 MW of offshore wind by December 31, 2030. On December 5, 2019 the State of Connecticut awarded 804 MW. This 804 MW is in addition to the 304 MW of offshore wind awarded to the joint Rhode Island/Connecticut Revolution Wind project. This analysis assumes another award for up to the remaining 1,196 MW is possible by 2022.

https://portal.ct.gov/DEEP/News-Releases/News-Releases---2019/August/DEEP-Releases-Offshore-Wind-RFP

https://portal.ct.gov/DEEP/News-Releases/News-Releases---2019/December/Selection-of-804-MW-of-Offshore-Wind-Power-from-Park-City-Wind-Project

New York: New York's original goal for offshore wind was 2,400 MW by 2030. The state increased the target for offshore wind to 9,000 MW by 2035. The full 9,000 MW target for offshore wind has no anticipated timeframe and therefore the full 9,000 MW is not considered in this analysis. There are three projects within New York that have been awarded contracts: Ørsted (880 MW), Equinor (816 MW), and Long Island Power Authority has awarded 130 MW to South Fork. In 2020 New York is planning to award another procurement for at least 1,000 MW and up to 2,500 MW. The timing of the remaining capacity is not considered reasonably foreseeable or the current National Environmental Policy Act analysis.

https://www.nyserda.ny.gov/All%20Programs/Programs/Offshore%20Wind/Offshore%20Wind%20in%20New%20York%20State%20Overview

http://documents.dps.ny.gov/public/MatterManagement/MatterFilingItem.aspx?FilingSeq=239315&MatterSeq=55709

New Jersey: The state passed legislation in May 2018 to increase New Jersey's offshore wind target from 1,100 MW to 3,500 MW by 2030. The New Jersey Board of Public Utilities granted the state's first award for offshore wind to Ørsted's Ocean Wind 1,100 MW project. New Jersey Economic Development Authority anticipates a Request for Proposal for up to an additional 1,200 MW sometime in 2020 and the remaining 1,200 MW of the state's goal will be solicited in 2022. The governor of New Jersey signed an executive order on

November 19, 2019, that effectively raised New Jersey's offshore wind goal by 4,000 MW to a total of 7,500 MW. It is unclear how the additional desired capacity can be fulfilled with existing lease areas and technology and therefore is not included in this analysis.

https://www.nj.gov/governor/news/news/562019/approved/20190621d.shtml

https://www.njeda.com/pdfs/April-2019_New-Jersey-Offshore-Wind-Industry-Overv.aspx

https://www.nj.gov/dep/aqes/offshorewind.html

Delaware: Delaware does not currently have a renewable energy target for offshore wind.

http://www.dnrec.delaware.gov/energy/Documents/Offshore%20Wind%20Working%20Group/Offshore%20Wind%20Working%20Group%20Report%20June%2029%202018.pdf

Maryland: The Maryland Public Services Commission awarded offshore wind renewable energy credits (ORECs) to Skipjack Offshore Energy, LLC (Deepwater Wind, LLC) and US Wind Inc. for 368 MW of total offshore wind capacity. Senate Bill 516 increased Maryland's renewable energy goal to 50 percent by 2030, including 1,200 MW of "Phase II" offshore wind. Per the law the Maryland Public Service Commission plan would open Phase II application periods in:

- 2020 to begin creating ORECs in 2026 or 2027;
- 2021 to begin creating ORECs in 2028 or 2029; and
- 2022 to begin creating ORECs no later than 2030. [1,200 MW split evenly (3 x 400)]

http://dnr.maryland.gov/pprp/Documents/RPS-Study-PPRAC-06122019.pdf

https://energy.maryland.gov/Pages/Info/renewable/offshorewind.aspx

http://mgaleg.maryland.gov/2019RS/fnotes/bil_0006/sb0516.pdf

Virginia: An Office of the Secretary of Commerce and Trade report recommends 2,000 MW of offshore wind by 2028. Virginia's SB 966 was signed into law in 2018 and affirms that up to 5,000 MW of nameplate wind and solar capacity is in the public interest by 2028. Executive Order #43 (2019) establishes an offshore wind goal of 2,500 MW in addition to Dominion Energy's Coastal Virginia Offshore Wind project (12 MW total). Dominion Energy has proposed a 2,640 MW project on its commercial lease. This analysis assumes Virginia will approve Dominion's proposed 2,640 MW offshore wind project to meet approximately 50 percent of the state's 5,000 MW solar/wind goal. In 2020, Virginia's General Assembly passed HB 1526 which requires at least 5.2 gigawatt to be added by 2034.

https://www.governor.virginia.gov/media/governorvirginiagov/secretary-of-commerce-and-trade/2018-Virginia-Energy-Plan.pdf

https://www.governor.virginia.gov/media/governorvirginiagov/executive-actions/EO-43-Expanding-Access-to-Clean-Energy-and-Growing-the-Clean-Energy-Jobs-of-the-Future.pdf

https://news.dominionenergy.com/2020-01-07-Dominion-Energy-Selects-Siemens-Gamesa-as-Preferred-Turbine-Supplier-for-Largest-Offshore-Wind-Power-Project-in-United-States

https://openstates.org/va/bills/2020/HB1526/

North Carolina: The governor has issued clean energy and wind energy executive orders, but the state has not passed enacting legislation. North Carolina Clean Energy Executive Order: https://governor.nc.gov/documents/executive-order-no-80-north-carolinas-commitment-address-climate-change-and-transition. If developed, the North Carolina Kitty Hawk lease would tie into the Virginia PJM grid. The lessee (Avangrid) has submitted interconnection applications to PJM which is a preliminary first step toward development.

https://www.boem.gov/Kitty-Hawk-Offshore-Wind-stakeholder-webinar/

South Carolina: The State of South Carolina does not currently have any published targets or goals for offshore wind energy.

http://www.energy.sc.gov/renewable

APPENDIX B

Tables and Figures

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APPENDIX B. TABLES AND FIGURES

B.1. TABLES

Table 1.3-1: Required Environmental Permits and Consultations for the Proposed Project

Agency/Regulatory Authority	Permit/Approval/Determination/ Consultation	Status
Federal		
Bureau of Ocean Energy Management (BOEM)	Site Assessment Plan (SAP)	SAP Approved May 2018.
	COP	COP filed with BOEM December 19, 2017. Decision anticipated by December 17, 2020.
	NEPA Environmental Review	*DEIS published in the Federal Register December 7, 2018. Decision anticipated by Summer 2019.*
	Consultation under Section 7 of the Endangered Species Act with National Marine Fisheries Service and U.S. Fish and Wildlife Service	Formal consultations with NMFS initiated on April 10, 2019. NMFS issued a Biological Opinion and concluded the conclusion on September 11, 2020. U.S. Fish and Wildlife Service issued a letter of concurrence on October 16, 2020.
U.S. Environmental Protection Agency (USEPA)	National Pollutant Discharge Elimination System (NPDES) General Permit for Construction Activities	TBF immediately before start of construction.
	OCS Air Permit	NOI to apply for an air permit filed on December 11, 2017; Complete Clean Air Act OCS Permit application received January 29, 2019. Issuance of decision for permit approval within 90 days of the ROD.
	Vessel General Permit	TBF
U.S. Army Corps of Engineers (USACE)	Clean Water Act (CWA) Section 404/Rivers and Harbors Act of 1899 Section 10 Individual Permit	Joint permit application submitted December 18, 2018. Final verification and permit decision rendered within 90 days of the ROD.
U.S. National Marine Fisheries Service (NMFS)	Marine Mammal Protection Act (MMPA)/Incidental Take Authorization (ITA)	Complete application received for ITA on February 15, 2019. NMFS published proposed Incidental Harassment Authorization in the Federal Register on April 30, 2019. Final ITA issued within 90 days of the ROD.
	Consultation to Protect Essential Fish Habitat (EFH) under the Magnuson–Stevens Fishery Conservation and Management Act	NMFS received complete EFH assessment to initiate consultation on April 24, 2019 and issued conservation recommendations on June 27, 2019. NMFS received an updated EFH Assessment from BOEM on June 26, 2020. On November 25, 2020, BOEM responded to NMFS' EFH conservation recommendations, concluding the consultation. NMFS provided additional comments to BOEM by letter on December 11, 2020. BOEM followed up with NMFS on the additional comments to incorporate them into the FEIS.
U.S. Coast Guard (USCG)	Private Aids to Navigation Approval	TBF
	Ballast Water Management (33 CFR Part 151 and 46 CFR Part 162)	Pending Coordination with USCG.

Agency/Regulatory Authority	Permit/Approval/Determination/ Consultation	Status
Federal Aviation Administration (FAA)	Determinations of No Hazard	Notice of Proposed Construction or Alteration (Form FAA 7460-1) for the WTGs and ESPs submitted December 20, 2018 and re-filed for the ESP February 12, 2019 for Aeronautical Study for the Notice of Proposed Construction or Alternation. Determinations of No Hazard for WTGs and ESPs issued on August 5, 2019 and November 13, 2019 respectively. Vineyard Wind filed updated Notices of Proposed Construction or Alteration forms on October 28, 2020. Notice of Proposed Construction or Alteration for onshore staging locations and vessel transit corridors filed April 8, 2019 for Aeronautical Study. Determinations of No Hazard for these locations and corridors issued on May 24, August 5, August 28, and December 23, 2019.
Federal Aviation Administration (FAA)	ADLS Authorization	Notice of Proposed Construction or Alteration form for the Aircraft Detection Lighting System submitted May 13, 2019. Vineyard Wind submitted ADLS information to BOEM on May 16, 2019. FAA requested additional information from Vineyard Wind specific to ADLS filing on May 23, 2019. Vineyard Wind provided additional mapping information to FAA in response to additional information request on May 29, 2019. Vineyard Wind provided GIS shapefiles for previously provided mapping and figures on June 6, 2019, as FAA requested. FAA confirmed receipt of all information, mapping, and data required or requested on June 12, 2019. FAA review of proposed ADLS was completed on November 20, 2019. The FAA determined that the frequency bands used by the ADLS would not present an adverse effect on air traffic control operations.
State/Massachusetts (for Portions of the Project within State Jurisdiction)		
Massachusetts Environmental Policy Act (MEPA) Office	Certificate of Secretary of Energy and Environmental Affairs on Final Environmental Impact Report	Environmental Notification Form (ENF) filed on December 15, 2017; Secretary's Certificate on ENF issued February 9, 2018. Draft Environmental Impact Report (DEIR) filed on April 30, 2018; Secretary's Certificate on DEIR issued June 15, 2018. Supplemental DEIR filed on August 31, 2018; Secretary's Certificate on Supplemental DEIR issued October 12, 2018. Final EIR filed on December 17, 2018; Secretary's Certificate on FEIR issued February 1, 2019.
Massachusetts Energy Facilities Siting Board (EFSB)	Massachusetts General Law Chapter 164, § 69 Approval	Petition filed December 18, 2017; evidentiary hearings completed October 26, 2018; briefs filed November and December 2018. EFSB decision and approval on May 10, 2019.
Massachusetts Department of Public Utilities (MDPU)	Massachusetts General Law Chapter 164, § 72, Approval to Construct Massachusetts General Law Chapter 40A, § 3 Zoning Exemption (if needed)	Section 72 and Section 40A petitions filed with the MDPU on February 15, 2018, together with a request for consolidated review by EFSB, which was granted on April 5, 2018.

Agency/Regulatory Authority	Permit/Approval/Determination/ Consultation	Status
Massachusetts Department of Environmental Protection (MDEP)	Chapter 91 Waterways License and Dredge Permit/ Water Quality Certification (Section 401 of the CWA)	Joint Chapter 91 and Water Quality Certification application filed January 18, 2019. WQC issued July 31, 2019. Chapter 91 License issued March 10, 2020.
Massachusetts Department of Marine Fisheries (MDMF)	Letter of Authorization and/or Scientific Permit (for surveys and pre-lay grapnel run)	TBF
Massachusetts Department of Transportation (MDOT)	Non-Vehicular Access Permits	Permit application filed July 1, 2019. Issued December 23, 2019.
Massachusetts Board of Underwater Archeological Resources (MBUAR)	Special Use Permit	Provisional permit issued May 23, 2017, final permit issued September 28, 2017, and extended on September 28, 2018.
Massachusetts Natural Heritage and Endangered Species Program (NHESP)	Conservation and Management Permit (if needed)	Massachusetts Endangered Species Act Project Review Checklist submitted December 17, 2018; Determination that the Project will not result in an adverse impact to Resource Area Habitats and will not result in a prohibited Take pursuant to MESA issued May 14, 2019.
Massachusetts Historical Commission (MHC)	Field Investigation Permits (980 Code of Massachusetts Regulations § 70.00)	Reconnaissance survey application filed November 14, 2017 and approved. Permit to Conduct Archaeological Field Investigation issued September 28, 2018; field investigation at substation site completed November 2, 2018; final report submitted to MHC on January 3, 2019 (no further investigations recommended). Permit amended on March 5, 2020 to conduct a supplemental field investigation at expanded substation site.
Massachusetts Office of Coastal Zone Management/Rhode Island Coastal Resources Management Council	Federal Consistency (15 CFR § 930, Subpart E) under the Coastal Zone Management Act	Joint Massachusetts/Rhode Island Consistency Certification Request submitted April 6, 2018; Rhode Island concurrence received on February 26, 2019. Massachusetts Office of Coastal Zone Management concurrence received on May 22, 2020.
Regional (Portions of the Project within Regional Jurisdiction)		
Cape Cod Commission (Barnstable County)	Development of Regional Impact (DRI) Review	DRI filed on February 8, 2019. Full Commission voted to approve the Project May 2, 2019, and Final Decision was issued May 2, 2019.
Martha's Vineyard Commission	DRI Review	Referral from Edgartown Conservation Commission to Martha's Vineyard Commission occurred on December 27, 2018; DRI filed January 23, 2019. Full Commission voted to approve the Project May 2, 2019. Final Decision was issued May 16, 2019.
Local (Portions of the Project within Local Jurisdiction)		
Barnstable Conservation Commissions	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	Filed April 24, 2019. Barnstable Order of Conditions issued May 23, 2019. Superseding Order of Conditions affirming approval issued July 18, 2019. MassDEP Adjudicatory Appeal initiated by appellant August 1, 2019 and dismissed January 15, 2020.
Barnstable Department of Public Works and/or Town Council	Street Opening Permits/Grants of Location	TBF; addressed on October 3, 2018 HCA with Barnstable.

Agency/Regulatory Authority	Permit/Approval/Determination/ Consultation	Status
Barnstable Planning/Zoning	Zoning approvals as necessary	TBF; exemption from zoning requested in EFSB filing; addressed in October 3, 2018 HCA with Barnstable.
Edgartown Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	Filed December 26, 2018 with denial issued July 18, 2019. Superseding Order of Conditions issued August 5, 2019. MassDEP Adjudicatory Appeal initiated by appellant August 19, 2019 with Settlement Agreement signed September 18, 2019 and Final Decision issued October 1, 2019.
Nantucket Conservation Commission	Order of Conditions (Massachusetts Wetlands Protection Act and municipal wetland non zoning bylaws)	Filed January 18, 2019 (applicable to eastern route through Muskeget Channel only). Nantucket Order of Conditions issued March 21, 2019.

CFR = Code of Federal Regulations; COP = Construction and Operations Plan; DEIS = Draft Environmental Impact Statement; ESP = electrical service platform; FEIS = Final Environmental Impact Statement; HCA = Host Community Agreement; ITA = Incidental Take Authorization; MassDEP = Massachusetts Department of Environmental Protection; NEPA = National Environmental Policy Act; NOI = Notice of Intent; OCS = Outer Continental Shelf; WTG = wind turbine generator

[a] Required because the onshore route would pass through a Zone I area.

Table 1.7-1: Atlantic Offshore Wind Commitments by State (in megawatts) (as of December 2020)

State [a]	<2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030+	Total MW
Maine		12 (AN)											**12**
New Hampshire													**0**
Massachusetts	1,600 (AW)				800 (P)			800 (P)					**3,200**
Rhode Island	430 (AW)												**430**
Connecticut	1,108 (AW)			1,196 (AN)									**2,304**
New York	1,826 (AW)	2,500 (AN)			1,200 [b]		1,200 [b]		1,200 [b]		1,074 [b]		**9,000**
New Jersey	1,100 (AW)	1,200 (AN)		1,200 (AN)		1,200 [c]		1,400 [c]		1,400 [c]			**7,500**
Delaware													**0**
Maryland	368 (AW)	400 (AN)	400 (AN)	400 (AN)									**1,568 [d]**
Virginia	12 (AW)			880 (P)	880 (P)	880 (P)						2,600 [c]	**5,252**
North Carolina													**0**
South Carolina													**0**
Total	**6,444**	**4,112**	**400**	**3,676**	**2,880**	**880**	**1,200**	**800**	**1,200**	**0**	**1,074**	**4,000**	**29,266**

AN = Announced; AW = Awarded; MW = megawatt; P = Planned but currently unscheduled.

[a] See Attachment A in Appendix A for a state-by-state summary of authorizing legislation and caveats.

[b] Beyond the pending procurement (January 2020 petition to State of New York Public Service Commission for up to 2,500 MW), New York is not likely to announce additional procurements without additional leasing in the New York Bight. Therefore, offshore wind development beyond the announced and awarded procurements is not considered reasonably foreseeable at this time.

[c] Similar to table note b, New Jersey and Virginia are not likely to announce additional procurements without additional leasing. Therefore, offshore wind development beyond the announced and awarded procurements is not considered reasonably foreseeable at this time.

[d] In Maryland, the developer plans to use larger turbines and have a higher capacity than it has Offshore Wind Renewable Energy Credits approved. Excess electricity may be sold into the open market without subsidies.

The reasonably foreseeable state offshore wind commitments total 17,992 MW: AW (Awarded) = 6,444 MW; AN (Announced) = 7,308 MW; P (Planned, but currently unscheduled) = 4,240 MW.

Table 1.7-2: Atlantic Offshore Wind Projects (as of December 2020)

Leased but Project Not Yet Announced	Announced but COP Not Submitted	COP Submitted but Not Approved	Approved	Notes
	Liberty Wind (Massachusetts)			Up to 1,200 MW in bids total planned capacity; *Currently No Offtake*
		Proposed Project (Vineyard Wind, Massachusetts)		COP proposes 800 MW; Massachusetts PPA
		Vineyard Wind 2 (Massachusetts)		Up to 1,668 MW in two phases total planned capacity; Connecticut PPA for 804 MW
		Bay State (Massachusetts)		COP proposed 800 MW; *Currently No Offtake*
	Mayflower Wind (Massachusetts)			Massachusetts PPA for 804 MW
Equinor (Massachusetts)				*Currently No Offtake*
		Sunrise Wind (Massachusetts/ Rhode Island)		COP proposes up to 1,300 MW; New York PPA for 880 MW
		Revolution Wind (Massachusetts/ Rhode Island)		COP proposes up to 880 MW; Rhode Island/Connecticut PPAs totaling 704 MW
		South Fork (Massachusetts/ Rhode Island)		COP proposes 130 to 180 MW; New York PPA for 90 MW
		Empire Wind (New York)		COP proposes 2,400 MW; New York PPA for 816 MW
Atlantic Shores (New Jersey)				Developer stated capacity of lease is 2,500 MW; *Currently No Offtake*
		Ocean Wind (New Jersey)		1,100 MW; New Jersey PPA
		Skipjack (Delaware)		120 MW; Maryland OREC
		U.S. Wind (Maryland)		COP proposed 1,500 MW; Maryland OREC for 248 to 250 MW
			CVOW (Virginia)	12 MW; Research project
	Virginia Commercial (Virginia)			Developer stated capacity of lease 2,640 MW; *Currently No Offtake*
Avangrid (NC)				*Currently No Offtake*
		Subtotal up to 8,914 MW		
	Subtotal up to 13,558 MW			

COP = Construction and Operation Plan; CVOW = Coastal Virginia Offshore Wind; MW = megawatts; OREC = Offshore Wind Renewable Energy Credit; PPA = Power Purchase Agreement.
All projects listed in this table are included within the expanded planned action analysis.

Table 1.7-3: Primary Impact-Producing Factors Addressed in This Analysis

Impact-Producing Factors	Description
Accidental releases • Fuel/fluids/hazmat • Invasive species • Trash and debris	Refers to unanticipated release or spills of a fluid or other substance that can affect the quality of a resource. Could include invasive species from ballast water. Can occur from a stationary source (e.g., renewable energy structures), or a mobile source (e.g., vessels). Accidental releases are distinct from discharges (see below) that are authorized and typically controlled through permit systems.
Air emissions • Construction and decommissioning • O&M • Power generation emissions reductions	Refers to the release of gaseous or particulate pollutants into the atmosphere from stationary sources, vessels, vehicles, or aircrafts, which can affect air quality and associated resources. Can occur both onshore and offshore and during construction, operations and maintenance, and decommissioning.
Anchoring	Refers to anchoring of a vessel or a structure to the sea bottom, which can cause alterations to the seafloor from the anchor or anchor chain sweep. Does not refer to designated anchorage areas for marine transportation, all of which are far from wind energy areas.
Beach restoration	Refers to renourishment and restoration activities at coastal beaches involving the replacement of sand lost through erosion or drift.
Climate Change • Ocean acidification • Warming and sea level rise, storm severity and frequency • Warming and sea level rise, altered habitat and ecology • Warming and sea level rise, altered migration patterns • Warming and sea level rise, disease frequency • Warming and sea level rise, property and infrastructure damage • Warming and sea level rise, protective measures (barriers, seawalls) • Warming and sea level rise, storm severity, frequency, sediment erosion, deposition • Warming and sea level rise, storm severity and frequency, property and infrastructure damage	Warming and sea level rise refers to the effects associated with climate change, storm severity and frequency, and sea level rise. Ocean acidification refers to the effects associated with the decreasing pH of seawater caused by rising levels of atmospheric CO_2.
Discharges	Refers to routine permitted operational effluent discharges to receiving waters. Generally restricted to uncontaminated or properly treated effluents.
EMF	Refers to active power transmission cables and other sources that can produce electromagnetic fields emanating from the operating source.
Energy generation and security	Refers to the generation of electricity and its provision of reliable energy sources as compared with other energy sources.
Gear utilization • Dredging	Refers to entanglement and benthic disruptions that may affect biota. Primarily associated with commercial and recreational fishing activities, but also may be associated with marine minerals extraction and military uses. The sub-IPFs reference gear types that may lead to the entanglement and benthic disruptions.
Ingestion • Plastics and debris	Refers to the ingestion by biota of non-natural materials.
Land disturbance • Erosion and sedimentation • Onshore construction • Onshore, land use changes	Refers to land disturbances, including those associated with residential, commercial, or industrial development.

Impact-Producing Factors	**Description**
Light • Structures • Vessels	Refers to the presence of light from artificial sources onshore, offshore, above the water, or underwater.
New cable emplacement and maintenance	Refers to disturbances associated with installing new offshore submarine cables.
Noise • Aircraft • Cable laying and trenching • Drilling • G&G • O&M • Pile driving • Turbines • Vessels	Refers to noise from various sources. Commonly associated with construction activities (onshore and offshore), G&G surveys, naval testing and training, and vessel traffic. May be impulsive (e.g., pile driving) or may be broad spectrum and continuous (e.g., noise from marine transportation vessels). There is also noise from natural sources (e.g., wind and wave action, and noises produced by animals).
Port utilization • Expansion • Maintenance and dredging	Refers to changes in port usage and maintenance. Includes activities related to port expansion, reconfiguration, and other changes to accommodate increased vessel activity, larger vessels, and new uses of dockside facilities.
Presence of structures • Allisions • Behavioral disruptions – breeding and migration • Displacement into higher risk areas • Disturbed hydraulics and hydrologic regimes • Entanglement, gear loss and damage • Fish aggregation • Habitat conversion • Migration disturbances • Navigation hazard • Onshore, space use conflicts • Offshore, space use conflicts • Transmission cable infrastructure • Turbine strikes • Viewshed	Refers to impacts associated with onshore or offshore structures other than those related to construction, installation, and decommissioning.
Regulated fishing effort	Refers to limits or controls on commercial and recreational fishing activities.
Seabed profile alterations	Refers to modification of the seabed associated with marine minerals (sand and gravel) extraction, not maintenance dredging of navigation channels.
Sediment deposition and burial	Refers to the deposition of dredged materials at approved offshore dredge spoil disposal sites or to discharges of drilling muds and drill cuttings from oil and gas development or geotechnical survey activities. Can also be associated with construction-related activities that increase the amount of suspended sediment (e.g., setting anchors or submarine cable emplacement).
Traffic • Aircraft • Onshore • Vessel strikes, sea turtles and marine mammals • Vessels • Vessel collisions	Refers to marine vessel and onshore vehicle congestion, including collisions, allisions, and vessel strikes of sea turtles and marine mammals.

CO^2 = carbon dioxide; EMF = electromagnetic field; G&G = Geological and Geophysical; IPF = impact-producing factor; hazmat = hazardous materials; O&M = Operations and Maintenance

Table 3-1: Definitions of Potential Adverse Impact Levels

Impact Level	Biological, Archaeological, and other Physical Resources	Socioeconomic Resources
Negligible	Either no effect or no measurable impacts.	Either no effect or no measurable impacts.
Minor	Most adverse impacts on the affected resources, including: • Local ecosystem health • The extent and quality of local habitat for both special-status species and species common to the proposed Project area • The richness or abundance of local species common to the proposed Project area • Air or water quality • Archaeological resources Could be avoided; OR impacts that could occur would be small and the affected resource would recover completely without remedial or mitigating action.	• Most adverse impacts on the affected activity or community could be avoided; • Impacts would not disrupt the normal or routine functions of the affected activity or community; OR • The affected activity or community is expected to return to a condition with no measurable effects without remedial or mitigating action.
Moderate	A notable and measurable adverse impact on the affected resources, including: • Local ecosystem health • The extent and quality of local habitat for both special-status species and species common to the proposed Project area • The richness or abundance of local species common to the proposed Project area • Air or water quality • Archaeological resources Could occur, some of which may be irreversible; OR the affected resource would recover completely when remedial or mitigating action is taken.	• Mitigation would reduce adverse impacts substantially during the life of the proposed Project, including decommissioning; • The affected activity or community would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts of the project; OR • Once the impacting agent is gone, the affected activity or community is expected to return to a condition with no measurable effects, when remedial or mitigating action is taken.
Major	A regional or population-level impact on the affected resources, including: • Ecosystem health • The extent and quality of habitat for both special-status species and species common to the proposed Project area • Species common to the proposed Project area • Air or water quality • Archaeological resources Could occur; AND the affected resource would not fully recover, even after the impacting agent is gone and remedial or mitigating action is taken.	• Mitigation would reduce adverse impacts somewhat during the life of the proposed Project, including decommissioning; • The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the project; AND • The affected activity or community may retain measurable effects indefinitely, even after the impacting agent is gone and remedial action is taken.

Table 3-2: Definitions of Potential Beneficial Impact Levels

Benefit Level	Biological, Archaeological, and other Physical Resources	Socioeconomic Resources
Negligible	Either no effect or no measurable impacts.	Either no effect or no measurable impacts.
Minor	A small and measurable: • Improvement in ecosystem health; • Increase in the extent and quality of habitat for both special-status species and species common to the proposed Project area; • Increase in populations of species common to the proposed Project area; • Improvement in air or water quality; OR • Limited aerial extent or short-term temporal duration of improved protection of archaeological resources.	A small and measurable: • Improvement in human health; • Benefits for employment; • Improvement to infrastructure or facilities and community services; • Economic improvement; OR • Benefit for tourism or cultural resources.
Moderate	A notable and measurable: • Improvement in local ecosystem health; • Increase in the extent and quality of local habitat for both special-status species and species common to the proposed Project area; • Increase in individuals or populations of species common to the proposed Project area; • Improvement in air or water quality; OR • Extensive or complete aerial extent, or long-term temporal duration of, improved protection of archaeological resources.	A notable and measurable: • Improvement in human health; • Benefits for employment; • Improvements to infrastructure or facilities and community services; • Economic improvement; OR • Benefit for tourism or cultural resources.
Major	A regional or population-level: • Improvement in the health of ecosystems; • Increase in the extent and quality of habitat for both special status and commonly occurring species; • Improvement in air or water quality; OR • Permanent protection of archaeological resources.	A large local or notable regional: • Improvement in human health; • Benefits for employment; • Improvements to infrastructure or facilities and community services; • Economic improvement; OR • Benefit to tourism or cultural resources.

Table 3-3: Maximum-case WTG Scenario for each Resource

Resource	WTGs in Maximum-case Scenario	Rationale
Terrestrial and Coastal Fauna	NA	The number of offshore WTGs would not alter onshore impacts.
Coastal Habitats	NA	The number of offshore WTGs would not alter the coastal habitat impacts.
Benthic Resources	100	Due to the potential total amount of surface disturbance.
Finfish, Invertebrates and Essential Fish Habitat	100	Due to the potential loss of area and change in habitat.
Maine Mammals	100	Due to the potential for noise and loss of area.
Sea Turtles	100	Due to the potential for noise and loss of area.
Demographics, Employment, and Economics	57	Due to the potential for smaller beneficial economic impacts from reduced number of WTGs manufactured, fabricated, and installed, and increased visual impacts for taller WTGs (minimum beneficial impact in this case).
Environmental Justice	57	Due to the potential for the taller WTGs to be more visible from more coastal locations.
	100	Due to the potential for impacts on vessel traffic for commercial and recreational fishing and boating and related industries that provide employment for low-income workers.
Cultural Resources	57	Due to the potential for the taller WTGs to be more visible within the area of potential effect.
Recreation and Tourism	57	Due to the potential for the taller WTGs to be more visible from more coastal locations.
	100	Due to the potential for increased navigational complexity associated with recreational fishing.
Commercial Fisheries and For-Hire Commercial Fishing	100	Due to the potential for increased navigational complexity, space use conflicts, and loss of area.
Land Use and Coastal Infrastructure	NA	The number of offshore WTGs would not alter impacts on land use and coastal infrastructure.
Navigation and Vessel Traffic	100	Due to the potential for increased navigational complexity.
Other Uses	57	Due to the potential for the taller WTGs to create potential hazards.
Air Quality	100	Due to the potential total number of trips required for construction.
Water Quality	100	Due to the potential total amount of sediment disturbance and spills.
Birds	100	Due to the potential for collisions and more air space being occupied.
Bats	100	Due to the potential for collisions and more air space being occupied.

NA = not applicable; WTG = wind turbine generator

Table 3.1-1: Summary of Activities and the Associated Impact-Producing Factors for Coastal Habitats

Baseline Conditions: Shorelines in the geographic analysis area for coastal habitats are primarily sand beaches, rocky shores, and armored shorelines. Landward of the intertidal zone, coastal habitat is mostly a mixture of sandy beaches, rocks, and developed spaces. Other coastal habitats on land in the geographic analysis area include sand dunes, salt ponds, salt marshes, and scattered maritime forest.

Submerged habitats out to 3 nautical miles from land are primarily sandy but include some areas of shell aggregate, gravel-cobble beds, biogenic structures, sand waves, sponge beds, and isolated boulders. Hard bottom typically consists of a combination of coarse deposits such as gravel, cobble, and boulders in a sand matrix. Certain hard-bottom areas also include piles of exposed boulders. At least 10 bedrock outcrops are in the analysis area, although none is present in the proposed WDA or OECC. Massachusetts defined special, sensitive, and unique (SSU) habitats to include eelgrass beds, hard and/or complex bottom, and North Atlantic right whale (*Eubalaena glacialis*) core habitat.

Conditions of coastal habitats in the geographic analysis area are mostly relatively stable. There is often marked patchiness and sample-to-sample variability in habitats and fauna across space and time. Sand waves are locally abundant and are mobile over the course of days to years. Eelgrass habitats in this region are in decline, with a loss of over 20 percent from 1994 to 2011 (Costello and Kenworthy 2011). Sandy beaches in these areas are subject to erosion and are vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015). Coastal habitats on land in the geographic analysis area for coastal habitats mostly consists of sandy beach and dune vegetation; much of this is developed for public beach and private residences, and this development is likely to continue.

Commercial fishing using bottom trawls and dredge fishing methods disturbs swaths of seafloor habitat. When this intersects SSU habitats, long-term disruptions can result. Their impacts are similar in nature but much greater in extent and severity than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation. Dredging for navigation, marine minerals extraction, and/or military uses disturbs swaths of seafloor habitat. When this intersects SSU habitats, long-term disruptions can result. Their impacts are similar in nature but much greater in extent and severity than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation.

Commercial and recreational regulations for finfish and shellfish implemented and enforced by either Massachusetts or the towns of Barnstable and Yarmouth, depending on whether the fishery is within state or town waters, affect coastal habitats by modifying the nature, distribution, and intensity of fishing-related impacts.

Coastal habitats are also vulnerable to non-point-source nutrient pollution, much of which is due to discharges from septic systems onshore. These increases can affect coastal wetlands and other nearshore coastal habitats. Nutrient overloading in estuaries and coastal waters goes back several decades (Cape Cod Commission 2013). Discharges from vessels are not permitted within 3 nautical miles of shore.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	Appendix A Section A.8.2 discusses ongoing accidental releases. Accidental releases of fuel/fluids/hazmat have the potential to cause habitat contamination and harm to the species that build biogenic coastal habitats (e.g., eelgrass, oysters, mussels, slipper limpets, salt marsh cordgrass) from releases and/or cleanup activities. Only a portion of the ongoing releases contact coastal habitats in the geographic analysis area. Impacts are small, localized, and temporary.	Appendix A Section A.8.2 discusses accidental releases.	Potential but unlikely impacts include habitat contamination and harm to the species that build biogenic coastal habitats (e.g., eelgrass, oysters, mussels, slipper limpets, salt marsh cordgrass) from spills and/or cleanup activities. Appendix A Section A.8.2 discusses quantification. The greatest risk to coastal habitats is related to transportation of crews and equipment during construction and operations, as well as accidental releases from any nearshore equipment associated with transmission cables. Accidental releases from offshore structures would likely not reach coastal habitats. Onshore, the use of heavy equipment could result in potential spills during use or refueling activities. Onshore construction and installation activities and associated equipment would involve fuel, lubricating oil, and hydraulic oil. Accidental releases may occur primarily during construction, but also during operations and decommissioning. Accidental releases would increase under an expanded planned action scenario; however, there does not appear to be evidence that the volumes and spatial and temporal extents would have any combined impact.	Table A.8.2-1 in Appendix A contains a quantitative analysis of these risks. The Proposed Action would increase the risk of releases, primarily during construction, but also during operations and decommissioning. Impacts, if any, on coastal habitats contamination would be localized, temporary, and **minor**. An accidental release from an offshore structure or offshore vessel associated with the proposed Project would be unlikely to extend far enough to reach a coastal habitat.	Table A.8.2-1 in Appendix A contains a quantitative analysis of these risks. The impacts on coastal habitats from this sub-IPF under the Proposed Action would include an increased potential for a release that would have localized, temporary, and **minor** impacts of habitat contamination. The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of releases and impacts on coastal habitats. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall risk from ongoing activities. In context of reasonably foreseeable environmental trends, combined fuel/fluids/hazmat impacts on coastal habitats (contamination) from ongoing and planned actions, including the Proposed Action, are expected to be localized, temporary, and **minor** due to the likely limited extent and duration of a release (described in detail in the FEIS Section 3.1.2).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Trash and debris	Ongoing releases of trash and debris occur from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. As population and vessel traffic increase, accidental releases of trash and debris may increase. Such materials may be obvious when they come to rest on shorelines; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes that all vessels will comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, small event in the vicinity of projects. Nearshore project activities, such as transmission cable installation or transportation of equipment and personnel from ports would have a higher likelihood of releases. Accidental releases of trash and debris may occur primarily during construction, but also during operations and decommissioning; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats.	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes that all vessels will comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, small event in the vicinity of Project activities. Nearshore project activities such as transmission cable installation or transportation of equipment and personnel from ports would have a higher likelihood of impacts. Accidental releases of trash and debris may occur primarily during construction, but also during operations and decommissioning; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats. Therefore, the Proposed Action would have no impact on coastal habitats through this sub-IPF.	Accidental releases of trash and debris would have no impact; they are not likely to have any detectable impact on coastal habitats. In context of reasonably foreseeable environmental trends, combined accidental trash and debris release impacts from ongoing and planned actions, including the Proposed Action, would occur but would likely have no impact, given that there does not appear to be evidence that the likely volumes and extents would have any detectable impact on coastal habitats.
Anchoring	Vessel anchoring related to ongoing military, survey, commercial, and recreational activities will continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and potential for contact to cause physical damage to coastal habitats. All impacts are localized; turbidity is short-term and temporary; physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	If future offshore wind activities overlap with the geographic analysis area, there will be increased anchoring during survey activities and during the construction and installation of offshore export cables. There may also be anchoring in the analysis area during operations and decommissioning. These impacts would include increased turbidity levels and potential for contact causing physical damage to coastal habitats. All impacts would be localized; turbidity would be short-term and temporary; physical damage could be permanent if it occurs in eelgrass beds or hard bottom.	The Proposed Action is estimated to have anchoring disturb up to 4.4 acres (17,806 m^2), some of which would occur outside the geographic analysis area. This would occur primarily during construction, but also during operations and decommissioning and would include increased turbidity and the potential for contact to damage coastal habitats. The proposed Project would not anchor in eelgrass. Anchoring disturbances would recover naturally, unless they occur on a boulder pile, which is unlikely. The overall impact of anchoring on coastal habitats would be **minor** to **moderate**.	Anchoring associated with the Proposed Action would disturb up to 4.4 acres (17,806 m^2), some of which would occur outside the geographic analysis area, resulting in temporary to short-term to permanent **minor** to **moderate** impacts on coastal habitats. Ongoing and future non-offshore wind activities would cause a series of temporary to permanent localized impacts. Offshore wind activities other than the proposed Project may also contribute an unknown amount of anchoring in the analysis area. In context of reasonably foreseeable environmental trends, combined anchoring impacts on coastal habitats from ongoing and planned actions, including the Proposed Action, would likely be localized, temporary, and **minor** to **moderate**, but could be permanent if they occur in eelgrass beds or hard bottom.
EMF	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. There are no existing cables in the geographic analysis area for coastal habitats. New cables generating EMFs are infrequently installed in the analysis area. Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of impacts is likely less than 50 feet (15.2 meters) from the cable and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	EMF would emanate from operating transmission cables if any enter the geographic analysis area for coastal habitats. Sections 3.2 and 3.3 discuss the nature of potential impacts. Submarine power cables in the analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMFs resulting from cable operation to low levels. EMFs of any two sources would not overlap, because developers typically allow at least 330 feet (100 meters) spacing between cables, EMF strength diminishes rapidly with distance, and potentially meaningful EMFs would likely extend less than 50 feet (15.2 meters) from the cable(s). The intensity of impacts on coastal habitats would likely be undetectable.	During operations, the Proposed Action would emit EMFs from the portion of transmission cables in the geographic analysis area for coastal habitats. Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of the EMFs would likely be less than 50 feet (15.2 meters) from the cable(s), and the intensity of impacts on coastal habitats would likely be **negligible**.	EMFs from the Proposed Action would cause **negligible** impacts on coastal habitats. The impact of EMFs from future offshore wind activities on coastal habitats would likely be undetectable. In context of reasonably foreseeable environmental trends, combined impacts of EMFs on coastal habitats from ongoing and planned actions, including the Proposed Action, within the geographic analysis area would likely be **negligible**.
Light: Vessels	Navigation lights and deck lights on vessels would be a source of ongoing light. Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of impacts is limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	Light is expected to continue to increase gradually with increasing vessel traffic over the next 30 years. Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of	Light from navigation lights on vessels transiting between berths in coastal locations to and from nearshore and offshore work locations (e.g., installation, operations, maintenance of nearshore cables; construction, operations, maintenance of offshore facilities) or from vessels installing cables, if any, in the analysis area could occur primarily during construction, but also during operations and decommissioning. Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of	Light from navigation lights on vessels transiting between berths in coastal locations to and from nearshore and offshore wind locations (e.g., installation, operations, maintenance of nearshore cables; construction, operations, maintenance of offshore facilities). Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be **negligible**.	Light from vessels from the Proposed Action would cause **negligible** impacts on coastal habitats. Impacts on coastal habitats of light from vessels related to ongoing and future non-offshore wind activities are undetectable. Impacts on coastal habitats of light from vessels related to future offshore wind activities would likely be undetectable. In context of reasonably foreseeable environmental trends, combined vessel light impacts on coastal habitats from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		impacts on coastal habitats would likely be undetectable.	the lights, and the intensity of impacts on coastal habitats would likely be undetectable.		
Light: Structures	Ongoing lights from navigational aids and other structures onshore and nearshore. Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of impacts is likely limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	Onshore/nearshore structures associated with offshore wind (e.g., construction and/or operations and maintenance facilities) may produce light in marinas/berthing facilities during operations of those facilities. Habitat in these locations would likely already be subjected to light impacts. Sections 3.2 and 3.3 discuss the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be undetectable.	The Proposed Action would not result in new lighted structures within the geographic analysis area for coastal habitats and therefore, would have no impact on coastal habitats.	The Proposed Action would not result in new lighted structures within the geographic analysis area for coastal habitats; therefore, there will be no impact. Impacts on coastal habitats of light from structures related to ongoing and future non-offshore wind activities are undetectable. Impacts on coastal habitats of light from structures related to future offshore wind activities would likely be undetectable. No impacts of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although light from existing structures and future offshore wind-related structures onshore or nearshore may reach coastal habitats near shore.
New cable emplacement/ maintenance	There are no existing cables in the geographic analysis area. Any new cable emplacement/maintenance activities would infrequently disturb bottom sediments; these disturbances would be local and limited to the emplacement corridor (see the Sediment deposition and burial IPF).	No future activities were identified within the geographic analysis area other than ongoing activities.	New offshore submarine cables associated with the expanded planned action scenario could cause short-term disturbance of seafloor habitats if one or more cable routes enter(s) the analysis area. If routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent (see the Sediment deposition and burial IPF). Any dredging necessary before cable installation could also contribute further impacts, especially to eelgrass beds and hard-bottom habitats.	During construction, the Proposed Action would cause short-term disturbance of seafloor habitats; impacts on hard-bottom habitat would likely be permanent. Vineyard Wind estimated that up to 117 acres (0.5 km^2) of sea floor within the OECC could be disturbed during cable installation, although some of these areas would lie outside the geographic analysis area for coastal habitats. Overall, these impacts would likely be **minor** to **moderate**. (See the IPFs of Seabed profile alterations and Sediment deposition and burial.)	The Proposed Action estimated that up to 117 acres (0.5 km^2) of sea floor within the OECC could be disturbed during cable installation, although some of these areas would lie outside the geographic analysis area for coastal habitats, leading to localized, short-term to permanent, **minor** to **moderate** impacts on seafloor habitats. Ongoing and future non-offshore wind activities, if any, that involve cables in the analysis area may cause short-term impacts. Future offshore wind activities other than the proposed Project would cause similar impacts where they overlap the analysis area. In context of reasonably foreseeable environmental trends, combined new cable emplacement/maintenance impacts on coastal habitats from ongoing and planned actions, including the Proposed Action, would likely be localized, short-term to permanent, and **minor** to **moderate** disturbances of seafloor habitats.
Noise: Onshore/offshore construction	Ongoing noise from construction occurs frequently near shores of populated areas in New England and the mid-Atlantic, but infrequently offshore. Noise from construction near shore is expected to gradually increase over the next 30 years in line with human population growth along the coast of the geographic analysis area. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary.	No future activities were identified within the analysis area other than ongoing activities.	Noise from offshore wind construction activities is not expected to reach the geographic analysis area.	Noise from Vineyard Wind construction activities is not expected to reach the geographic analysis area, and therefore would have no impact on coastal habitats.	The Proposed Action would have no impacts on coastal habitats through construction noise. Construction noise from ongoing activities does cause temporary local impacts on coastal habitats. Future offshore wind would not cause impacts on coastal habitats in the analysis area through construction noise. No impacts of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing activities are expected to result in local temporary impacts.
Noise: G&G	Site characterization surveys and scientific surveys are ongoing. The intensity and extent of the resulting impacts are difficult to generalize, but are local and temporary.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise that penetrates deep into the seabed. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity	G&G surveys are anticipated to occur intermittently over an assumed 4-year construction period in the geographic analysis area. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Noise from G&G surveys may occur during inspection and/or monitoring of cable routes, likely leading to temporary, **negligible** impacts in the immediate vicinity of the cable routes.	G&G survey noise from the Proposed Action may result in localized, temporary, **negligible** impacts on coastal habitats along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent. Future offshore wind activities (other than the Proposed Action), if they enter the geographic analysis area, would likely result in impacts similar to those of the Proposed Action. All G&G noise would be temporary and it would likely not occur simultaneously from multiple sources in the analysis area. In context of reasonably foreseeable environmental trends, combined G&G noise impacts on coastal habitats from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.			
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can reach coastal habitats. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.	Noise from pile driving is not expected to be noticeable within the geographic analysis area. Based on estimates from the COP Section 4.2.3 (Volume III; Epsilon 2020b; Pyć et al. 2018), sound pressure levels of 150 decibels are likely to extend no more than 5.7 miles (8.0 kilometers) around each pile-driving location. Based on the distance of all lease areas from the geographic analysis area, the intensity of impacts on coastal habitats would likely be undetectable.	Noise from pile driving for the Proposed Action is not expected to be noticeable within the geographic analysis area. Sound pressure levels of 150 decibels are likely to extend no more than 5.7 miles around each pile-driving location. Because the closest proposed foundation location is more than 11 miles from the geographic analysis area, the Proposed Action would have no impact on coastal habitats through pile-driving noise.	The Proposed Action would have no impact on coastal habitat through pile-driving noise. Ongoing activities may involve nearshore pile driving, which would cause temporary local impacts. Future offshore wind activities would not cause impacts on coastal habitat through pile-driving noise. No impacts of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing activities may result in local temporary impacts.
Noise: Cable laying/trenching	Rare but ongoing trenching for pipeline and cable laying activities emits noise; cable burial via jet embedment also causes similar noise impacts. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines may occur in the geographic analysis area infrequently over the next 30 years. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	Noise from trenching of export cables could reach the geographic analysis area; cable burial via jet embedment also causes similar noise impacts. This noise is anticipated to occur intermittently over an assumed 4-year construction period in the geographic analysis area. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	Noise from trenching of export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. Trenching noise would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. Noise from trenching would likely have **negligible** impacts on coastal habitats. Cable burial via jet embedment also causes similar noise impacts.	The Proposed Action would likely have **negligible** impacts on coastal habitat through trenching noise, if the Proposed Action uses trenching at all. The impact on coastal habitats of trenching noise associated with ongoing activities, future non-offshore wind activities, and future offshore wind activities is discountable compared to the impacts of the physical disturbance and sediment suspension. In context of reasonably foreseeable environmental trends, combined cable laying/trenching noise impacts on coastal habitats from ongoing and planned actions, including the Proposed Action, would likely be **negligible**. Cable burial via jet embedment also causes similar noise impacts.
Presence of structures: Habitat conversion	Various structures, including pilings, piers, towers, riprap, buoys, and various means of hard protection, are periodically added to the seascape, creating uncommon vertical relief in a mostly flat seascape and converting previously existing habitat (whether hard-bottom or soft-bottom) to a type of hard habitat, although it differs from the typical hard-bottom habitat in the analysis area, namely, coarse substrates in a sand matrix. The new habitat may or may not function similarly to hard-bottom habitat typical in the region (Kerckhof et al. 2019; HDR 2019). Soft bottom is the dominant habitat type on the OCS, and structures do not meaningfully reduce the amount of soft-bottom habitat available (Guida et al. 2017; Greene et al. 2010). Structures can also create an artificial reef effect, attracting a different community of organisms.	Any new cable or pipeline installed in the geographic analysis area would likely require hard protection atop portions of the route (see cells to the left). Such protection is anticipated to increase incrementally over the next 30 years. Where cables would be buried deeply enough that protection would not be used, presence of the cable would have no impact on coastal habitats.	Any new cable installed in the geographic analysis area would likely require hard protection atop portions of the route (see cells to the left). Cable protection is anticipated to be added incrementally over an assumed 4-year construction period in the geographic analysis area. Where cables would be buried deeply enough that protection would not be used, presence of the cable would have no impact on coastal habitats. No foundations or other large offshore wind structures would be built within the geographic analysis area for coastal habitats.	The Proposed Action estimated that up to 35 acres (0.1 km^2) of cable corridor within the OECC would need protection, although some of this would occur outside the geographic analysis area for coastal habitats. Cable protection could remain permanently after cable installation (see cells to the left). The impacts of this sub-IPF on coastal habitats would likely be **minor beneficial** and **minor**. No foundations or other large offshore wind structures would be built within the geographic analysis area for coastal habitats.	The Proposed Action is expected to cause local, **minor beneficial** and **minor** impacts on coastal habitats through this sub-IPF up to 35 acres (0.1 km^2) within the OECC, although some of this would occur outside the geographic analysis area for coastal habitats. Existing structures and future non-offshore wind structures are also expected to cause localized impacts on coastal habitats through this sub-IPF. Offshore wind structures other than those associated with the proposed Project are also expected to cause localized impacts on coastal habitats through this sub-IPF. In context of reasonably foreseeable environmental trends, combined habitat conversion impacts from ongoing and planned actions, including the Proposed Action, are anticipated to be local, permanent, **minor beneficial** and **minor** impacts on coastal habitats.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Transmission cable infrastructure	Various means of hard protection atop existing cables can create uncommon hard-bottom habitat. Where cables are buried deeply enough that protection is not used, presence of the cable has no impact on coastal habitats. There are no existing cables in the geographic analysis area for coastal habitats.	See above.	See above.	See above.	See above.
Land disturbance: Erosion and sedimentation	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term erosion and sedimentation of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.	If cable landfall sites are within the geographic analysis area, erosion and sedimentation could occur. This could occur primarily during construction and decommissioning, with sporadic events within those windows. The staggered nature of construction activities would limit the total erosion and sedimentation contribution at any given time, allowing coastal habitats to recover between events.	The Proposed Action would not involve erosion and sedimentation within the geographic analysis area for coastal habitats, and therefore, would have no impact.	The Proposed Action would not cause impacts on coastal habitat through erosion and sedimentation, resulting in no impact on coastal habitats. Ongoing and future non-offshore wind activities periodically cause short-term erosion and sedimentation of coastal habitats. Future offshore wind activities other than the Proposed Action could cause erosion and sedimentation if cable landfall sites are within the geographic analysis area. No impact of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing and future activities may result in short-term to permanent local impacts.
Land disturbance: Onshore construction	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term to permanent degradation of onshore coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.	If cable landfall sites and/or onshore transmission routes are within the geographic analysis area, localized degradation of onshore coastal habitats could occur during construction.	The Proposed Action would not involve onshore construction within the geographic analysis area for coastal habitats, and therefore, would have no impact.	The Proposed Action would not cause impacts on coastal habitat through onshore construction, resulting in no impact on coastal habitats. Ongoing activities involving onshore construction cause short-term to permanent degradation of onshore coastal habitats. Future offshore wind activities other than the Proposed Action could cause impacts on coastal habitats through onshore construction if cable landfall sites and/or onshore transmission routes are within the geographic analysis area. No impact of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing and future activities may result in short-term to permanent local impacts.
Land disturbance: Onshore, land use changes	Ongoing development of onshore properties, especially shoreline parcels, periodically causes the conversion of onshore coastal habitats to developed space.	No future activities were identified within the geographic analysis area other than ongoing activities.	If cable landfall sites and/or onshore transmission routes are within the geographic analysis area, localized land use changes could occur during construction and could be permanent.	The Proposed Action would not involve land use changes within the geographic analysis area for coastal habitats, and therefore would have no impact.	The Proposed Action would have no impact on coastal habitat through onshore land use changes. Ongoing activities involving this sub-IPF periodically cause the permanent conversion of onshore coastal habitats to developed space. Future offshore wind activities other than the Proposed Action could cause impacts on coastal habitats through this sub-IPF if cable landfall sites and/or onshore transmission routes are within the geographic analysis area. No impact of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing and future activities may result in permanent local impacts.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized, short-term impacts on coastal habitats through this IPF. For example, the Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year (Barnstable County Undated; CapeCod.com 2019). Dredging typically occurs only in sandy or silty habitats, which are abundant in the analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little effect on the general character of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.	If dredging is used in the course of cable installation within the geographic analysis area, localized short-term impacts on coastal habitats could result. Dredging typically occurs only in sandy or silty habitats, which are abundant in the analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little effect on the general character of coastal habitats.	During construction, the Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, although part of this area may lie offshore of the 3-nautical-mile seaward limit of the geographic analysis area for coastal habitats. The impacts would likely be short-term, considering the natural mobility of sand waves in the analysis area. The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Overall, the impacts on coastal habitats from this IPF would be **minor**.	The Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, although part of this area may lie outside the geographic analysis area, likely leading to short-term, **minor** impacts on coastal habitats. Ongoing activities cause similar impacts, but with an unknown extent. Future offshore wind activities other than the Proposed Action could also cause similar impacts over an area that is unknown but would likely be similar to the area affected by the Proposed Action. In context of reasonably foreseeable environmental trends, combined seabed profile alteration impacts on coastal habitats from ongoing and planned actions, including the Proposed Action, would likely be **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition within coastal habitats. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. No dredged material disposal sites were identified within the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.	If any dredging occurs in the analysis area, dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site. These impacts would likely be short-term to long-term. Cable emplacement and maintenance activities in or near the analysis area during construction or maintenance of future offshore wind projects could cause sediment suspension for 4 to 6 hours at a time. The areal extent of such impacts is unknown but would likely be similar to the area affected by the Proposed Action. The area with a combined greater sediment deposition from simultaneous activities would be limited.	The Proposed Action would cause short-term and localized turbidity increases and sediment deposition due to dredged material disposal and cable installation (including pre-lay dredging) during construction. Sediment deposition greater than 0.8 inch (20 millimeters) may extend up to 0.5 mile (0.9 kilometer) from each disposal site and cover up to 34.6 acres (0.1 km^2) (COP Volume III, Appendix III-A; Epsilon 2020b). Deposition of 0.04 to 0.2 inch (1 to 5 millimeters) of sediment could potentially be deposited on up to 2,248 acres (9.1 km^2). Part of this area would lie outside the geographic analysis area. These impacts would likely be short-term to permanent. The Proposed Action would not dredge in, or dispose of, dredged material in eelgrass beds or hard-bottom habitats. Installation of submarine cable would mostly be done by jet or mechanical plow. The resultant plume is predicted to stay in the lower portion of the water column (the bottom 9.8 feet [2.7 meters]). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet (199.9 meters) from the route centerline but could extend up to 1.2 miles (1.6 kilometers). Modeling showed that sediment concentrations greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Epsilon 2018b). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018b). Attachment C of Epsilon (2018b) depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, sediment deposition would have no impact outside eelgrass beds and hard-bottom habitats. Overall, the impacts on coastal habitats from this IPF would be **minor**.	The Proposed Action would cause sediment deposition on up to 2,248 acres (9.1 km^2), although part of this area would lie outside the geographic analysis area for coastal habitats; however, sediment deposition would have no impact on coastal habitats outside eelgrass beds and hard-bottom habitats, where the impacts would be **minor**. The Proposed Action would not dredge in, or dispose of, dredged material in eelgrass beds or hard-bottom habitats. Ongoing activities cause similar impacts over an unknown extent. Future offshore wind activities (other than the Proposed Action), if they enter the analysis area, could also cause similar impacts over an area that is unknown but would likely be similar to the area affected by the Proposed Action. In context of reasonably foreseeable environmental trends, combined impacts of sediment deposition and burial on coastal habitats from ongoing and planned actions, including the Proposed Action, would likely be **minor**.
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.	Impacts are the same as under ongoing activities to the left. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under ongoing activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF would contribute to the reduced growth or decline of some types of coastal habitats. Because this sub-IPF is a global phenomenon, impacts on coastal habitats through this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change. The intensity of impacts resulting from climate change are uncertain, but are anticipated to qualify as **minor** to **moderate**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by ongoing greenhouse gas emissions, is expected to continue to contribute to a widespread loss of shoreline habitat from rising seas and erosion. In submerged habitats, warming is altering ecological relationships and the distributions of ecosystem engineer species, likely causing permanent changes of unknown intensity gradually over the next 3 years.	See above.	See above.	See above.	See above.

BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; COP = Construction and Operations Plan; EIS = Environmental Impact Statement; EMF = electromagnetic field; FEIS = Final Environmental Impact Statement; G&G = Geological and Geophysical; IPF = impact-producing factor; km^2 = square kilometer; m^2 = square meter; mg/L = milligram per liter; OCS = Outer Continental Shelf; OECC = offshore export cable corridor; SSU = special, sensitive, and unique; WDA = Wind Development Area

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Table 3.1-2: Habitat Areas Potentially Disturbed by Offshore Export Cable Installation

Seafloor Habitat Type [a]	Area of Potential Cable Installation Disturbance [b] (acres)		Area within 328 feet [c] (100 meters) of the Proposed Cable [b] (acres)	
	Eastern Muskeget Option	Western Muskeget Option	Eastern Muskeget Option	Western Muskeget Option
Hard Bottom / Coarse Deposits	5.56	4.12	274.20	206.04
Complex Seafloor / Sand Waves	19.71	20.62	995.09	1,022.50
Biogenic Surface	3.56	3.56	154.47	154.47
Eelgrass	0.00	0.00	0.00	0.00
Other (mostly flat sand and mud)	67.18	63.59	3,377.92	3,212.24
Total	96.01	91.89	4,801.68	4,595.25

Source: Vineyard Wind 2019

Note: The proposed cable route alignment should be considered preliminary. Route changes and/or the presence of unmapped habitats may alter the actual areas potentially disturbed.

[a] As defined in the *2015 Massachusetts Ocean Management Plan* (Commonwealth of Massachusetts 2015).

[b] This is based on the preliminary cable alignment. The proposed cable could be located anywhere within the OECC; no bottom-disturbing activities would occur outside of the OECC.

[c] The maximum distance from cable centerline that may be disturbed through deposition of sediment greater than 1 millimeter. Deposition of 1 millimeter or greater is typically constrained within 80 meters (262 feet) from the route centerline, though it may extend up to 100 meters (328 feet) in limited areas.

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Table 3.2-1: Summary of Activities and the Associated Impact-Producing Factors for Benthic Resources

Baseline Conditions: The geographic analysis area is located within the greater Georges Bank area (though not part of the bank itself) of the U.S. Northeast Shelf Large Marine Ecosystem. Typical faunal assemblages in the region include polychaetes, crustaceans (particularly amphipods), mollusks (gastropods and bivalves), echinoderms (e.g., sand dollars, brittle stars, and sea cucumbers), and various other groups (e.g., sea squirts and burrowing anemones) (Guida et al. 2017). Guida et al. (2017) reported that amphipods and polychaetes numerically dominated infaunal communities in the RI and MA Lease Areas, while sand shrimp (*Crangon septemspinosa*) and sand dollars dominated benthic epifaunal assemblages. Grab samples taken in 2011 south of Cape Cod found abundant nut clams, polychaetes, and amphipods, as well as oligochaetes and nemertean ribbon worms (AECOM 2012). The region experiences strong seasonal variations in water temperature and phytoplankton concentrations, with corresponding seasonal changes in the densities of benthic organisms.

The seafloor in the geographic analysis area is predominantly composed of unconsolidated sediments ranging from silt and fine-grained sands to gravel. Local hydrodynamic conditions largely determine sediment types. Parts of the geographic analysis area, particularly in the vicinity of Muskeget Channel, overlap with hard and/or complex seafloor. Hard bottom is important habitat for attachment of sessile (immobile) organisms and increases community complexity.

Studies of the Atlantic Coast from 1990 to 2010 show endemic benthic invertebrates shifting their distribution northward in response to rising water temperatures, resulting in changes to benthic community structure (Hale et al. 2016). Historical data on Centerville Harbor, which includes Covell’s Beach, show a slow decline in eelgrass bed habitat since 1951 (MassDEP 2011). New England horseshoe crab (*Limulus polyphemus*) stocks are in decline (ASMFC 2013). According to MA DMF (2016, 2018), nesting horseshoe crabs use Covell’s Beach from late spring to early summer.

Commercial fishing using bottom trawls and dredge-fishing methods disturbs swaths of seafloor habitat. Fishing occurs multiple times each day in many places across the whole continental shelf. Other anthropogenic sources of bottom disturbance also occur in specific project areas, such as pipeline trenching or submarine cable emplacement.

Commercial and recreational fishing gear are periodically lost, but they can continue to capture or otherwise harm benthic resources. The lost gear, moved by currents, can disturb benthic resources, creating small, short-term, localized impacts.

Dredging for navigation, marine minerals extraction, and/or military uses disturb swaths of seafloor habitat. Their impacts are similar in nature but much greater in extent and severity than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation.

FEIS Section 3.2 provides additional information on benthic baseline conditions.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/hazmat	Section A.8.2 discusses ongoing accidental releases. Accidental releases of hazmat occur periodically, mostly consisting of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they rarely contact benthic resources. The chemicals with potential to sink or dissolve rapidly often dilute to non-toxic levels before they affect benthic resources. The corresponding impacts on benthic resources are rarely noticeable.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Previous cell and Section A.8.2 discuss Water Quality details.	Accidental releases would increase under an expanded planned action scenario. Accidental releases of hazmat mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to contact benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. Larger spills, though unlikely, could have larger impacts on benthic resources due to larger adverse impacts on water quality. The low likelihood and small size of potential releases, along with the cleanup measures in place, indicate that these impacts on benthic resources are unlikely to be noticeable. Section A.8.2 discusses additional Water Quality details.	The Proposed Action would increase the risk of accidental releases, primarily during construction but also during operations and decommissioning. Accidental releases of hazmat mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to contact benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. The corresponding impacts on benthic resources are unlikely to be noticeable. Larger spills, though unlikely, could have larger impacts on benthic resources due to adverse impacts on water quality. The low likelihood and small size of potential releases, along with the cleanup measures in place, indicate that these impacts (mortality, decreased fitness, disease) would likely be **negligible**. Section A.8.2 discusses additional Water Quality details.	Under the Proposed Action, the impacts on benthic resources from this sub-IPF would include an increased potential for a release that would have localized and temporary impacts, including mortality and decreased fitness, likely resulting in **negligible** impacts. The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing, chronic releases. Future offshore wind activities would contribute to an increased risk of releases and impacts on benthic resources. The contribution from future offshore wind and the Proposed Action would represent a low percentage of the overall risk from ongoing activities. In context of reasonably foreseeable environmental trends, the combined impacts on benthic resources (mortality, decreased fitness, disease) from this sub-IPF from ongoing and planned actions, including the Proposed Action, are expected to be **negligible**, localized, and temporary due to the likely limited extent and duration of a release, as described in detail in Section A.8.2.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on benthic resources (e.g., competitive disadvantage, smothering) depend on many factors, but can be noticeable, widespread, and permanent.	No future activities were identified within the geographic analysis area other than ongoing activities.	Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on benthic resources depend on many factors, but could be noticeable, widespread, and permanent.	The increased vessel traffic associated with the Proposed Action, especially traffic from foreign ports, would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on benthic resources depend on many factors, but could be widespread and permanent. The increase in the risk of	The Proposed Action would cause a **negligible** increase in the risk of accidental releases of invasive species, stemming primarily from construction. Ongoing activities currently present a risk of accidental releases. Offshore wind activities other than the Proposed Action would increase this risk. In context of reasonably foreseeable environmental trends, the risk of impacts on benthic resources due to accidental releases of invasive species from ongoing and planned actions, including the Proposed Action, is anticipated to be **major**, and

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				accidental releases of invasive species attributable to the Proposed Action would be **negligible**.	most of this risk comes from ongoing activities, as it is generally related to the volume of vessel traffic.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occurs from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. However, there does not appear to be evidence that ongoing releases have detectable impacts on benthic resources.	No future activities were identified within the geographic analysis area other than ongoing activities.	Accidental releases of trash and debris may occur from vessels primarily during construction, but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of projects. There is a higher likelihood of releases from nearshore project activities, e.g., transmission cable installation, and transportation of equipment and personnel from ports. However, there does not appear to be evidence that the volumes and extents anticipated would have any detectable impact on benthic resources.	Accidental releases of trash and debris may occur from vessels primarily during construction, but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of project activities. There is a higher likelihood of releases from nearshore project activities, e.g., transmission cable installation, and transportation of equipment and personnel from ports. However, there does not appear to be evidence that the volumes and extents anticipated would have any detectable impact on benthic resources. Therefore, the Proposed Action would likely have no impact on benthic resources through this sub-IPF.	Accidental releases of trash and debris are not likely to have any detectable impact on benthic resources. In context of reasonably foreseeable environmental trends, accidental trash and debris releases from ongoing and planned actions, including the Proposed Action, would occur, but would likely have no impact, given that there does not appear to be evidence that the volumes and extents would have any impact on benthic resources.
Anchoring	Regular vessel anchoring related to ongoing military, survey, commercial, and recreational activities continues to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and the potential for physical contact to cause injury and mortality of benthic resources, as well as physical damage to their habitats. All impacts are localized; turbidity is temporary; injury and mortality are recovered in the short term; and physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area other than ongoing activities.	There would be increased anchoring during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. There may also be increased anchoring/mooring of met towers or buoys. These impacts would include increased turbidity levels and potential for physical contact to cause mortality. Up to 56 acres (0.2 km^2) could be affected. All impacts would be localized; turbidity would be temporary; physical damage can be permanent if it occurs in eelgrass beds or hard bottom; mortality from contact would be recovered in the short term.	The COP estimated that anchoring would disturb up to 4.4 acres (17,806 m^2). These impacts would occur primarily during construction, but also during operations and decommissioning, and would include increased turbidity and potential for contact causing mortality of benthic resources. All impacts would be localized; turbidity would be temporary; physical damage can be permanent if it occurs in hard-bottom habitat; mortality from contact would be recovered in the short term. The Proposed Action would not anchor in eelgrass. Anchoring disturbances would recover naturally, unless they occur on hard bottom, which is unlikely. The overall impact of anchoring on benthic resources would be **minor** to **moderate.**	Anchoring associated with the Proposed Action would disturb up to 4.4 acres (17,806 m^2), resulting in **minor** to **moderate** temporary to short-term impacts (turbidity, mortality) on benthic resources. Ongoing and future non-offshore wind activities would cause a series of temporary localized impacts. Offshore wind activities, other than the proposed Project, would affect up to 56 acres (0.2 km^2). In context of reasonably foreseeable environmental trends, combined anchoring impacts from ongoing and planned actions, including the Proposed Action, could affect up to 60 acres (0.2 km^2), although some of this may occur after the benthic resources have recovered from the earlier impact(s), resulting in **minor** to **moderate** impacts on benthic resources. Such impacts are expected to be localized and temporary, but could be permanent if they occur in eelgrass beds or hard-bottom habitats.
EMFs	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. In the geographic analysis area, there are six existing power cables connecting Martha's Vineyard and Nantucket to the mainland. New cables generating EMFs are infrequently installed in the geographic analysis area. Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to movement. The extent of impacts (behavioral changes) is likely less than 50 feet (15.2 meters) from the cable and	No future activities were identified within the geographic analysis area other than ongoing activities.	EMFs would emanate from new operating transmission cables. In the expanded planned action scenario, an estimated 943 miles (1,518 kilometers) of cable would be added in the geographic analysis area, producing EMFs in the immediate vicinity of each cable during operation. (See cells to the left.) Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMFs to low levels. Wherever a cable is not buried, the exposure of benthic resources to magnetic fields may be stronger. EMFs of any two sources would not	EMFs would emanate from operating transmission cables within the geographic analysis area. With the shielding and burial depths proposed, impacts are expected to be localized and difficult to detect, but permanent. The extent of effects would likely be less than 50 feet (15.2 meters) from the cable(s), and the intensity of impacts on benthic resources would likely be **negligible.**	EMFs from the Proposed Action are expected to lead to **negligible** impacts on benthic resources. Impacts of EMFs from existing operating cables on benthic resources are likely undetectable. Impacts of EMFs from future offshore wind activities on benthic resources would likely be undetectable. Noticeable effects on benthic resources would be unlikely. Therefore, impacts of EMFs on benthic resources from ongoing and planned actions, including the Proposed Action, would likely be **negligible**. Furthermore, most benthic resources are primarily not mobile or move very slowly, and thus are not susceptible to multiple exposures to EMFs. In the case of mobile species, an individual exposed to EMFs would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	the intensity of impacts on benthic resources is likely undetectable.		overlap because developers typically allow at least 330 feet (100 meters) between cables, even for multiple cables within a single OECC. The extent of effects would likely be less than 50 feet (15.2 meters) from the cable(s), and the intensity of impacts on benthic resources would likely be undetectable.		whether previous exposure to EMFs would influence the impacts of future exposure. EMFs do not appear to constitute a barrier to migration.
New cable emplacement/ maintenance	Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. In the geographic analysis area, there are six existing power cables. See BOEM (2019b) for details. New cables are infrequently added near shore. Cable emplacement/maintenance activities injure and kill benthic resources, and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPFs of Seabed profile alterations and Sediment deposition and burial.)	No future activities were identified within the geographic analysis area other than ongoing activities.	New offshore submarine cables associated with the expanded planned action scenario would cause short-term disturbance of seafloor habitats, and injury and mortality of benthic resources in the immediate vicinity of the cable emplacement activities. The total area of disturbance by new cable emplacement is estimated to be up to 1,269 acres (5.1 km^2). Increased turbidity would occur during construction for 1 to 6 hours at a time over an assumed 7-year construction period in the geographic analysis area. Disturbed seafloor from construction of those projects may affect benthic resources, but assuming similar installation procedures, the duration and extent of impacts would be limited and short-term, and benthic assemblages would recover following the disturbance. If routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent. Some types of cable installation equipment use water withdrawals, which can entrain planktonic larvae of benthic fauna (e.g., larval polychaetes, mollusks, and crustaceans) with assumed 100 percent mortality of entrained individuals. Due to the limited time and volume involved, population-level impacts are not anticipated. (See also the IPFs of Seabed profile alterations and of Sediment deposition and burial.)	The Proposed Action would cause short-term disturbance, injury, and mortality of benthic resources, and likely permanent impacts on hard-bottom habitat. The Proposed Action would not install cables through eelgrass beds. The Proposed Action is estimated to disturb up to 328 acres (1.3 km^2) of seafloor by cable installation and up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation. Cable installation would mostly be done by jet or mechanical plow. Overall, the impacts of this IPF on benthic resources would likely be **moderate**. (See also the IPFs of Seabed profile alterations and of Sediment deposition and burial.)	The COP estimated that up to 328 acres (1.3 km^2) of seafloor in the OECC and 394 acres (1.6 km^2) in the WDA could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term, **moderate** impacts including disturbance, injury, and mortality. In most locations, the affected areas are expected to recover naturally, and impacts would be short-term, except in hard-bottom habitat, where impacts may be permanent. Ongoing and future non-offshore wind activities, if any involve cables in the geographic analysis area, may cause short-term impacts and possibly long-term habitat alterations if cables pass through hard bottom and/or eelgrass. Future offshore wind activities other than the Proposed Action would cause similar impacts across up to 1,269 acres (5.1 km^2). In context of reasonably foreseeable environmental trends, impacts (disturbance, injury, mortality) on benthic resources from ongoing and planned actions, including the Proposed Action, would be additive among sources, totaling 1,590 acres (6.4 km^2) and would likely be **moderate**.
Noise: Onshore/offshore construction	See Table 3.3-1 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table 3.3-1 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources would rarely, if ever, overlap from multiple sources.	See Table 3.3-1 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources would rarely, if ever, overlap from multiple sources.	Construction of up to 102 offshore structures would generate noise and temporarily impact benthic resources. The greatest impact from noise is likely to be caused by pile driving (see the Pile driving sub-IPF).	The majority of impacts from construction noise are likely to be related to pile driving (see the Pile driving sub-IPF). All other sources of construction noise would likely not lead to detectable impacts on benthic resources in the geographic analysis area.
Noise: G&G	See Table 3.3-1 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table 3.3-1 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.	See Table 3.3-1 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys can disturb benthic resources in the immediate vicinity of the investigation. Impacts on benthic resources (disturbance) are anticipated to be temporary and **negligible**.	G&G survey noise from the Proposed Action may result in **negligible** temporary impacts on benthic resources along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent, and could possibly also result in injury or mortality during seismic surveys. Future offshore wind activities other than the Proposed Action would likely have similar impacts as the Proposed Action, but across a greater area. In context of reasonably foreseeable environmental trends, combined G&G noise impacts from planned actions, including the Proposed Action, would likely be approximately equal to the sum of all of these impacts and would be **negligible**. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: O&M	See Table 3.3-1 on finfish, invertebrates, and EFH.	See Table 3.3-1 on finfish, invertebrates, and EFH.	See Table 3.3-1 on finfish, invertebrates, and EFH. Noise from operational WTGs would increase noise near the WTGs. While continuous noise associated with operational WTGs may be audible to some invertebrates, this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would adversely affect benthic resources (English et al. 2017).	See Table 3.3-1 on finfish, invertebrates, and EFH. Noise from operational WTGs would increase noise near the WTGs. While continuous noise associated with operational WTGs may be audible to some invertebrates, this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would adversely affect benthic resources (English et al. 2017).	There does not appear to be evidence that noise related to operations and maintenance of offshore wind facilities would adversely affect benthic resources. The Proposed Action is not expected to cause impacts on benthic resources through this sub-IPF. Ongoing and future non-offshore wind activities may result in small local impacts on benthic resources, such as disturbance. Future offshore wind activities other than the Proposed Action are not expected to cause impacts on benthic resources through this sub-IPF. No impacts of this sub-IPF on benthic resources can be attributed to the Proposed Action (although it would increase noise near the WTGs, but not to an extent that would cause impacts), although ongoing and activities may cause small local impacts.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures. This would occur during construction for approximately 2 to 3 hours per foundation or 4 to 6 hours per day over an assumed 7-year construction period in the geographic analysis area, likely during spring, summer, and fall. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions; based on estimates from the Proposed Action, the extent of behavioral impacts is likely less than 5.7 miles (9.2 kilometers) around each pile, and the extent of mortality is assumed to cover approximately 9.7 acres (39,254 m^2) per foundation. If all 257 foundations in the expanded planned action scenario are summed, mortality is expected to cover approximately 2,493 acres (10.1 km^2). The affected areas would likely be recolonized in the short term.	The Proposed Action would produce noise from pile driving during installation of foundations for approximately 2 to 3 hours per foundation or 4 to 6 hours per day during construction. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The estimated extent of behavioral impacts is likely less than 5.7 miles around each pile and the extent of mortality is assumed to cover 9.7 acres per foundation, totaling approximately 989 acres. The affected areas would likely be recolonized in the short term, and the overall impact on benthic resources would be **moderate**.	Noise from pile driving during construction of the Proposed Action is expected to cause **moderate** short-term impacts, with potential injury or mortality occurring across approximately 989 acres (4 km^2) of the seafloor. Ongoing and future non-offshore wind activities may have similar effects, perhaps with a smaller extent. Future offshore wind activities other than the Proposed Action could cause potential injury or mortality across approximately 2,493 acres (10.1 km^2). In context of reasonably foreseeable environmental trends, combined pile-driving noise impacts from planned actions, including the Proposed Action, would be **moderate**. The total area affected by pile-driving noise would be the sum of all these affected areas and is expected to include potential injury or mortality across approximately 3,482 acres (14.1 km^2). If multiple piles are driven simultaneously, the areas of potential injury or mortality would not overlap. The areas of behavioral impacts may overlap; although the noises from driving multiple piles are unlikely to overlap at any one time, individuals may be affected by noise from sequential events before they have fully recovered from previous exposures.
Noise: Cable laying/trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area. These disturbances would be infrequent over the next 30 years, local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Noise from trenching/burial of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension, deposition and burial. This noise would be intermittent and would occur over an assumed 7-year construction period in the geographic analysis area.	Noise from trenching of export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. The jet plowing method also creates noise. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of physical disturbance and sediment suspension. This noise would likely have **negligible** impacts on benthic resources.	The Proposed Action would likely have **negligible** impacts on benthic resources through trenching/cable burial noise. The impact on benthic resources of this type of noise associated with ongoing activities, future non-offshore wind activities, and future offshore wind activities is discountable compared to the impacts of physical disturbance and sediment suspension. In context of reasonably foreseeable environmental trends, the combined impact of this noise on benthic resources from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Port utilization: Expansion	See Table 3.3-1 on finfish, invertebrates, and EFH.	See Table 3.3-1 on finfish, invertebrates, and EFH.	Increases in port utilization due to other offshore wind energy projects would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a 7-year period and would decrease during operations, but increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and temporary to permanent habitat alteration. At least one project is contemplating port expansion/modification in Vineyard Haven. Ports have already affected benthic resources, and future port projects would implement BMPs to minimize impacts. Therefore, the degree of impacts on benthic resources would likely be undetectable in the geographic analysis area.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect benthic resources near ports. Therefore, there would be no impact on benthic resources from this sub-IPF.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect benthic resources near ports. Ongoing and future non-offshore wind activities are expected to cause impacts through this sub-IPF on benthic resources that are difficult to detect. Future offshore wind activities other than the Proposed Action are expected to cause impacts through this sub-IPF on benthic resources that are difficult to detect. No impacts of this sub-IPF on benthic resources can be attributed to the Proposed Action, although ongoing and activities are expected to result in difficult to detect impacts on benthic resources.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear are periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb, injure, or kill benthic resources, creating small, short-term, localized impacts.	Future new cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would present additional risk of gear loss, resulting in small, short-term, localized impacts (disturbance, injury).	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection incrementally over an assumed 7-year construction period in the geographic analysis area, and the structures would remain until decommissioning of each project is complete. In the expanded planned action scenario, there could be up to 257 new foundations, 219 acres (0.9 km^2) of foundation scour protection, and 250 acres (1.1 km^2) of new hard protection atop cables. This would increase the risk of gear loss/damage by entanglement and the ensuing impacts on benthic resources (disturbance, injury). The intermittent impacts at any one location would likely be short-term and localized, although the risk of occurrence would persist as long as the structures remain.	The Proposed Action would add up to 102 foundations, 53 acres (0.2 km^2) of scour protection, and 98 acres (0.4 km^2) of cable protection. This would permanently increase the risk of gear loss/damage by entanglement and the ensuing impacts (disturbance, injury) on benthic resources as long as the structures remain. The intermittent impacts at any one location would likely be localized, short-term, and **negligible**, and the risk of occurrence would persist as long as the structures remain.	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations, 53 acres (0.2 km^2) of scour protection, and 98 acres (0.4 km^2) of cable protection, resulting in **negligible** impacts (disturbance, injury) on benthic resources through this sub-IPF. Ongoing entanglement and gear loss/damage at existing structures also periodically results in short-term, localized impacts. Future offshore wind activities other than the Proposed Action would add approximately 219 acres (0.9 km^2) of scour protection, 250 acres (1.1 km^2) of cable protection, and the vertical surfaces of up to 257 new foundations. Planned actions may add up to 359 foundations, 272 acres (1.1 km^2) of scour protection, and 348 acres (1.4 km^2) of cable protection, which would increase the risk of periodic short-term, highly localized impacts. In context of reasonably foreseeable environmental trends, the impact on benthic resources through this sub-IPF from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.
Presence of structures: Hydrodynamic disturbance	See Table 3.3-1 on finfish, invertebrates, and EFH.	See Table 3.3-1 on finfish, invertebrates, and EFH.	See above for quantification and timing. New structures, especially foundations, would disturb hydrodynamics as long as the structures remain. Impacts would likely be highly localized and difficult to detect. BMPs would be in place to minimize scour; therefore, sediment plumes, if any, would return to baseline conditions in the area and would not likely have a detectable impact. Additional impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be undetectable to small, to be localized, and to vary seasonally. See Table 3.3-1 on finfish, invertebrates, and EFH.	See above for quantification and timing. See Table 3.3-1 on finfish, invertebrates, and EFH for additional details on the nature of potential impacts. COP Volume III, Appendix III-K (Epsilon 2020b) discusses local hydrodynamic forces. The WTG and ESP foundations result in localized alterations of water currents, but the low current speeds at the seabed in the lease area and minimal seabed mobility lower scour concerns. Overall, BOEM anticipates the Proposed Action would cause a **negligible** impact on benthic resources through this sub-IPF.	See above for quantification and timing. The Proposed Action is expected to cause small local disturbances, resulting in **negligible** impacts on benthic resources. Existing structures and future non-offshore wind structures also cause localized disturbances, but not to a degree that results in detectable impacts on benthic resources. Other offshore wind structures would also cause localized disturbances, resulting in little to no impact on benthic resources. In context of reasonably foreseeable environmental trends, combined impacts of this sub-IPF from ongoing and planned actions, including the Proposed Action, are anticipated to be permanent, highly localized changes that have a **negligible** impact on benthic resources.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes can adversely affect populations and communities of benthic resources. These impacts are local and permanent.	New cables installed in the geographic analysis area over the next 30 years would likely require hard protection atop portions of the route (see the "New cable emplacement/maintenance" row in this table). Any new towers, buoy, or piers would also create uncommon relief in a mostly flat, sandy seascape. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and to be permanent as long as the structures remain.	See above for quantification and timing. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and permanent as long as the structures remain.	See above for quantification and timing. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local, permanent, and **minor** as long as the structures remain.	See above for quantification and timing. The Proposed Action is expected to cause localized **minor** impacts (increased predation) on benthic resources. Existing structures and future non-offshore wind structures also cause small, localized impacts of this type. Other offshore wind structures would also cause localized impacts of this type. In context of reasonably foreseeable environmental trends, combined impacts of this sub-IPF from ongoing and planned actions, including the Proposed Action, are anticipated to be permanent, highly localized changes that have **minor** impacts on benthic resources as long as the structures remain.
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously provide uncommon hard-bottom habitat. A large portion is homogeneous sandy seascape, but there is some other hard and/or complex habitat. Benthic species dependent on hard-bottom habitat can benefit on a constant basis, although the new habitat can also be colonized by invasive species (e.g., certain tunicate species). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	See above for quantification and timing. Any new towers, buoys, piers, or cable protection structures would create uncommon relief in a mostly sandy seascape. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).	See above for quantification and timing. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts are expected to be local and permanent as long as the structures remain.	See above for quantification and timing. Benthic species dependent on hard-bottom habitat could benefit (Claisse et al. 2014; Smith et al. 2016), although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). Impacts on benthic resources would include both **moderate beneficial** and **minor** impacts that are local and permanent.	See above for quantification and timing. The Proposed Action is expected to cause localized impacts that would include both **moderate beneficial** and **minor** impacts. Existing structures and future non-offshore wind structures are also expected to cause localized impacts on benthic resources through this sub-IPF. Offshore wind structures other than those associated with the Proposed Action are also expected to cause localized impacts on benthic resources through this sub-IPF. In context of reasonably foreseeable environmental trends, the combined impacts of this sub-IPF on benthic resources from ongoing and planned actions, including the Proposed Action, are anticipated to include many permanent local impacts on benthic resources that may include both **moderate beneficial** and **minor** impacts.
Presence of structures: Transmission cable infrastructure	The presence of transmission cable infrastructure, especially hard protection atop cables, causes impacts through entanglement/gear loss/damage, fish aggregation, and habitat conversion. Therefore, see those sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.
Discharges	The gradually increasing amount of vessel traffic is increasing the total permitted discharges from vessels. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. However, there does not appear to be evidence that the volumes and extents have any impact on benthic resources.	There is the potential for new ocean dumping/dredge disposal sites in the Northeast. Impacts (disturbance, reduction in fitness) of infrequent ocean disposal to benthic resources are short-term because spoils are typically recolonized naturally. In addition, the USEPA has established dredge spoil criteria and it regulates the disposal permits issued by the USACE; these discharges are required to comply with permitting standards established to ensure	There would be increased potential for discharges from vessels during construction, operations, and decommissioning. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in these wastes, particularly during construction and decommissioning, but the discharges would be staggered over time and localized. Permitted discharges of dredged material may also increase. There does not appear to be evidence that the volumes and extents anticipated would have any impact on benthic resources.	Permitted discharges from the Proposed Action would include uncontaminated water and treated liquid wastes. There does not appear to be evidence that the volumes and extents anticipated would have any impact on benthic resources. Therefore, the Proposed Action is anticipated to cause no impact on benthic resources through discharges.	The Proposed Action is anticipated to cause no impact on benthic resources through discharges. Ongoing and future non-offshore wind activities may cause short-term, local impacts (disturbance, reduction in fitness) through this IPF. Future offshore wind activities other than the Proposed Action are expected to cause little to no impact on benthic resources through this IPF. No impacts of this IPF on benthic resources can be attributed to the Proposed Action, although future non-offshore wind activities may cause short-term, local impacts. Overall, these impacts would fall within the range of impacts from ongoing activities. Any new ocean disposal sites would not overlap the corresponding impacts of the Proposed Action. Many discharges are required to comply with permitting standards, established to ensure that potential discharge impacts on the environment are mitigated.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		potential impacts on the environment are minimized or mitigated.			
Regulated fishing effort	Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by Massachusetts, towns, and/or NOAA, depending on jurisdiction, affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area other than ongoing activities.	Offshore wind development could influence this IPF (Section 3.10), possibly influencing when, where, and to what degree fishing activities affect benthic resources.	The Proposed Action could influence this IPF (Section 3.10), possibly influencing when, where, and to what degree fishing activities affect benthic resources.	Regulated fishing effort can affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance; Section 3.10). The impacts of regulated fishing effort (disturbance, mortality) through its influence on bottom-directed fishing gear may contribute alongside impacts from other IPFs that result in seafloor disturbance. The intensity of impacts on benthic resources under future fishing regulations are uncertain, but would likely be similar to or less than under the *status quo*, and would likely qualify as **moderate**.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized, short-term impacts (habitat alteration, injury, and mortality) on benthic resources through this IPF. For example, the Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little impact on benthic resources in the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.	Dredging and/or mechanical trenching used in the course of cable installation can cause localized, short-term impacts (habitat alteration, injury, and mortality) through seabed profile alterations, as well as through sediment deposition. Assuming the extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities would likely be on the order of 3 times more than under the Proposed Action alone. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after cable installation in the trench. Therefore, seabed profile alterations, while locally intense, have little impact on benthic resources in the geographic analysis area.	During construction, the Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, potentially leading to short-term impacts including habitat alteration, injury, and mortality. The impacts would likely be short-term, considering the natural mobility of sand waves in the WDA and OECC, although full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Overall, the impacts on benthic resources from this IPF would be **minor**. However, Vineyard Wind currently does not expect a need for dredging.	The Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, likely leading to short-term **minor** impacts on benthic resources. Ongoing activities cause similar impacts, but with a much larger extent. Future offshore wind activities other than the Proposed Action could also cause similar impacts over an area that would likely be on the order of 3 times more than under the Proposed Action. In context of reasonably foreseeable environmental trends, the combined impacts of this IPF on benthic resources from ongoing and planned actions, including the Proposed Action are likely to be widespread and **minor**.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local and limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season/time of year. The Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year. Where dredged materials are disposed, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	The USACE and/or private ports may undertake dredging projects periodically. Where dredged materials are disposed, benthic resources are buried. However, such areas are typically recolonized naturally in the short term. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	Cable emplacement and maintenance activities in or near the geographic analysis area during construction or maintenance of future offshore wind projects could cause sediment suspension for 1 to 6 hours at a time. Assuming the extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities would likely be on the order of 3 times more than under the Proposed Action alone. Increased sediment deposition may occur during multiple years. The area with a greater sediment deposition from simultaneous or sequential activities would be limited, as most lightly sedimented areas would recover naturally in the short term. If any dredging occurs in the geographic analysis area, dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial of benthic organisms at the immediate disposal site. The impacts of burial would likely be short-term to long-term.	See Table 3.3-1 on finfish, invertebrates, and EFH. Because most lightly sedimented areas would recover naturally, and most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area, impacts on benthic resources would be **minor**.	The Proposed Action would cause sediment deposition on up to 2,594 acres (10.5 km^2), which would result in **minor** impacts. Ongoing activities would cause similar impacts over an unknown extent. Future offshore wind activities (other than the Proposed Action) would also cause similar impacts over an area that is unknown, but would likely be on the order of 3 times more than under the Proposed Action alone. The incremental impact of the Proposed Action with respect to this IPF would be additive with the impact(s) of other offshore wind activities within the geographic analysis area. In context of reasonably foreseeable environmental trends, the combined impacts of this IPF on benthic resources from ongoing and planned actions, including the Proposed Action, would likely be short-term to long-term and **minor**.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of benthic invertebrates that have calcareous shells, as well as reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.	Impacts are practically the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are practically the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to the reduced growth or decline of benthic invertebrates that have calcareous shells. Because this sub-IPF is a global phenomenon, impacts on benthic resources through this sub-IPF would be practically the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change. The intensity of impacts resulting from climate change are uncertain, but are anticipated to be **minor** to **moderate**.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by ongoing greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions of benthic species and altering ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 30 years.	See above.	See above.	See above.	See above.
Climate change: Warming and sea level rise, altered migration patterns	See above.	See above.	See above.	See above.	See above.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by ongoing greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of benthic species, and likely causing permanent changes of unknown intensity over the next 30 years.	See above.	See above.	See above.	See above.

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; COP = Construction and Operations Plan; EFH = Essential Fish Habitat; EMF = electromagnetic field; ESP = electrical service platform; G&G = Geological and Geophysical; hazmat = hazardous materials; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meter; MA = Massachusetts; MA DMF = Massachusetts Division of Marine Fisheries; met = meteorological; NOAA = National Oceanic and Atmospheric Administration; OECC = Offshore Export Cable Corridor(s); RI = Rhode Island; USACE = U.S. Army Corps of Engineers; USEPA = U.S. Environmental Protection Agency; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.2-2: Maximum Areas of Impact Predicted from Installation, Vessels, and Dredging

Bottom Disturbance Due to Installation, Jack-up Vessels, and Dredging	Maximum Area of Disturbance	
	Acres	km^2
Export Cables	117	0.47
Inter-link Cable	7	0.03
Inter-array Cables	204	0.83
Dredging [a]	69	0.28
Jack-up Vessels (WTG Installation)	65	0.26
Jack-up Vessels (ESP Installation)	0.3	0.001
Anchoring	4.4	0.017
Total in the WDA (Cables and Jack-up)	277	1.12
Total in the OECC (Cables and Dredging)	186	0.75

Source: Modified from COP Table 6.5-5 (Volume III; Epsilon 2020b); Final Environmental Impact Report Table 2-3 (Epsilon 2018a).

ESP = electrical service platform; km^2 = square kilometers; OECC = Offshore Export Cable Corridor; WDA = Wind Development Area; WTG = wind turbine generator

[a] Dredging prior to cable installation. To avoid double-counting impacts, Vineyard Wind's total area of dredging disturbance does not include the 6.6-foot-wide (2-meter-wide) export cable.

Table 3.2-3: Maximum Areas of Impact Predicted from Scour/Cable Protection

Bottom Disturbance Due to Addition of Rock or Structures (Protection)	Total Area of Protection	
	Acres	km^2
WTG Foundations and Scour Protection	52	0.21
ESP Foundations and Scour Protection	1	0.01
Export Cable Protection [a]	35	0.14
Inter-link Cable Protection	2	0.01
Inter-array Cable Protection	61	0.25
Total Scour and Cable Protection in the WDA	117	0.47
Total Cable Protection along the OECC	35	0.14

Source: Modified from COP Table 6.5-5 (Volume III; Epsilon 2020b).

ESP = electrical service platform; km^2 = square kilometers; OECC = Offshore Export Cable Corridor; WDA = Wind Development Area; WTG = wind turbine generator

[a] Maximum length of export cable includes the length for both export cables to be installed within the corridor.

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Table 3.3-1: Summary of Activities and the Associated Impact-Producing Factors for Finfish, Invertebrates, and Essential Fish Habitat

Baseline Conditions: The geographic analysis area for finfish, invertebrates, and EFH consists of the Northeast U.S. Continental Shelf ecosystem. This ecosystem has a very diverse and abundant fish assemblage that can be generally categorized according to life habitats or preferred habitat associations (e.g., pelagic [inhabit the water column], demersal [bottom feeders], resident, and high migratory species). Many of these same species are federally managed species, meaning they have a designated EFH. Some species of commercial importance include Atlantic cod (*Gadus morhua*), flounders, skates, black sea bass (*Centropristis striata*), haddock (*Melanogrammus aeglefinus)*, hakes, monkfish, bay scallops (*Argopecten irradians*), Atlantic sea scallops (*Placopecten magellanicus*), blue mussels (*Mytilus edulis)*, ocean quahogs (*Arctica islandica*), soft shell clams (*Mya arenaria*), whelks, horseshoe crabs (*Limulus polyphemus*), longfin squid (*Doryteuthis pealeii*), and shortfin squid (*Illex illecebrosus*), among others. Many species vary in abundance and distribution across seasons. There are also finfish and invertebrates listed under the Endangered Species Act, although only four of those species (Atlantic sturgeon [*Acipenser oxyrinchus oxyrinchus*], shortnose sturgeon [*Acipenser brevirostrum*], Atlantic salmon [*Salmo salar*], and giant manta [*Manta birostris*]) are likely to occur in the region surrounding the proposed Project.

In the early 2000s, the majority of commercially exploited stocks in this ecosystem were categorized as overfished. A 2015 assessment of 20 groundfish species in the Southern New England sub-region indicates that while the number of overfished stocks has generally decreased, depletion continues for certain stocks (NEFSC 2015). In particular, winter flounder (*Pseudopleuronectes americanus*), yellowtail flounder (*Limanda ferruginea*), and wolffish (*Anarhichas lupus*) remain overfished (NEFSC 2015). According to a more recent assessment, in the New England and Mid-Atlantic regions, 17 fish stocks are in an overfished condition and 5 are currently subject to overfishing (NOAA 2020f). Lobster (*Homarus americanus*) catches in southern New England have declined sharply since the late 1990s. Other species have increased in commercial importance, including Jonah crab (*Cancer borealis*) and whelks, known in some places as conch. Striped bass (*Morone saxatilis*), once depleted regionally due to overfishing in the early 1980s, are now important regional recreational and commercial fisheries, with 3 million pounds harvested in 2016 (Nelson 2017). The understanding and rebuilding of finfish and invertebrate stocks are complicated by variables such as long-term shifts occurring at the base of the food web (Perretti et al. 2017) and warming ocean temperatures (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold (20°C) may affect the recovery of the American lobster stock (ASMFC 2015).

In addition to harvest, finfish, invertebrates, and EFH are subject to pressures from ongoing activities. Water-quality impacts from onshore and offshore activities affect nearshore habitats and food webs. Commercial fishing using bottom trawls and dredge-fishing methods regularly disturbs seafloor habitat. Their impacts are similar in nature but much greater in extent (spatially and temporally) than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation. Commercial fishing and recreational fishing using other methods results in mortality of finfish and invertebrates through harvest and bycatch. See Section 3.10 for details. Commercial and recreational fishing gear is periodically lost, but they can continue to capture or otherwise harm finfish and invertebrates. The lost gear, moved by currents, creates small, localized, short-term impacts. Dredging for navigation, marine minerals extraction, and/or military uses disturbs swaths of seafloor habitat. Their impacts are similar in nature but much greater in extent (spatially and temporally) than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	See Table A.8.2-1 in Appendix A for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Impacts, including mortality, decreased fitness, and contamination of habitat, are localized and temporary, and rarely affect populations.	See Table A.8.2-1 in Appendix A for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Impacts are unlikely to affect populations.	See Table A.8.2-1 in Appendix A for details. Using the assumptions in Appendix A, there would be a low risk of a release from any of 2,021 WTGs and 45 ESPs, with a total of approximately 13.1 million gallons (49.6 million liters) of fuel/fluids/hazmat contained in all offshore wind facilities. According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,533 liters) is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years. The likelihood of a spill occurring from multiple WTGs and ESPs at the same time is very low and, therefore, the potential impact from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. Based on these rates, the additional impact of releases from future offshore wind facilities, the risk of which would primarily exist during construction, but also during operations and decommissioning, would fall within the range of ongoing activities.	See Table A.8.2-1 in Appendix A for a quantitative analysis of these risks. The Proposed Action would increase the risk of releases, which would have temporary localized impacts including mortality and decreased fitness. The low likelihood and small size of potential releases, along with the measures in place to clean them up, indicate that these impacts would likely be **negligible**.	The impacts on finfish, invertebrates, and EFH from this sub-IPF under the Proposed Action would include an increased potential for a release that would have localized and temporary impacts, including mortality and decreased fitness, likely resulting in **negligible** impacts. The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and impacts on this resource, including mortality, decreased fitness, and increased disease occurrence due to fuel/fluid/hazmat exposure. The contribution from future offshore wind and Alternative A would be a low percentage of the overall spill risk from ongoing activities. In context of reasonably foreseeable environmental trends, the impacts on finfish, invertebrates, and EFH (mortality, decreased fitness, disease) from this sub-IPF from ongoing and planned actions, including the Proposed Action, would likely be localized, temporary, and **negligible** to **minor** due to the likely limited extent and duration of a release. See Table A.8.2-1 in Appendix A for additional details.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on finfish, invertebrates, and EFH depend on many factors, but can be widespread and permanent.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on finfish, invertebrates, and EFH depend on many factors, but could be widespread and permanent. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities.	The increased vessel traffic associated with Alternative A, especially traffic from foreign ports, would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on finfish, invertebrates, and EFH depend on many factors, but could be widespread and permanent. The increase in risk of accidental releases of invasive species attributable to the Proposed Action would be **negligible**.	The Proposed Action would cause a **negligible** increase in the risk of accidental releases of invasive species, primarily during construction. Ongoing activities currently present a risk of accidental releases. Offshore wind activities other than the Proposed Action would increase this risk. In context of reasonably foreseeable environmental trends, the risk of impacts on finfish, invertebrates, and EFH due to accidental releases of invasive species from ongoing and planned actions, including the Proposed Action, could qualify as **major**, and most of this risk comes from ongoing activities, as it is generally related to the volume of vessel traffic.
Anchoring	Vessel anchoring related to ongoing military use and survey, commercial, and recreational activities continues to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish).	Impacts from anchoring may occur on a semi-regular basis over the next 30 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. These impacts would include increased turbidity levels and potential for contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long-term to permanent.	Using the assumptions in Table A-4 in Appendix A, anchoring could affect up to approximately 276 acres (1.1 km^2). Impacts (turbidity, mortality, degradation of sensitive habitats) would be localized, occurring primarily during construction, but also during operations and decommissioning; turbidity would be temporary, and impacts from contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long-term to permanent.	The Proposed Action is estimated to have anchoring disturb up to 4.4 acres (17,806 m^2). These impacts would primarily occur during construction, but could also occur during operations and decommissioning and would include increased turbidity levels and the potential for contact to cause mortality of benthic species. All impacts would be localized; turbidity would be temporary; impacts from contact would be recovered in the short term. The Proposed Action would not anchor in eelgrass. The overall impact of anchoring on finfish, invertebrates, and EFH would be **minor**.	Anchoring associated with the Proposed Action would disturb up to 4.4 acres (17,806 m^2), resulting in temporary to short-term **minor** impacts (turbidity, mortality) on finfish, invertebrates, and EFH. Ongoing and future non-offshore wind activities would cause a series of temporary localized impacts. Offshore wind activities other than the proposed Project would affect up to 276 acres (1.1 km^2). In context of reasonably foreseeable environmental trends, anchoring from ongoing and planned actions, including the Proposed Action, could affect up to 276 acres (1.1 km^2), although some of this may occur after the resource has recovered from the earlier impact(s), resulting in **minor** impacts on finfish, invertebrates, and EFH. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long-term to permanent.
EMF	EMF emanates continuously from installed telecommunication and electrical power transmission cables. Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences, Inc. and Exponent 2019 and see Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchinson et al. 2018). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from undersea AC power cables negatively affects commercially and recreationally important fish species within the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019).	During operation, future new cables would produce EMF. (See cell to the left.) Submarine power cables in the geographic analysis area for this resource are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (See Section 5.2.7 of MMS 2007.) EMF of any two sources would not overlap (even for multiple cables within a single OECC). Although the EMF would exist as long as a cable was in operation, impacts, on finfish, invertebrates, and EFH would likely be difficult to detect.	In the expanded planned action scenario, up to 5,947 miles (9,571 kilometers) of cable would be added in the geographic analysis area for this resource, producing EMF in the immediate vicinity of each cable during operations. (See cells to the left.)	EMF would emanate from the Proposed Action's AC cables during operation. The shielding and burial depths under the Proposed Action would minimize EMF intensity and extent. Although the EMF would exist as long as a cable was in operation, a study by CSA Ocean Sciences Inc. and Exponent (2019) found that EMF from offshore wind energy projects are not expected to affect commercial and recreational fishes within the southern New England area; therefore, impacts on pelagic species are expected to be **negligible** and impacts on bottom-dwelling species are expected to be **minor**.	EMF from the Proposed Action is expected to lead to **negligible** to **minor** impacts on finfish, invertebrates, and EFH. Although EMF would emanate from any operating cable related to the Proposed Action, ongoing activities, future non-offshore wind activities, or future offshore wind activities, it does not appear likely that there would be any noticeable effect on finfish, invertebrates, and EFH. According to CSA Ocean Sciences Inc. and Exponent (2019), EMF from offshore wind energy projects are not expected to affect commercial and recreational fishes within the southern New England area. In context of reasonably foreseeable environmental trends, the combined impacts of EMF on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, would likely be **negligible** to **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Light: Vessels	Marine vessels have an array of lights including navigational lights and deck lights. There is little downward-focused lighting, and therefore only a small fraction of the emitted light enters the water. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts.	See cell to the left. Also see Section 3.11.	In a maximum-case scenario, lights on vessels used for offshore wind construction could be active 24 hours per day during construction. This could attract finfish and invertebrates to construction zones, potentially exposing them to greater harm from other IPFs (e.g., Noise). If there were no nighttime construction, this would not be a factor. Minimal vessel light could also occur during operations and decommissioning.	Vineyard Wind has agreed to avoid nighttime pile driving, and the Proposed Action would allow other nighttime work only on an as-needed basis, in which case the Project would reduce lighting of vessels, minimizing the potential for attracting finfish and invertebrates. These impacts would be highly localized and would exist only as long as the lights were in use. Navigation lights during construction, operations, and decommissioning would be minimal, and are expected to cause a **negligible** impact on finfish, invertebrates, and EFH.	The Proposed Action would cause **negligible** impacts on finfish, invertebrates, and EFH from this sub-IPF. The impacts of ongoing activities and future non-offshore wind activities (attraction, behavioral disruption) are highly localized, temporary to short-term, and greater than the expected impacts of future offshore wind activities. Future offshore wind activities would likely result in the same type of impacts, but with a smaller spatial and temporal extent. In context of reasonably foreseeable environmental trends, the combined impacts of this sub-IPF on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, would likely be limited to **negligible** short-term and highly localized attraction and potential disruption of spawning cycles.
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including buildings and ports, emit a great deal more on an ongoing basis. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts. Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	Up to 2,021 WTGs and 45 ESPs would have lights during their operational phase, and these would be incrementally added over time. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM guidance. This would increase the amount of light on the OCS. Because there would be no downward-focused lighting, only a small fraction of the emitted light would enter the water. Therefore, no impacts on finfish, invertebrates, and EFH are expected.	Up to 100 turbines and two ESPs would have aviation hazard and/or navigation lights during the 30-year operational phase of the Proposed Action. There would be no downward-focused lighting, and therefore only a small fraction of the emitted light would enter the water, causing no impact on finfish, invertebrates, and EFH.	The Proposed Action is not expected to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. The impacts from ongoing activities and future non-offshore wind activities are widespread and permanent near the coast, but minimal offshore. Future offshore wind activities would be unlikely to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. No impacts of this sub-IPF on finfish, invertebrates, and EFH can be attributed to the Proposed Action, although ongoing and future non-offshore wind activities are expected to cause permanent impacts, primarily driven by light from onshore structures.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local, limited to the cable corridor. Refer to BOEM (2019b) for details. New cables are infrequently added near shore. Cable emplacement/maintenance activities disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPF of Sediment deposition and burial.)	Future new cables would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in local short-term impacts. The FCC has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the geographic analysis area for this resource, short-term disturbance would be expected. The intensity of impacts would depend on the time (season) and place (habitat type) where the activities would occur.	Assuming similar installation procedures as the proposed Project, the extent of impacts would be limited to approximately 6 feet (2 meters) to either side of each cable and finfish, invertebrates, and most EFH would recover following the disturbance, although some habitats would not fully return to their previous conditions. Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term effects on populations could occur in the immediate vicinity of installation activities. The total area of seafloor disturbance is estimated to be up to 8,153 acres (33 km^2). If routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent; otherwise, impacts would be recovered in the short term. (See also the IPF of Sediment deposition and burial.)	The Proposed Action would cause short-term disturbances during construction and possibly during maintenance. The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation. (See also the IPF of Sediment deposition and burial.) Where cables intersect hard-bottom habitats, impacts may be long-term to permanent. Cable installation would mostly be done by jetting or jet plowing. Overall, these impacts would likely be **moderate**.	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term, **moderate** impacts including mortality and reduced fitness, and possibly long-term to permanent **moderate** impacts in hard-bottom habitats. Ongoing and future non-offshore wind activities may cause local short-term impacts. Future offshore wind activities other than the Proposed Action would disturb up to 8,153 acres (33.0 km^2). In context of reasonably foreseeable environmental trends, impacts (mortality, short-term reductions in fitness) would occur as a result of an estimated 8,153 acres (33.0 km^2) of disturbance from ongoing and planned actions, including the Proposed Action, leading to **moderate** impacts on finfish, invertebrates, and EFH.
Noise: Aircraft	Noise from aircraft reaches the sea surface on a regular basis. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH, as very little of the aircraft noise propagates through the water.	Aircraft noise is likely to continue to increase as commercial air traffic increases. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.	Offshore wind projects may use aircraft for crew transport during maintenance and/or construction over the next 30 years. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.	Vineyard Wind may use aircraft for crew transport during maintenance over the life of the Project. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.	There is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH in the geographic analysis area for this resource.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Onshore/offshore construction	Noise from construction occurs frequently in near shores of populated areas in New England and the mid-Atlantic but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. See also sub-IPF for Noise: Pile driving.	Noise from construction near shores is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource.	In the expanded planned action scenario, construction of 2,066 offshore structures would create noise and temporarily impact finfish, invertebrates, and EFH. The greatest impact of noise is likely to be caused by pile driving (see below). Such noise would be intermittent and would occur over an assumed 6- to 10-year period.	Construction of up to 102 offshore structures would create noise and temporarily impact finfish, invertebrates, and EFH. The greatest impact of noise is likely to be caused by pile driving (see below).	The majority of impacts from construction noise are likely to be related to pile driving (see below). All other sources of construction noise would likely not lead to noticeable impacts on finfish, invertebrates, and EFH.
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise that penetrates deep into the seabed. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Site characterization surveys for offshore wind facilities would create intermittent noise around sites of investigation over a 2- to 10-year period. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. Impacts on finfish, invertebrates, and EFH are anticipated to be temporary and **negligible**.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts (behavioral effects) on finfish, invertebrates, and EFH along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts to the Proposed Action over an unknown extent. Future offshore wind other than the proposed Project would likely have similar impacts as the Proposed Action, but across a much greater area. In context of reasonably foreseeable environmental trends, the impacts from ongoing and planned actions, including the Proposed Action, would likely be approximately equal to the sum of all of these impacts and would likely qualify as **negligible**.
Noise: O&M	Some finfish and invertebrates may be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Farm, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015), sound pressure levels would be expected to be at or below ambient levels at relatively short distances (approximately 164 feet [50 meters]) from WTG foundations. These low levels of elevated noise likely have little to no impact. Noise is also created by operations and maintenance of marine minerals extraction and commercial fisheries, each of which has small local impacts.	New or expanded marine minerals extraction and commercial fisheries may intermittently increase noise during their operations and maintenance over the next 30 years. Impacts would likely be small and local.	While continuous noise associated with operational WTGs may be audible to some finfish and invertebrates, this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would adversely affect finfish, invertebrates, and EFH (English et al. 2017).	While noise associated with operational WTGs may be audible to some finfish and invertebrates, this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would adversely affect finfish, invertebrates, and EFH (English et al. 2017).	There does not appear to be evidence that noise related to operations and maintenance of offshore wind energy facilities would negatively affect finfish, invertebrates, and EFH. The Proposed Action is not expected to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. Ongoing and future non-offshore wind activities may result in small local impacts on finfish and invertebrates, such as behavioral effects and/or displacement. Future offshore wind activities other than the proposed Project are not expected to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. No impacts of this sub-IPF on finfish, invertebrates, and EFH can be attributed to the Proposed Action, although ongoing and future activities may cause small local impacts.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 2 to 3 hours per foundation or 4 to 6 hours per day over a 6- to 10-year period, likely causing injury and/or mortality to finfish and invertebrates in a small radius around each pile and short-term stress and behavioral changes to individuals over a greater area. Based on estimates from the COP, if all 2,066 foundations in the expanded planned action scenario are summed, the risk of mortality is expected to occur over	Noise from pile driving would occur during installation of foundations for 2 to 3 hours per foundation or 4 to 6 hours per day. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area, particularly for species that use sound to coordinate spawning activity, such as cod and squid, possibly leading to additional impacts on reproduction. The estimated extent of behavioral effects is up to 5.7 miles (8 kilometers) around each pile, the radius for injury is estimated to extend up to 2,618 feet (798 meters), and the radius for mortality is estimated to	The Proposed Action is expected to cause short-term, **minor** impacts, with potential injury or mortality occurring across approximately 472 acres (1.9 km^2) of sea surface and behavioral changes occurring over a greater area. Ongoing and future non-offshore wind activities may have similar effects, perhaps with a smaller extent. Future offshore wind activities other than the proposed Project could cause potential injury or mortality across approximately 9,758 acres (39.5 km^2) and behavioral changes over a greater area. The total area affected by pile-driving noise would be the same regardless of whether the proposed Project COP is approved, approved with modifications, or disapproved, and is expected to include potential mortality across approximately 9,758 acres (39.5 km^2)

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	resulting from this noise, although thresholds of exposure are not known (Weilgart 2018, Hawkins and Popper 2017). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable for the duration of the noise. The extent depends on pile size, hammer energy, and local acoustic conditions.		approximately 9,758 acres (39.5 km^2). The impact on finfish and invertebrates would depend on the time of year it occurs; the impact could be greater if the noise occurs in spawning habitat during a spawning period. Noise from pile driving could affect the same populations or individuals multiple times in 1 year or in sequential years. The affected spaces would likely be recolonized in the short term.	extend 256 feet (78 meters) from each foundation. The area potentially subject to mortality totals approximately 472 acres (1.9 km^2). The affected areas would likely be recolonized in the short term, and the overall impact on finfish, invertebrates, and EFH would be **minor**.	and potential injury and behavioral changes over a greater area. In context of reasonably foreseeable environmental trends, the combined impact of pile-driving noise on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, would likely qualify as **minor** to **moderate**. If multiple piles are driven in any single day, areas with enough noise to generate behavioral changes may overlap. Over a longer time scale, noise from pile driving could affect the same populations or individuals multiple times in 1 year or in sequential years; it is currently unknown whether it would be less impactful to drive many piles sequentially or concurrently.
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area for this resource. These disturbances would be infrequent over the next 30 years, temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Noise from trenching/burial of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. This noise would be intermittent and would occur over a 6- to 10-year period.	Noise from trenching of export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. The jet-plowing method also creates noise. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. This noise would likely have **negligible** impacts on finfish, invertebrates, and EFH.	The Proposed Action would likely have **negligible** impacts on finfish, invertebrates, and EFH through trenching/cable burial noise. The impact on finfish, invertebrates, and EFH of this type of noise associated with ongoing activities, future non-offshore wind activities, and future offshore wind activities is discountable compared to the impacts of the physical disturbance and sediment suspension. The impact of this noise on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.
Noise: Vessels	See Section 3.11. While ongoing vessel noise may have some effect on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	See Section 3.11.	Pelagic species may temporarily avoid vessel noise, which would occur primarily during construction but also during operations and decommissioning, but in general, the noise would not be loud enough for long enough to induce injury (MMS 2009).	Pelagic and demersal species may temporarily avoid vessel noise caused by the proposed Project construction, operations, and decommissioning activities, but in general, the noise would not be loud enough for long enough to induce injury or death (MMS 2009). Analysis of vessel noise related to the Cape Wind Energy Project found that noise levels from construction vessels at 10 feet (3 meters) were loud enough to induce avoidance, but not physically harm finfish and/or invertebrates (MMS 2009). Overall, impacts of this sub-IPF would likely be temporary and **minor**.	Vessel noise from the Proposed Action is anticipated to cause **minor** temporary local impacts on finfish and invertebrates. Vessel noise from ongoing activities and future non-offshore wind activities is also expected to cause small, temporary, local impacts on finfish and invertebrates. Vessel noise from future offshore wind activities other than the proposed Project is also expected to cause small, temporary, local impacts on finfish and invertebrates. In context of reasonably foreseeable environmental trends, combined vessel noise impacts, equal to the sum of all of these impacts from ongoing and planned actions, including the Proposed Action, are anticipated to constitute **minor** impacts on finfish, invertebrates, and EFH in the geographic analysis area.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 30 years.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. In addition, the general trend along the coast from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase may require port modifications, leading to local impacts. Future channel deepening activities will likely be undertaken. Existing ports have already affected finfish, invertebrates,	At least two projects are contemplating port expansion/modification in Vineyard Haven and in Montauk. It is likely that other ports would be upgraded along the east coast, and some of this may be attributable to supporting the offshore wind industry. This would increase the total amount of disturbed habitat. Intermittent increases in port utilization due to other offshore wind energy projects would lead to increased vessel traffic over an assumed 6- to 10-year period. Existing ports have already affected finfish, invertebrates, and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species and/or life stages may lead	The Proposed Action is not anticipated to cause any port expansion or otherwise affect finfish, invertebrates, and EFH near ports.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect finfish, invertebrates, and EFH near ports. Ongoing and future non-offshore wind activities are expected to cause impacts through this sub-IPF on finfish, invertebrates, and EFH that are less than noticeable. Future offshore wind activities other than the proposed Project are expected to cause impacts through this sub-IPF on finfish, invertebrates, and EFH that are less than noticeable. No impacts of this sub-IPF on finfish, invertebrates, and EFH can be attributed to the Proposed Action, although ongoing and future activities are expected to result in less than noticeable impacts on finfish, invertebrates, and EFH.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.	to temporary to permanent impacts on finfish and invertebrates beyond the vicinity of the ports.		
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. Approximately 1,221 acres (4.9 km^2) of hard protection atop cables, 1,723 acres (7.0 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on finfish, invertebrates, and EFH. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until decommissioning of each facility is complete. Rock used for cable/scour protection may remain permanently. The intermittent impacts at any one location would likely be difficult to detect, short-term, and localized, although the risk of occurrence would persist as long as the structures remain.	The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. This would increase the risk of gear loss/damage by entanglement and the ensuing impacts on finfish, invertebrates, and EFH. Impacts at any one location would likely be localized, short-term, and **negligible**, although the risk of occurrence would persist as long as the structures remain.	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection, resulting in **negligible** impacts (injury) on finfish, invertebrates, and EFH through this sub-IPF. Ongoing entanglement and gear loss/damage at existing structures also periodically results in short-term, localized impacts. Future offshore wind activities other than the proposed Project would add approximately 1,221 acres (4.9 km^2) of hard protection atop cables, 1,723 acres (7.0 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations. Planned actions would result in up to 2,066 foundations, 1,221 acres (4.9 km^2) of hard protection atop cables, and 1,723 acres (7.0 km^2) of foundation scour protection, which would increase the risk of highly localized, periodic, short-term impacts (e.g., habitat disturbance, harm to individuals); the impact on finfish, invertebrates, and EFH through this sub-IPF from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.
Presence of structures: Hydrodynamic disturbance	Manmade structures, especially tall vertical structures such as foundations for towers of various purposes, continuously alter local water flow at a fine scale. Water flow typically returns to background levels within a relatively short distance from the structure. Therefore, impacts on finfish, invertebrates, and EFH are typically undetectable. Impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. New structures are periodically added.	Tall vertical structures can increase seabed scour and sediment suspension. Impacts would likely be highly localized and difficult to detect. Impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood.	See above for quantification. New structures would disturb hydrodynamics as long as the structures remain. Impacts would likely be highly localized and difficult to detect. Impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood.	See above for quantification. An alteration of local water currents caused by the presence of WTG and ESP foundations during the life of the Project could affect the dispersal of planktonic stages of organisms. A modeling study by Chen et al. (2016) found that WTGs in the region would not have a significant influence on southward larval transport, although foundation placement could either increase or decrease larval dispersion and speed, depending on initial location; however, the models never found the foundations to trap or block larvae from settling in habitat previously occupied. The same study found that on the scale of a single turbine in a current-only regime, mean flows return to within 5 percent of background levels by approximately 8.3 times the pile diameter away from the pile. In a combined current and wave regime, flow returned to background levels within 3.5 times the pile diameter. A separate study by Cazenave et al. (2016) found that downstream effects have a length scale of up to 50 times the pile diameter, or in the case of a 33.8-foot (10.3-meter) diameter pile, within 163 to 1,148 feet (20 to 350 meters) from the pile. A shelf-scale model used by Cazenave et al. (2016) found that disruptions	See above for quantification. The Proposed Action is expected to cause localized disturbances, resulting in **negligible** impact on finfish, invertebrates, and EFH. Existing structures and future non-offshore wind structures also cause localized disturbances, resulting in little to no impact on finfish, invertebrates, and EFH. Other offshore wind structures also would cause localized disturbances, resulting in little to no impact on finfish, invertebrates, and EFH. In context of reasonably foreseeable environmental trends, ongoing and planned actions, including Alternative A, would likely cause permanent, highly localized changes that have **negligible** impact on finfish, invertebrates, and EFH through this sub-IPF.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				could reach as far as approximately 0.5 nautical mile (1 kilometer) downstream of a monopile foundation. COP Appendix III-K discusses local hydrodynamic forces. The WTG and ESP foundations result in localized alterations of water currents, but the low current speeds at the seabed in the lease area and minimal seabed mobility lower scour concerns. Impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. Overall, BOEM anticipates the Proposed Action would cause a **negligible** impact on finish, invertebrates, and EFH through this sub-IPF.	
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and often permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	New cables, installed incrementally in the geographic analysis area for this resource over the next 20 to 30 years, would likely require hard protection atop portions of the route (see the new cable emplacement/ maintenance IPF). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are local and may be permanent.	See above for quantification. New structures would attract structure-oriented fishes as long as the structures remain. Abundance of certain fishes may increase (Claisse et al. 2014, Smith et al. 2016). There may also be an increase in recreational fishing, both personal and for-hire. These impacts are expected to be local and may be permanent.	See above for quantification. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local, **moderate**, and may be permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	See above for quantification. The Proposed Action is expected to cause local, **moderate** impacts on finfish and invertebrates through this sub-IPF. Existing structures and future non-offshore wind structures expected to cause localized impacts on finfish and invertebrates through this sub-IPF. Offshore wind structures other than those associated with the proposed Project are also expected to cause local impacts on finfish and invertebrates through this sub-IPF. In context of reasonably foreseeable environmental trends, ongoing and planned actions, including Alternative A, are anticipated to cause many local impacts that may be short-term to permanent, overall resulting in **moderate** impacts on finfish, invertebrates, and EFH through this sub-IPF; BOEM does not anticipate that this sub-IPF would result in considerable changes in fish distributions across the geographic analysis area.
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structure-oriented species thus benefit on a constant basis; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). New surfaces can also be colonized by invasive species (e.g., certain tunicate species) found in hard-bottom habitats on Georges Bank (Frady and Mecray 2004). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	New cable, installed incrementally in the analysis area over the next 20 to 30 years, would likely require hard protection atop portions of the route (see New cable emplacement/ maintenance). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented species would benefit (Claisse et al. 2014; Smith et al. 2016); however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres [242,811 km^2]), and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).	See above for quantification and timing of impacts. See cells to the left for the nature of impacts. The presence of many distinct areas of hard structure could also increase connectivity between geographically distant populations (Folpp et al. 2011; Mora et al. 2003), as the structures may provide patches of attractive habitat, helping structure-oriented species traverse the mostly sandy OCS.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. All of this would provide new hard-structure habitat and would replace existing soft-bottom and hard-bottom habitat. Structure-oriented species would benefit; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). These impacts would be local, permanent, and **moderate beneficial** and **moderate** adverse.	See above for quantification. The Proposed Action is expected to cause localized impacts that would be both beneficial and adverse, and of a **moderate** level. Existing structures and future non-offshore wind structures are also expected to cause localized impacts on finfish and invertebrates through this sub-IPF. Offshore wind structures other than those associated with the proposed Project are also expected to cause localized impacts on finfish and invertebrates through this sub-IPF. Collectively, this sub-IPF is anticipated to cause many permanent local impacts on finfish, invertebrates, and EFH that may be beneficial. In context of reasonably foreseeable environmental trends, the combined impacts of this sub-IPF on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, are anticipated to include both **moderate beneficial** and **moderate** adverse impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure is (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 30 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.	See above for quantification. New structures would be added intermittently over an assumed 6- to 10-year period and could tend to slow migration of some migratory species. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure would be (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.	See above for quantification. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently This could tend to slow migration. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure would be (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact is anticipated to be **negligible**.	See above for quantification. The Proposed Action is expected to present a **negligible** risk of slowing migrations of finfish and invertebrates. Existing structures and future non-offshore wind structures are also expected to present a risk of slowing migrations of finfish and invertebrates. Offshore wind structures other than those associated with the proposed Project are also expected to present a risk of slowing migrations of finfish and invertebrates. In context of reasonably foreseeable environmental trends, the presence of many distinct structures from ongoing and planned actions, including the Proposed Action, could increase the time required for migrations, resulting in a **minor** impact.
Presence of structures: Transmission cable infrastructure	See other sub-IPFs within the Presence of structures IPF. See Table 3.1-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.1-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.1-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.2-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.1-1 on Coastal Habitats.
Regulated fishing effort	Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates and can also influence bycatch of non-regulated species. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, municipalities, and/or NOAA, depending on jurisdiction, affect finfish, invertebrates, and EFH by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Offshore wind development could influence this IPF (Section 3.10) by influencing the management measures chosen to support fisheries management goals, which may alter the nature, distribution, and intensity of fishing-related impacts on finfish, invertebrates, and EFH.	The Proposed Action could influence this IPF (Section 3.10), possibly influencing the nature, distribution, and intensity of fishing-related impacts on finfish, invertebrates, and EFH.	Regulated fishing effort can affect finfish, invertebrates, and EFH by modifying the nature, distribution and intensity of fishing-related impacts (mortality, bottom disturbance). See Section 3.10 for the contribution of ongoing, future non-offshore wind, future offshore wind other than the Proposed Action, and the Proposed Action on regulated fishing effort. The intensity of impacts on finfish, invertebrates, and EFH under future fishing regulations is uncertain, but would likely be similar to or less than under the *status quo*, and would likely qualify as **moderate**.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through this IPF. For example, the Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year, and other municipalities, states, private entities, and the USACE undertake many more. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have little impact on finfish,	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Dredging used in the course of cable installation can cause localized short-term impacts (habitat alteration, change in complexity) through seabed profile alterations, as well as through sediment deposition (see below). Assuming the extent of such impacts is proportional to the length of cable installed (Table A-4), such impacts from future offshore wind activities would likely be on the order of 20 times more than under the Proposed Action alone. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance, although full recovery of faunal assemblage may require several years (Boyd et al. 2005). Therefore,	During construction, the Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, potentially leading to short-term impacts including habitat alteration and change in complexity. The impacts would likely be short-term, considering the natural mobility of sand waves in the OECC and WDA. The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Overall, the impacts on finfish, invertebrates, and EFH from this IPF would be **minor**.	The Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, likely leading to short-term, **minor** impacts on finfish, invertebrates, and EFH. Ongoing activities cause similar impacts but with a much larger extent. Future offshore wind activities other than the Proposed Action could also cause similar impacts over an area that would likely be on the order of 20 times more than under the Proposed Action. In context of reasonably foreseeable environmental trends, the impacts of this IPF on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, are likely to be widespread and **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.		seabed profile alterations, while locally intense, have little impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.		
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. There are also 15 active and 4 inactive/closed dredged material disposal sites within the geographic analysis area for this resource (BOEM 2019b). Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial. Impacts may vary based on season/time of year.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site. Cable emplacement / maintenance activities (including dredging) during construction or maintenance of future offshore wind projects could cause sediment suspension and deposition. Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs. Impacts may vary based on season and location. Assuming the areal extent of such impacts is proportional to the length of cable installed (Table A-4), such impacts would likely be on the order of 20 times more than under the Proposed Action. Increased sediment deposition may occur during multiple years. The area with a greater sediment deposition from simultaneous or sequential activities would be limited, as most of the affected areas would only be lightly sedimented (less than 0.04 inch [1 millimeter]) and would recover naturally in the short term.	The Proposed Action would cause localized and short-term turbidity increases and sediment deposition due to dredged material disposal and cable installation (including pre-lay dredging) during construction. Sediment deposition greater than 0.8 inch (20 millimeters) may extend up to 0.5 mile (0.9 kilometer) from each disposal site and cover up to 34.6 acres (0.1 km^2) (Volume III, Appendix III-A; Epsilon 2020b). Deposition of 0.04 to 0.2 inch (1 to 5 millimeters) of sediment could potentially occur on up to 2,594 acres (10.5 km^2). These impacts would likely be short-term to long-term. The Proposed Action would not dispose of dredged material in hard-bottom habitats. Installation of submarine cable would mostly be done by jet or mechanical plow. The resultant plume is predicted to stay in the lower portion of the water column (bottom 9.8 feet [2.7 meters]). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet (199.9 meters) from the route centerline but could extend up to 1.2 miles (1.6 kilometers). Modeling showed that sediment concentrations greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Epsilon 2018b). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018b). Attachment C of Epsilon 2018b depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, sediment deposition would have minimal impact outside eelgrass beds and hard-bottom habitats unless sediment is deposited on sensitive life stages. The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Because sedimented areas would recover naturally, impacts would be short-term. Sediment could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid, which deposit eggs within the WDA and adjacent areas are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial; however, the Proposed Action would avoid dredging and export cable installation during the longfin squid spawning season.	The Proposed Action would cause sediment deposition on up to 2,594 acres (10.5 km^2); however, sediment deposition would have no impact on finfish, invertebrates, and EFH outside of eelgrass beds and hard-bottom habitats, where the impacts would be **minor**. Ongoing activities cause similar impacts over an unknown extent. Future offshore wind activities (other than the Proposed Action) could also cause similar impacts over an area that is unknown but would likely be similar to the area affected by the Proposed Action, and could also cause impacts to sensitive life stages, such as demersal eggs. In context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on finfish, invertebrates, and EFH from ongoing and planned actions, including he Proposed Action, are likely to be **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				Overall, the impacts on finfish, invertebrates, and EFH from this IPF would be **minor**.	
Climate change: Ocean acidification	Continuous carbon dioxide emissions causing ocean acidification may contribute to reduced growth or the decline of invertebrates that have calcareous shells over the course of the next 30 years.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of finfish, invertebrates, and EFH. Because this sub-IPF is a global phenomenon, impacts on finfish, invertebrates, and EFH though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change. The intensity of impacts resulting from climate change are uncertain, but are anticipated to qualify as **minor** to **moderate**.
Climate change: Warming and sea level rise, altered habitat/ ecology	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the distributions of finfish, invertebrates, and EFH. This sub-IPF has been shown to affect the distribution of fish in the northeast United States, with several species shifting their centers of biomass either northward or to deeper waters (Hare et al. 2016).	See above.	See above.	See above.	See above.
Climate change: Warming and sea level rise, altered migration patterns	See above.	See above.	See above.	See above.	See above.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the frequencies of various diseases of finfish and invertebrates.	See above.	See above.	See above.	See above.

°C = degrees Celsius; AC = alternating current; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; DC = direct current; EFH = essential fish habitat; EMF = electromagnetic field; ESP = electrical service platform; FCC = Federal Communications Commission; G&G = Geological and Geophysical; IPF = impact-producing factor; km^2 = square kilometers; m^2 = square meters; met = meteorological; mg/L = milligrams per liter; NOAA = National Oceanic and Atmospheric Administration; O&M = operations and maintenance; OCS = outer continental shelf; OECC = Offshore Export Cable Corridor(s); USACE = United States Army Corps of Engineers; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.3-2: Radial Distance (meters) of Impact Hammering Sound Exceeding Thresholds for Fish

Group	Metric	Threshold (dB)	Distance (meters) to Threshold in Simulation P1 at Hammer Energy (kJ)					Distance (meters) to Threshold in Simulation P2 at Hammer Energy (kJ)				
			500	1,000	1,500	2,000	2,500	500	1,000	1,500	2,000	2,500
Mortality and Potential Mortality												
Invertebrate or fish without swim bladder	L_E	219	112					112				
	L_{pk}	213	23	28	28	30	38	9	9	14	18	29
Fish with swim bladder not involved in hearing	L_E	210	451					503				
	L_{pk}	207	41	53	54	57	78	14	14	23	32	56
Fish with swim bladder involved in hearing	L_E	207	752					798				
	L_{pk}	207	41	53	54	57	78	14	14	23	32	56
Eggs and larvae	L_E	210	451					503				
	L_{pk}	207	41	53	54	57	78	14	14	23	32	56
Recoverable Injury												
Small fish (< 2 g)	$L_{E, 12 hr}$	183	7,400					9,075				
	L_{pk}	206	46	59	61	64	87	15	15	26	35	63
Large fish (> 2 g)	$L_{E, 12 hr}$	187	5,714					6,894				
	L_{pk}	206	46	59	61	64	87	15	15	26	35	63
Behavioral Responses												
Small or large fish	L_{pk}	150	4,428	5,438	6,519	7,167	7,598	4,733	6,351	7,760	8,689	9,229
Temporary Threshold Shift												
All fish	L_E	186	6,121					7,444				

Source: COP Volume III, Appendix III-M, Tables A-34 and A-35, Epsilon 2020b; Popper et al. 2014; and NMFS 2018a

dB = decibel; kJ = kilojoule; L_E = cumulative sound exposure level; L_{pk} = peak sound pressure
Note: Impact from hammering of a 34-foot (10.3-meter) pile using an IHC S-4000 hammer with 6 dB attenuation. Although Vineyard Wind has proposed to achieve 12 dB attenuation, this Environmental Impact Statement assesses an attenuation level of only 6 dB as a maximum-case scenario.

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Table 3.4-1: Summary of Activities and the Associated Impact-Producing Factors for Marine Mammals

Baseline Conditions: Past and current impacts on marine mammals involve a variety of anthropogenic impacts, including collisions with vessels (ship strikes), whaling/hunting, entanglement with fishing gear, anthropogenic noise, pollution, disturbance of marine and coastal environments, climate change, effects on benthic habitat, waste discharge, and accidental fuel leaks or spills. Many marine mammal migrations cover long distances, so these factors impact animals over very broad geographical scales.

Regional, pre-existing threats to marine mammals in the Project area include fisheries interactions, vessel traffic, ocean noise, and climate change. Due to the changing water temperatures, ocean currents, and increased acidity, climate change has the potential to impact marine mammals prey distribution and abundance. Specific details regarding baseline conditions for specific species is provided in the FEIS Section 3.4 as well as the Project-specific Biological Assessment (BA; BOEM 2019c).

Entanglement in fishing gear in an ongoing threat to marine mammals, and fisheries interactions are likely to have demographic effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands individuals each year (Read et al. 2006). In the Atlantic, bycatch occurs in various gillnet and trawl fisheries in New England and the Mid-Atlantic Coast, with hotspots driven by marine mammal density and fishing intensity (Lewiston et al. 2014; NMFS 2018b). Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARWs, and may be a limiting factor in the species recovery (Knowlton et al. 2012). Entanglement may also be responsible for high mortality rates in other large whale species. Additionally, bottom trawling and benthic disruption have the potential to result in impacts on prey availability and distribution. However, impacts would be localized and no effects on individual fitness or population level effects would be expected.

Several IPFs related to climate change, including increased storm severity and frequency, increased erosion and sediment deposition, increased disease frequency, ocean acidification, as well as altered habitat, ecology, and migration patterns, have the potential to result in impacts on marine mammals. These long-term, high consequence impacts could include increased energetic costs associated with altered migration routes, reduction of suitable breeding and/or foraging habitat, and reduced individual fitness, particularly juveniles.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/hazmat	Appendix A Table A.8.2-1 provides a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008, Smith et al. 2017; Sullivan et al. 2019; Takeshida et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table 3.3-1).	Appendix A Table A.8.2-1 provides a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008, Smith et al. 2017; Sullivan et al. 2019; Takeshida et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table 3.3-1).	Similar to future non-offshore wind activities, accidental releases from offshore vessel usage, spills and releases associated with vessel traffic resulting from future offshore wind development will likely continue on a similar trend as described under Ongoing Activities. Impacts resulting from accidental releases may pose a long-term risk to marine mammals and could potentially lead to mortality and sublethal impacts on individuals present in the vicinity of the spill, but the potential for exposure would be limited give the isolated nature of these accidental releases and the patchy distribution of marine mammals in the geographic analysis area.	Given that vessel discharges would be limited to uncontaminated or treated liquids impact on water quality, and thus to marine mammals would not be expected to occur. As described in the FEIS, the mostly likely type of accidental release of hazardous materials would range from 90 to 440 gallons (Bejarano 2013) and result in localized, temporary, **negligible** impacts on marine mammals. Impacts on individual marine mammals, including decreased fitness, health effects, and mortality, may occur, if present in the vicinity of the spill, but accidental releases are expected to be rare and injury or mortality would not be expected to occur. Further, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on marine mammals resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012).	Appendix A Table A.8.2-1 provides a quantitative analysis of these risks. The Proposed Action could lead to an increased potential for a release that may result in localized and temporary **negligible** impacts, including individual mortality, decreased individual fitness, and health effects. However, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills, minimizing effects on marine mammals resulting from the release of debris, fuel, ha, or waste (BOEM 2012). The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and impacts on marine mammals, including mortality, health effects, and decreased fitness due to fuel/fluid/hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. In the context of reasonably foreseeable trends, combined fuel/fluids/hazmat impacts on marine mammals (mortality, decreased fitness, and health effects) from ongoing and planned actions, including the Proposed Action, are expected to be localized, temporary, and **negligible** due to the likely limited extent and duration of a release.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Worldwide	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. Trash and debris may continue to be accidentally released through fisheries use and other offshore and onshore activities. There may also be a long-term risk from exposure to plastics	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with future offshore wind development, it is likely that some debris could be	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with the proposed Project, it is likely that some debris could be lost overboard during construction, maintenance, and	The Proposed Action could lead to non-measurable **negligible** impacts on marine mammals, ranging from decreased fitness to mortality. However, BMPs proposed for waste management and mitigation for marine debris training and awareness of project personnel will be required, reducing the likelihood of occurrence to a very low risk. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities would likely result in much more accidental trash and debris releases relative to the Proposed Action, but the overall risk would still be considered low. In the context of

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	62 of 123 (50.4%) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data indicate potential debris induced mortality rates of 0 to 22%. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects to individuals to population level impacts (Browne et al. 2015).	and other debris in the ocean. Worldwide 62 of 123 (50.4%) of marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Mortality has been documented in cases of debris interacts, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014).	lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release of trash and debris, it would be an accidental, low probability event in the vicinity of project areas.	routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release of trash and debris, it would be an accidental, localized event in the vicinity of the Project area or the areas from ports to the Project area used by vessels, likely resulting in non-measurable **negligible** impacts, if any. Further, proposed BMPs for waste management and mitigation as well as marine debris awareness and elimination training for the Vineyard Wind 1 Project personnel would be required, reducing the likelihood of an accidental release.	reasonably foreseeable trends, combined trash and debris impacts on marine mammals from ongoing and planned actions, including the Proposed Action are expected to be **negligible,** localized, and short-term, with the Proposed Action having little to no influence on overall impacts through this sub-IPF.
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. In the marine mammal geographic analysis area, there are six existing power cables connecting Martha's Vineyard and Nantucket to the mainland. Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e., changes in magnetic field levels with distance) of 0.1% of the earth's magnetic field or about 0.05 μT (Kirschvink 1990) and are thus likely to be very sensitive to **minor** changes in magnetic fields (Walker et al. 2003). There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs. Depending on the magnitude and persistence of the confounding magnetic field, such an effect could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an effect on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). However, there are numerous transmission cables installed across the seafloor and no impacts on marine mammals have been demonstrated from this source of EMF.	During operation, future new cables would produce EMF. Submarine power cables in the marine mammal geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (Section 5.2.7 of MMS 2007.) EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Marine mammals have the potential to react to submarine cable EMF, however, no effects from the numerous submarine cables have been observed. Further, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result impacts on marine mammals would not be expected.	In the expanded planned action scenario, up to 5,947 miles (9,571 kilometers) of cable would be added in the marine mammal geographic analysis area, producing EMF in the immediate vicinity of each cable during operations. Marine mammals have the potential to react to submarine cable EMF, however, no effects from the numerous submarine cables have been observed. Further, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result, impacts such as changes in swimming direction and altered migration routes would not be expected.	EMF would emanate from any active cable during operations. The shielding and burial depths proposed would minimize EMF intensity and extent. Given the extremely small area where exposure to this IPF would occur and the proposed burial depth of the submarine cable, no measurable impacts such as changes in swimming direction and altered migration routes would be expected. These effects on marine mammals are more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). Because AC cables have been proposed for the Vineyard Wind 1 Project and the Project area represents an extremely small area within the coastal waters used by migrating marine mammals, BOEM expects non-measurable **negligible** impacts, if any, on migratory behavior of marine mammals.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on marine mammals through this IPF due to the localized nature of EMF along Project cables near the seafloor, wide ranges of marine mammals, and appropriate shielding and burial depth. Ongoing and future non-offshore wind activities may have similar effects. Future offshore wind activities would likely result in the same type of impacts, but with a greater spatial and extent than ongoing activities. In the context of reasonably foreseeable trends, combined EMF impacts on marine mammals from ongoing and planned actions, including the Proposed Action are expected to be **negligible** and long-term, but highly localized, with the Proposed Action having little to no influence on overall impacts through this IPF.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that since some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a	The FCC has two pending submarine telecommunication cable application in the North Atlantic. The impact on water quality from sediment suspension during cable emplacement is temporary and short-term. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary,	Future offshore wind development would require new cabling to bring generated electricity onshore, and would result in sea floor disturbance and elevated levels of suspended sediment. Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited and the resource would recover following the disturbance. Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term effects on individual marine mammals could occur in the immediate vicinity of installation activities. The total area of seafloor disturbance is estimated	Installation of submarine cable would mostly be done by jet or mechanical plow. The modeled resultant plume is predicted to stay in the lower portion of the water column (bottom 9.8 feet). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet from the route centerline but could extend up to 1.2 miles Modeling showed sediment concentrations greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term **negligible** impacts due to reduced foraging success and displacement, though no biologically significant impacts would be expected. Ongoing and future non-offshore wind activities may cause similar local, short-term impacts. Future offshore wind activities other than the Proposed Action would disturb up to 8,153 acres (33 km^2), though impacts would not be expected to be biologically significant. No measurable overall impacts on marine mammals would be attributed to the Proposed Action. Some non-measurable **negligible** overall impacts arising from future development, including future offshore wind, could occur if impacts occur in close

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	tolerance for increased turbidity. Similarly, McConnell et al. (1999) documented movements and foraging of grey seals in the North Sea. One tracked individual was blind in both eyes, but otherwise healthy. Despite being blind, observed movements were typical of the other study individuals, indicating that visual cues are not essential for grey seal foraging and movement (McConnell et al. 1999). If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be temporary and short-term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on marine mammal prey species (Table 3.3-1).	and any negative impacts would be temporary and short-term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some marine mammal prey species (Table 3.3-1).	to be up to 8,153 acres (33 km^2). These disturbances will be local and generally limited to the emplacement corridor. Further, suspended sediment concentrations in Nantucket Sound under natural conditions are 45 to 71 mg/L. Suspended sediment concentrations due to jet plow are within the range of natural variability for this area. The impact on water quality from sediment suspension during cable laying activities would be temporary and short-term. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative impacts would be temporary and short-term. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on marine mammal prey species (Table 3.3-1).	12 hours (Epsilon 2018b). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018b). Attachment C of Epsilon 2018b depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, the sediment no longer impacts water quality once it has settled. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, only occurring for less than 2 to 6 hours per day from April through October (Vineyard Wind 2018a), and any negative impacts would be short-term and temporary. Because the period of sediment suspension is very localized and short-term and the use of dredging is restricted, non-measurable **negligible** impacts, if any, would be expected.	temporal and spatial proximity, though these impacts would not be expected to be biologically significant (NOAA 2020e).
Noise: Aircraft	Aircraft routinely travel in the marine mammal geographic analysis area. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from marine mammals. If flights are at a sufficiently low altitude, marine mammals may respond with behavioral changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2,000 feet (610 meters) of a haul out area (Efroymson et al. 2000). However, this disturbance would be temporary, short-term, and result in minimal energy expenditure. These brief responses would be expected to dissipate once the aircraft has left the area.	Future low altitude aircraft activities such as survey activities and navy training operations could result short-term responses of marine mammals to aircraft noise. If flights are at a sufficiently low altitude, marine mammals may respond with a behavior changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area.	Future offshore wind development may require the use of helicopters to supplement crew transport during construction and operations. BOEM expects that helicopters transiting to the offshore WDAs would fly at altitudes above those that would cause behavioral responses from marine mammals except when flying low to inspect WTGs or take off and land on the SOV. If a listed whale is within 250 to 360 m of the helicopter, it is possible that behavior responses may occur, but they are expected to be temporary and short-term. NARW approach regulations (50 CFR 222.32) prohibit approaches within 500 yards. BOEM will require all aircraft operations to comply with current approach regulations for any sighted NARWs or unidentified large whale. While helicopter traffic may cause some temporary and short-term behavioral reactions in marine mammals while helicopters move to a safe distance, BOEM does not expect it to cause injury. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2000 feet (610 meters) of a haul out area. However, this disturbance would be temporary, short-term, and result in minimal energy expenditure.	Vineyard Wind may use helicopters to supplement crew transport and for Proposed Action support during both construction and operations (COP Volume I, Section 4.2.4; Epsilon 2020a) and may cause behavioral changes to NARWs, fin, and sei whales. Aircraft operation may ensonify areas, albeit for short periods at any one location while in transit. BOEM expects that helicopters transiting to the Project area would fly at altitudes above those that would cause behavioral responses from marine mammals except when flying low to inspect WTGs or to take off and land on the SOV. If a listed whale is within 250 to 360 meters of the helicopter, it is possible that behavior responses may occur, but they are expected to be temporary and short-term. NARW approach regulations (50 CFR 222.32) prohibit approaches within 500 yards. BOEM will require all aircraft operations to comply with current approach regulations for any sighted NARWs or unidentified large whale. While helicopter traffic may cause some short-term behavioral reactions in marine mammals while helicopters move to a safe distance, BOEM expects these impacts on be **negligible**. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2000 feet of a haul out area. However, this disturbance would be temporary, short-term, and result in minimal energy expenditure.	The proposed Action may result in non-measurable **negligible** behavioral responses, including short surface durations, abrupt dives, startle response, and percussive behaviors, through this sub-IPF. Aircraft operations associated with the Vineyard Wind 1 Project are not expected to occur in great numbers, but could possible occur during operations and mitigation-related surveys during construction. Impacts resulting from ongoing and future offshore development would be limited to rescue operations and would be expected to result in similar impacts on marine mammals. Future offshore wind activities would likely result in much more aircraft flights than the Proposed Action, but the overall impacts on individuals would still be considered low, and no biologically significant impacts would be expected. In the context of reasonably foreseeable trends, combined noise impacts on marine mammals from ongoing and planned actions, including the Proposed Action are expected to be localized and short-term, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have little to no influence on overall impacts through this sub-IPF.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in high intensity, high consequence impacts, including auditory injuries, stress, disturbance, and behavioral responses, if present within the ensonified area (NOAA 2018a). Survey protocols and underwater noise mitigation procedures are typically implemented to decrease the potential for any marine mammal to be within the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. The magnitude of effects, if any, is intrinsically related to many factors, including: acoustic signal characteristics, behavioral state (e.g., migrating), biological condition, distance from the source, duration and level of the sound exposure, as well as environmental and physical conditions that affect acoustic propagation (NOAA 2018a).	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise that penetrates deep into the seabed. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Site characterization surveys for offshore wind facilities would create intermittent, high-intensity impulsive noise around sites of investigation over a 2- to 10-year period. Sound sources used during G&G activities have the potential to produce stress, disturbance, and behavioral responses in marine mammals if they are present within the ensonified area (NOAA 2018a). Survey protocols and underwater noise mitigation procedures are implemented to decrease the potential for any marine mammal to be within the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. Seismic surveys can extend over a time scale of months, as does construction and installation of wind energy structures. However, identifying the locations and schedules of wind energy G&G and construction/installation activities as well as ongoing and future non-offshore wind G&G surveys could avoid overlapping noise impacts by scheduling activities to avoid overall impacts on marine mammals. BOEM concluded disturbance of marine mammals from underwater noise generated by site characterization and site assessment activities would likely result in temporary displacement and other behavioral or physiological consequences (BOEM 2019c) and impacts on marine mammals would not result in stock or population level effects.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. Higher frequency non-airgun HRG survey noise resulting from cable route surveys may be less intense than G&G noise from site investigation surveys in WDAs. Due to the higher frequency, only a few HRG sources (sub-bottom profilers, boomers, and sparkers) are detectable by marine mammals (BOEM 2018). Additionally, HRG surveys are lower energy and operate in smaller areas, and as such, the associated ensonified area is smaller, though impacts on marine mammals could occur at close ranges (within 656 feet [200 meters]). No injury to individuals would be expected as these sound sources have been shown to diminish rapidly with distance from the source (BOEM 2018). Impacts, if any, are anticipated to be temporary and **negligible**. Additionally, G&G surveys associated with the Proposed Action would be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts, including behavioral and physiological effects and injury along the cable routes during inspection. Compliance with the project-specific IHA would ensure that impacts remain **negligible**. Ongoing and future non-offshore wind impacts may result in similar types of impacts over an unknown extent. These activities would be conducted in compliance with project-specific IHAs, which require anticipated impacts to be **negligible**. Future offshore wind other than the Proposed Action would likely affect a much greater area than the Proposed Action would, but would also be subject to project-specific IHA requirements. As all potential activities associated with this sub-IPF would require compliance with a project-specific IHA, all impacts would be **negligible**. In context of reasonably foreseeable environmental trends, combined G&G noise impacts on marine mammals from ongoing and planned actions, including the Proposed Action, are expected to be **negligible**.
Noise: Turbines	Marine mammals would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from the WTG foundations.	This sub-IPF does not apply to future non-offshore wind development.	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1µPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of the project areas, if sound levels at the project areas are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 1µPa in the 70.8–224 Hz frequency band at the study area during 50% of the recording time between November 2011 and March 2015 (Kraus et al. 2016). Based on the results from Thomsen et al. (2015) and Kraus et al. (2016), the received SPLs generated by the Project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1µPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of the WDA, if sound levels at the WDA are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 1µPa in the 70.8 to 224 Hz frequency band at the study area during 50% of the recording time between November 2011 and March 2015 (Kraus et al. 2016). Based on the results from Thomsen et al. (2015) and Kraus et al. (2016), the received SPLs generated by the Project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from WTG bases,	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on marine mammals through this sub-IPF due to the assumption that operational turbine noise would be similar to ambient noise levels within 164 feet (50 meters) of the WTG foundations (Miller and Potty 2017). No impacts would occur from ongoing and future non-offshore wind development. Future offshore wind (other than the Proposed Action) would be expected to result in similar impacts, but across a greater spatial scale. In context of reasonably foreseeable environmental trends, combined turbine noise impacts on marine mammals from ongoing and planned actions, including the Proposed Action, are expected to be n**egligible** overall, if any, and would be expected due to operational turbine noise given the assumption that operational turbine noise would be similar to ambient levels within a short distance (164 feet [50 meters]) of WTG bases.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			WTG bases, no measurable impacts from this sub-IPF would be expected to occur.	non-measurable **negligible** impacts, if any, would be expected to occur.	
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high-intensity, low-exposure level, long-term, but localized intermittent risk to marine mammals. Impacts would be localized in nearshore waters. Pile driving activities may negatively affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Noise exposure associated with pile-driving activities can interfere with these functions, and have the potential to cause a range of responses, including insignificant behavioral changes, avoidance of the ensonified area, PTS, harassment, and ear injury, depending on the intensity and duration of the exposure. BOEM assumes that all ongoing and potential future activities will be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 4 to 6 hours at a time over a 6- to 12-year period. Under the expanded planned action scenario, up to 2,021 WTGs and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030. Pile-driving activities may affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Whales would be displaced from locations within the WDAs where pile driving is occurring for up to 6 hours per day during monopile installation and up to 14 hours per day during jacket installation. As pile driving would occur in open ocean areas where marine mammals may freely move away from the sound source, BOEM does not anticipate situations where individual marine mammals would not be able to escape from disturbing levels of noise. Thus, foraging disruptions would be temporary and are not expected to last longer than a day. This displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on whales. Although information is lacking, construction activities could temporarily displace animals into are areas that have a lower foraging quality, or result in higher risk of interactions with ships or fishing gear. Potential overall effects on marine mammals from multiple construction activities within the same calendar year could impact migration, feeding, calving, and individual fitness. Intermittent, long-term impacts may be high-intensity and high-exposure level. The magnitude of these impacts would be dependent upon the locations of concurrent construction operations as well as the number of hours per day, the number of days, and the time of year that pile driving would occur.	PTS and/or behavioral disturbance of some marine mammals is expected to result from pile-driving activities due to the large radial distance to these thresholds and the maximum-case scenario of a total of 102 days that pile driving may occur (NMFS 2020). As part of the proposed Project, Vineyard Wind has committed to voluntarily implement measures of utilizing soft start, PSOs, and PAM to reduce the potential impacts on marine mammals. Additionally, the peak season of NARW occurrence between January and April will be completed avoided and no pile driving will occur at that time. Additional details on the measures that Vineyard Wind has committed to voluntarily implement are described in detail in Pyć et al. 2018 and in the BA submitted to NOAA (BOEM 2019c), the Biological Opinion issued by NMFS (2020) and in Appendix D of this FEIS. Overall, the modeled predicted exposure rates would be expected to be low for mid- and high-frequency cetaceans and pinnipeds for both potential injury and behavior disruption based upon the number of individuals affected relative to the size of the overall populations, and would not be expected to result in effects on annual rates of recruitment or survival. For low-frequency cetaceans, under the maximum-case scenario, the modeled predicted risk of injury was a very low percentage of species abundance, without sound attenuation or aversion used in the modeled scenarios (Pyć 2018). Based on the analysis, BOEM considers impacts from pile driving to be **minor** for NARW (*Eubalaena glacialis*) due to avoidance of peak seasons of occurrence and **moderate** for all other marine mammals in the low-frequency hearing group.	Pile driving noise associated with the Proposed Action may result in **minor** to **moderate** temporary impacts, including behavioral and physiological effects and injury. Pile-driving activities would be conducted in accordance with a Project-specific IHA and Terms and Conditions provided in the Biological Opinion issued by NMFS (NMFS 2020), as well as additional measures Vineyard Wind has voluntarily committed to implement such as the use of soft-start procedures, PSOs, and PAM, Pile driving associated with ongoing, future non-offshore wind, and future offshore wind activities would also be conducted in accordance with a project-specific IHA that would avoid, minimize, and mitigate for impacts on marine mammals. In the context of reasonably foreseeable trends, pile-driving noise may result in greater impacts on marine mammals. Based upon the current anticipated construction schedule in Appendix A Table A-6, Revolution Wind and Sunrise Wind are expected to overlap with offshore construction of the Proposed Action. At this time, there is no available information regarding the potential mitigation measures that would be applied to pile-driving activities associated with these or other future offshore wind development. As such, overall impacts could be even greater. However, it is assumed that other future projects would be required to implement similar mitigation measures as the Proposed Action (seasonal restrictions, PSOs, PAM, and others) as a result of consultation with NMFS. As such, the overall impacts are expected to be **moderate**.
Noise: Cable laying/trenching	N/A	Cable laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects.	Noise associated with cable laying would be produced during route identification, trenching and backfilling, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Modeling using *in situ* data collected during cable-laying operations in Europe estimate that underwater noise would remain above 120 dB re 1μPa in an area of 98,842 acres (400 km²) around the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et	Noise associated with cable laying would be produced during route identification, trenching and backfilling, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Model results from DP thruster operation for the Deepwater Wind Project (NMFS 2015) indicated that the average ensonified area at the 120 dB RMS isopleth extends 2.95 miles (4.75 kilometers) from the source, with the total size of the area experiencing noise of 120 dB RMS or	The Proposed Action is expected to result in **minor** impacts on marine mammals through this sub-IPF, with marine mammals resuming normal behaviors once individuals are outside of the ensonified area. Future non-offshore wind development would be expected to result in similar localized and temporary impacts, but across a smaller geographic scale. Cable-laying impacts associated with future offshore wind development would also result in similar localized and temporary impacts, but on a larger temporal and spatial scale. In the context of reasonably foreseeable trends, little spatial and/or temporal overlap from the Proposed Action and planned actions would be expected. A portion of BSW's Export Cable 2 (as it approaches landfall) may be near enough to the OECC that the areas of potential effects from these cables may

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			al. 2018). Currently, there is no indication that noise associated with cable laying affects marine mammals, though models shows that the predicted impact ranges for cable laying are much smaller than those modeled for other activities, such as pile driving and seismic surveys (Nedwell and Howell 2004; Taormina et al. 2018). Though impact ranges are smaller, cable-laying activities may affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). If cable-laying activities are assumed to occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015). NMFS (2015) determined that any whales that may be foraging in the action area and are exposed to cable-laying noise are expected to continue foraging, but may forage less efficiently due to increased energy spent on vigilance behaviors. This change may have short-term metabolic consequences for individual animals and may result in a period of physiological stress; however, this stressed state and less efficient foraging is only expected to last as long as prey distribution overlaps with the area ensonified above 120 dB RMS, which is expected to be temporary.	greater ranging from 8.9 square miles (23 km^2) along the offshore export route to 9.7 square miles (25.1 km^2) along the inter-array cable route. If cable-laying activities are assumed to occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015). NMFS (2015) determined that any whales The radial distance to the threshold criteria for Level A Harassment or Level B Harassment for marine mammals in the Project area is not known. The distance to the threshold for Level A Harassment is expected to be relatively small and the distance to threshold for Level B Harassment is expected to be in the range of other vessel noise. BOEM therefore anticipates **minor** temporary impacts from cable laying noise, with marine mammal populations fully recovering following cable installation.	overlap (assuming a 10-mile [16.1-kilometer] radius around both cables) (see the BSW Project Overview map in Evans 2018). Other than this project all noise related to cable installation would be separated in space and time, and as such, **minor** overall impacts would be expected.
Noise: Vessels	See Section 3.11. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, scientific and academic research vessels, as well as other construction vessels. The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. Noise from vessels presents a long-term and widespread impact on marine mammals across in most oceanic regions. While vessel noise may have some effect on marine mammal behavior, it would be expected to limited to brief startle and temporary stress response. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 feet (50 meters) of the vessel by 26% (Jensen et al. 2009). Pilot	See Section 3.11. Any offshore projects that require the use of ocean vessels could potentially result in long term but infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no stock or population level effects would be expected.	Any offshore projects that require the use of ocean vessels could potentially result in moderate intensity, long term, infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes (Erbe et al. 2018; Erbe et al. 2019; Nowacek et al. 2007). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no population level effects would be expected.	No whales are expected to be exposed to PTS-causing SPLs from vessel noise. Although the radial distance in which harassment may occur is relatively large, vessels are transitory noise sources and are expected to have short-term and **minor** to **moderate** behavioral effects of an animal's behavior with no resulting injury to individuals (NMFS 2020). Communication between animals within and located on different sides of the Project area could be intermittently masked as vessels are transiting through the area on a daily basis. This masking is expected to last intermittently while animals remain in the area. Since the greatest amount of vessel traffic will occur concurrently with pile-driving activities, whales may choose to leave the area during construction. In either scenario, some short-term disturbance is expected to occur due to vessel operations. Restrictions on vessel approaches near whales will ensure that project vessels are never within 1,640 feet (500 meters) of NARWs and 328 feet (100 meters) from all other whales, minimizing the exposure to vessel noise. In non-	The Proposed Action is expected to result in **minor** to **moderate** impacts on marine mammals through this sub-IPF during the construction and decommissioning phases and **minor** during operations and maintenance. Ongoing and future non-offshore wind activities would be expected to result in similar impact on marine mammals but would have much larger impact given the volume of vessel traffic associated with these activities. Future offshore wind would also have similar impacts on marine mammals, but with a larger spatial extent than the Proposed Action. In the context of reasonably foreseeable trends, combined noise vessel impacts on marine mammals from ongoing and planned actions, including the Proposed Action would be expected to contribute **minor** to **moderate**, impacts on marine mammals, depending on project phase. However, the Proposed Action and other future offshore wind development would contribute only a small portion of the overall vessel traffic in the region (BOEM 2019b).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	whales in a quieter, deep-water habitat could experience a 50% reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther away from the sound source compared to higher frequencies, low frequency cetaceans are at a greater risk of experiencing Level B Harassment produced by vessel traffic.			peak vessel traffic periods, exposure to listed-whales within the Action Area is expected to be transient and temporary, as individual vessels pass by along their route, and whale behavior and use of the habitat would be expected to return to normal following the passing of a vessel (NMFS 2020). Thus, as no avoidance behaviors are anticipated and any effects to listed whale species from Project vessel noise outside of the construction period would be **negligible**.	
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in temporary, short-term impacts, if any, on marine mammals. Vessel noise may affect marine mammals, but response would be expect to be temporary and short-term (see Vessels: Noise sub-IPF above). The impacts on water quality from sediment suspension during port expansion activities is temporary, short-term, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. However, the existing suspended sediment concentrations in Nantucket Sound are already 45–71 mg/L, which is fairly high. Impacts from vessel traffic are likely to be masked by the natural variability. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strike could also occur (see the Traffic: Vessel collisions sub-IPF below).	At least two proposed offshore wind projects are contemplating port expansion/modification in Vineyard Haven and in Montauk. It is likely that other ports would be upgraded along the East Coast, and some of this may be attributable to supporting the offshore wind industry. This would increase the total amount of disturbed benthic habitat, potentially resulting in impacts on some marine mammal prey species. However, this will likely be a small percentage of available benthic habitat overall. Increases in port utilization due to other offshore wind energy projects will lead to an increased vessel traffic. This increase in vessel traffic will be at its peak during construction activities and will decrease during operations but will increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased turbidity in the coastal waters. Impacts associated with increased turbidity are not expected to be biologically significant (NOAA 2020e).	No port expansion is proposed for the Vineyard Wind 1 Project.	Given that no port expansion is proposed, the Vineyard Wind 1 Project would not be expected to contribute to this sub-IPF or overall impacts on marine mammals. Port expansion as a result of ongoing and non-offshore wind activities may have some temporary water quality impacts as well as long-term impacts relative to increased potential for vessel collisions as a result of increased vessel traffic. Port modifications, if contemplated, would most likely occur in areas that are already industrialized, have a high level of anthropogenic activity, and have been previously altered. Port expansion associated with future offshore wind development may result in similar impacts, but the incremental increase from offshore wind development would be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014). In the context of reasonably foreseeable trends, combined port expansion impacts on marine mammals from ongoing and planned actions, including the Proposed Action, are expected to be localized and short-term, with non-biologically significant **negligible** impacts. The Proposed Action t would have little to no influence on overall impacts through this sub-IPF.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Entanglement or ingestion of lost fishing gear	There are more than 130 artificial reefs in the Mid-Atlantic region. This sub-IPF may result in long-term, high intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs, long-term. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Moore and van der Hoop 2012), if present nearshore where these structures are located. There are very few, if any, areas within the OCS geographic analysis area for marine mammals that would serve to concentrate recreational fishing and increase the likelihood that marine mammals would encounter lost fishing gear.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. Approximately 2,944 acres (12 km^2) new scour protection and hard protection atop cables, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on marine mammals over an assumed 6- to 10-year period beginning in 2022 and that they would remain until decommissioning of each facility is complete (30 years). The presence of structures and the anticipated "reef effect" has the potential to lead to increased recreational fishing within the WDAs and result in moderate exposure, high intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death (Moore and van der Hoop 2012).	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Interactions with lost fishing gear around WTG foundations is a potential long-term risk and may be of high intensity, resulting in entanglement, ingestion, injury, and death (Moore and van der Hoop 2012). Exposure level would be considered low due to up to 102 foundations in the WDA, but would pose a long-term risk. As part of the Vineyard Wind 1 Project design, annual monitoring, reporting, and cleanup of fishing gear around the base of the WTGs would be conducted. This would remove any identified fishing gear and reduce the potential for impacts on marine mammals to **negligible** levels.	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Ongoing entanglement and gear loss/damage at existing structures also periodically results in localized, short-term, **negligible** impacts. Future offshore wind activities, other than the Proposed Action, would add approximately 2,944 acres (12 km^2) of scour/cable protection and the vertical surfaces of up to 2.066 new foundations. In the context of reasonably foreseeable trends, from ongoing and planned actions, including the Proposed Action, up to 2,066 foundations and 2,944 acres (12 km^2) of scour/cable protection associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would increase the risk of highly localized, periodic, short-term impacts which may be **minor**. Both the Vineyard Wind 1 Project and other future offshore wind development would be expected to contribute to overall impacts on marine mammals. The contribution of the maximum of 100 WTGs and 151 acres of scour/cable protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) of scour/ cable protection that are part of the full overall impact scenario in the region.
Presence of structures: Habitat conversion and prey aggregation	There are more than 130 artificial reefs in the Mid-Atlantic region. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near shore coastal waters have the potential to provide habitat for seals and small odontocetes as well as preferred prey species. This reef effect has the potential to result in long term, low-intensity benefits. Bridge foundations will continue to provide foraging opportunities for seals and small odontocetes with measurable benefits to some individuals. Hard-bottom (scour control and rock mattresses used to bury the offshore export cables) and vertical structures (i.e., WTG and ESP foundations) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; Causon and Gill 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for marine mammals compared to the surrounding soft-bottoms.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. Approximately 2,944 acres (12 km^2) of hard protection and the vertical surfaces of up to 2,066 new foundations can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; Causon and Gill 2018). Invertebrate and fish assemblages may develop around these reef-like elements within the first year or two after construction (English et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind facilities could potentially generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for some marine mammal species compared to the surrounding soft-bottoms.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Foundations could potentially serve as foraging opportunities for seals and small odontocetes. The Proposed Action could also potentially result in increased primary production and zooplankton abundance, which could serve as food for mysticete whales, compared to surrounding locations (Floeter et al. 2017). There could be measurable long-term **minor benefits** from the large number of foundations.	The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations may serve as foraging opportunities for seals, small odontocetes, and mysticetes, with anticipated long-term **minor benefits** from the large number of foundations. Ongoing and future non-offshore wind activities would be expected to result in similar impacts, but on a smaller geographic scale, and would be limited to nearshore habitat. Future offshore wind development would also be expected to result in similar impacts, but on a larger spatial scale, given the addition of 2,066 structures and 2,944 acres (12 km^2) of hard protection. In the context of reasonably foreseeable trends, impacts on marine mammals from ongoing and planned actions, including the Proposed Action, impacts would be expected to result in long-term **moderate beneficial** impacts due to the large number of structures. However, these beneficial impacts may be masked by impacts resulting from increased interactions with recreational fishing gear (see Presence of structures: Entanglement or ingestion of lost fishing gear sub-IPF above). The contribution of the maximum of 100 WTGs and 151 acres of scour protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) acres of scour/cable protection that are part of the full overall impact scenario in the region.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Avoidance/ displacement	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, and foundations, and hard protection. Under the full buildout scenario, an estimated 2,066 structures would be added to the OCS over a 6- to 10-year period beginning in 2022, and they would remain until decommissioning of each facility is complete (30 years). Although 2,066 structures are anticipated, spacing will be sufficient to allow unobstructed access within wind facilities and between wind facility projects. While avoidance of WDAs due to new structures is possible, it is unlikely due to the whales' size relative to turbine spacing. However, there is some uncertainty with the prediction of whales' behavior related to turbine presence due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior.	The Proposed Action is expected to add up to 102 foundations to the OCS. The proposed spacing between structures is expected to be sufficient to allow unimpeded access within the Project area, but there is a large amount uncertainty around large whale response to offshore wind facilities due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior. However, based on the best available information, none are anticipated. However, long-term, intermittent **minor** impacts on foraging, migratory movements, or other important behaviors may occur as a result of the Proposed Action. However, temporary displacement from the WDA during Project construction into areas with higher risk of interactions with fishing and commercial vessels (see increased Traffic: Vessel collisions below) may also occur.	The Proposed Action is expected to result in potentially long-term **minor** impacts on marine mammals through this sub-IPF. Although the proposed spacing between structures would be sufficient to allow unimpeded access within the Proposed Action area, but impacts on foraging, migratory movements, or other important behaviors may occur as a result of the Proposed Action. Ongoing and future non-offshore wind activities would not be expected to result in any impact on marine mammals. Future offshore wind activities would be expected to result in similar impacts, but over a greater spatial and temporal scale. However, the proposed spacing between structures would be sufficient to allow unimpeded access between offshore wind facilities and between individual WTGs. In the context of reasonably foreseeable trends, impacts on marine mammals from ongoing and planned actions, including the Proposed Action, related to avoidance/displacement as a result of 2,066 new, novel structures on the OCS would be expected to be **minor** to **moderate**. However**,** additional impacts may occur if individuals are displaced into areas with higher risk of vessel and/or fisheries interactions (see Traffic: Vessel collisions IPF below).
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although 2,066 structures are anticipated, spacing will be sufficient to allow unimpeded access within wind facilities and between wind facility projects. However, there is some uncertainty with the prediction of whales' behavior related to turbine presence due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior. However, based on the best available information, none are anticipated. However, it is important to acknowledge some uncertainty that the overall impacts several wind facilities along the Atlantic coast may have on large whales that migrate along these routes. Therefore, due to uncertainty and lack of information on the migratory impacts of wind facilities on large whales, some behavioral impacts may be expected under the expanded planned action scenario that are expected to be moderate in intensity, have moderate exposure level, and be long-term.	It is not likely that whales would avoid the Project Area during seasonal migrations due to the whales' size relative to turbine spacing. However, there is some uncertainty with the prediction of whales' behavior related to turbine presence due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior. However, based on the best available information, non-measurable, **negligible** impacts, if any, are anticipated.	Although an estimated 2,066 new foundations are anticipated, spacing would be sufficient to allow unimpeded access within the Proposed Action, and **negligible** impacts, if any, would be expected. No ongoing or non-offshore wind activities would contribute to this sub-IPF. Future offshore wind development would be expected to result in similar impacts, but over a greater geographic extent. In the context of reasonably foreseeable trends, combined impacts on marine mammals, from ongoing and planned actions, including the Proposed Action some behavioral impacts are expected due to uncertainty and lack of information on the migratory impacts of wind facilities (e.g., WTG presence or operational noise) on large whales. Potential **minor** impacts on foraging, migratory movements, or other important behaviors may occur as a result of ongoing and planned actions, including the Proposed Action. Additionally, temporary displacement from the WDA during Project construction into areas with higher risk of interactions with fishing and commercial vessels (see Traffic: Vessel collisions below) may also contribute to overall impacts on marine mammals.
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although construction activities would likely temporarily displace animals into areas that have a higher risk of interactions with ships or fishing gear, the operational phase may or may not result in any displacement. The 1-nautical-mile grid spacing and low operational noise levels allow unobstructed access to habitat in wind facility areas. However, due to uncertainty and lack of information on the impacts of wind facilities on large whales, some displacement may occur. The risk of displacement from WDAs would be widespread and present for long periods over the life of a lease. If marine mammals avoid the	If marine mammals avoid the Vineyard Wind 1 Project area, during construction, they may be at increased risk of interactions with potentially high vessel traffic including fisheries vessels and fisheries gear (Sections 3.10 and 3.11). Given that vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs, displacement due to the presence of structures may result in **moderate** impacts on marine mammals during construction. If individuals are displaced from the Project area permanently, these impacts would last for the life of the Project (30 years). Monitoring studies would be able to	The Proposed Action has the potential to result in **moderate** temporary impacts on marine mammals due to displacement from the Project area, potentially increasing the potential for fatal interactions with vessels and fisheries gear. No ongoing or non-offshore wind activities would contribute to this sub-IPF. Future offshore wind development would be expected to result in similar impacts, but over a greater geographic extent. In the context of reasonably foreseeable trends, combined impacts on marine mammals from ongoing and planned actions, including the Proposed Action are expected to be **moderate** temporary impacts associated with displacement from the lease areas but would not be expected to result in stock-level impacts because no critical habitat or feeding hotspots have been identified within the lease areas. However these **moderate** overall impacts have some potential to persist over the

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			Vineyard Wind 1 Project area, during construction, they may be at increased risk of interactions with potentially high vessel traffic including fisheries vessels and fisheries gear (Sections 3.10 and 3.11).	determine more precisely any changes in whale behavior and use of the Project during construction and operations.	course of a project's life if the displacement is permanent. The contribution of the maximum of 100 WTGs is relatively small when compared to the 2,066 that are part of the full overall impact scenario in the region.
Traffic: Vessel collisions	Current activities that are contributing to this sub-IPF include port traffic levels, fairways, traffic separation schemes, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs with as many as 75% of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the US and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel and when they are beneath the surface and not detectable by visual observers. Some conditions that make marine mammals less detectable include weather conditions with poor visibility (e.g., fog, rain, and wave height) or nighttime operations. Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Reported vessel collisions with whales show that serious injury rarely occurs at speeds below 10 knots (Laist et al. 2001). Data show that the probability of a vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of marine mammals makes stock or population-level effects to most species unlikely (Navy 2018). However, some species of baleen whales that spend considerable time at the surface, including NARW, are more susceptible to vessel strike. Vessel strike is a primary cause of NARW mortality and vessel strikes associated with future non-offshore wind activities have some potential for stock or population level effects to the species.	As described in BOEM 2019b, offshore wind will result in a small incremental increase in vessel traffic volume relative to ongoing and future non-offshore wind activities. At the peak of project construction from 2023 to 2024 up to 230 vessels associated with offshore wind development along the east coast may be operating in the marine mammal geographic analysis area. However, this vessel traffic increase would be expected to result in only a small incremental increase in overall vessel traffic within the geographic analysis area for marine mammals. This increased collision risk has the potential to result in injury or mortality to individuals, but would not be expected to have stock or population-level impacts on most marine mammal species given their patchy distribution within the geographic analysis area. However, some species of baleen whales that spend considerable time at the surface, including NARW, are more susceptible to vessel strike. Vessel strike is a primary cause of NARW mortality and vessel strikes associated with future non-offshore wind activities have some potential for stock or population-level effects to the species. Implementation of the following BMPs (Appendix A Table A-5) would reduce the potential for impacts relative to this sub-IPF during offshore wind development: Vessels related to project planning, construction, and operation must travel at reduced speeds when assemblages of cetaceans are observed and maintain a reasonable distance from whales, small cetaceans, and sea turtles as determined during site-specific consultations.	The increase in vessel traffic associated with the Vineyard Wind 1 Project would be greatest during construction, with an estimated maximum of 46 vessels operating in the WDA daily. Given the mobility of marine mammals, the use of PSO, PAM, and mitigation measures Vineyard Wind has voluntarily committed to implementing such as vessel speed restrictions, interactions with Vineyard Wind vessels and marine mammals would not be expected to occur. Although vessel strike is among the leading sources of human-caused whale mortalities, several factors reduce the probability of a Project-related strike. The Project will have a period of peak vessel activity lasting approximately 2 years (during construction), when an average of approximately seven vessel trips per day will occur. In the context of regional vessel traffic, Project-related vessel activity will add a relatively moderate (4.7, 1.6, and 4.0 percent annual increases in vessel traffic during construction, operations, and decommissioning, respectively; NMFS 2020), but temporary increase in vessel traffic to the region. The majority of Project vessel traffic will occur within the Project area (WDA, OECC), and vessel transit corridors to New Bedford and Vineyard Haven, where marine mammal densities are relatively low in comparison to the overall region.	While some increase in vessel traffic associated with the Vineyard Wind 1 Project would occur, the incremental increase would be very small relative to current vessel traffic in the area. Further, implementation of project-specific measures, including the use of PSO, PAM, and vessel speed restrictions, impacts on marine mammals through this sub-IPF would be expected to be **negligible**. Ongoing and future non-offshore wind activities have the potential to result in marine mammal mortality throughout the marine mammal geographic analysis area, though impacts would be concentrated in shipping lanes and other areas regularly traversed by vessels (Table 3.11-1 on navigation). Future offshore wind activities may also pose a significant risk to marine mammals through this sub-IPF, particularly if BOEM and NMFS measures are not included. In the context of reasonably foreseeable trends, combined impacts related to vessel collisions on marine mammals from ongoing and planned actions, including the Proposed Action, would be expected to be **minor to moderate**. Future offshore wind development would contribute only a small portion of the overall vessel traffic in the region (BOEM 2019b). The relative risk of vessel strikes from wind industry vessels is dependent upon the stage of development, location, time of year, number of vessels, and speed of vessels during each stage.
Climate change: Warming and sea level rise, storm severity/ frequency	Increased storm frequency could result in increased energetic costs for marine mammals and reduced fitness, particularly for juveniles, calves and pups.	No future activities were identified within the geographic analysis area for marine mammals other than ongoing activities.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to increased energetic costs and reduced fitness of individual marine mammals. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the overall contribution of these activities to climate change.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of some marine mammal prey species. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the overall contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammals as a result of changes in distribution, reduced breeding, and/or foraging habitat availability, and disruptions in migration.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to changes in the distribution and availability of breeding and/or foraging habitat as well as disruption in migration. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the overall contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammal habitat use and migratory patterns. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities related to climate change (Record et al. 2019; MacLeod 2009; Nunny and Simmonds 2019.)	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to changes in habitat use and seasonal migration timing and patters. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the overall contribution of these activities to climate change.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of marine mammals, such as Phocine distemper. Climate change is clearly influencing infectious disease dynamics in the marine environment; however, no studies have shown a definitive causal relationship between any components of climate change and increases in infectious disease among marine mammals. This is due in large part to a lack of sufficient data and to the likely indirect nature of climate change's impact on these diseases. Climate change could potentially affect the incidence or prevalence of infection, the frequency or magnitude of epizootics, and/or the severity or presence of clinical disease in infected individuals. There are a number of potential proposed mechanisms by which this might occur (see summary in Burge et al. 2014 Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to the incidence, prevalence, and severity of diseases in marine mammal populations. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the overall contribution of these activities to climate change.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Increased storm frequency could result in increased energetic costs for marine mammals, reduced fitness, particularly for juveniles, calves, and pups. Erosion could impact seal haul outs reducing their habitat availability, especially as things like sea walls are added, blocking seals access to shore.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. Appendix A Section A.8.1 discusses the contribution of these activities to climate change.	This sub-IPF may contribute to impacts on terrestrial pinniped haul out areas, potentially altering or eliminating currently suitable habitat. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. Appendix A Section A.8.1 discusses the overall contribution of these activities to climate change.

μPa = micropascal; μT = microtesla; AC = alternating current; BA = Biological Assessment; BOEM = Bureau of Ocean Energy Management; BMP = best management practice; BSW = Bay State Wind; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; dB = decibel; dB RMS = decibel root mean square; DP = dynamic positioning; EIS = Environmental Impact Statement; EMF = electromagnetic field; FCC = Federal Communications Commission; FEIS = Final Environmental Impact Statement; G&G = Geological and Geophysical; hazmat = hazardous material; HRG = High Resolution Geophysical; Hz = hertz; IHA = Incidental Harassment Authorization; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meters; met – meteorological; mg/L = milligrams per liter; MW = megawatt; NARW = North Atlantic right whale; NMFS = National Marine Fisheries Service; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; PAM = passive acoustic monitoring; PSO = protected species observer; PTS = permanent threshold shift; SOV = service operations vessel; TTS = temporary threshold shift; USCG = U.S. Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.4-2: Marine Mammals Regularly or Commonly Occurring in the Project Area

Common Name	Scientific Name	ESA (MMPA) Status [a]	Relative Occurrence in the Project Area [b]	Seasonal Occurrence
Order Cetacea, Suborder Mysticeti (baleen whales), Family Balaenopteridae				
NARW [c]	*Eubalaena glacialis*	E(D)	Common	Year-round, peak winter-spring
Fin whale [c]	*Balaenoptera physalus*	E(D)	Common	Year-round, peak spring-summer
Sei whale [c]	*Balaenoptera borealis*	E(D)	Regular	Spring-summer
Minke whale [c]	*Balaenoptera acutorostrata acutorostrata*	(N)	Common	Year-round, peak spring-fall
Humpback whale (West Indies distinct population segment) [c]	*Megaptera novaeangliae*	(N)	Common	Year-round, peak spring-summer
Suborder Odontoceti (toothed whales and dolphins)				
Family Physeteridae				
Sperm whale [c]	*Physeter macrocephalus*	E(D)	Common	Year-round, peak summer-fall
Family Delphinidae				
Risso's dolphin	*Grampus griseus*	(N)	Common Offshore	Year-round, peak spring-fall
Long-finned pilot whale	*Globicephala melas*	(S)	Common	Year-round, peak spring-summer
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	(N)	Common	Year-round, peak spring-fall
Short-beaked common dolphin	*Delphinus delphis*	(N)	Common	Year-round, peak summer-fall
Bottlenose dolphin (Western North Atlantic offshore stock)	*Tursiops truncatus*	(D)	Common	Year-round
Family Phocoenidae				
Harbor porpoise	*Phocoena phocoena*	(N)	Common	Year-round, peak fall-spring
Order Carnivora, Suborder Caniformia, Family Phocidae (earless seals)				
Harbor seal	*Phoca vitulina concolor*	(N)	Common	Year-round [e]
Gray seal	*Halichoerus grypus*	(N)	Common	Year-round [e]
Harp seal	*Pagophilus groenlandicus*	(N)	Common	Year-round [e]

[a] D = Depleted; E = Endangered; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; N = Not Strategic; NARW = North Atlantic right whale; S = Strategic
[b] Based on occurrence within Rhode Island Ocean Special Area Management Plan Study Area (which includes the WDA and surrounding Project area): Common = greater than 100 records; Regular = 10–100 records; Rare = less than 10 records (Kenney and Vigness-Raposa 2010).
[c] NEFSC and SEFSC 2011a
[d] Based on Kraus et al. 2016; BOEM 2014a. Region defined as the waters south of Martha's Vineyard and Nantucket and Nantucket Shoals.
[e] Based on Kenney and Vigness-Raposa 2010

Table 3.4-3: Summary of Species in the Rhode Island and Massachusetts Lease Areas between October 2011 and June 2015

Common Name	Scientific Name	Number of Sightings/Densities	Season of Sightings	Acoustic Presence Detected
*NARW	*Eubalaena glacialis*	60 (annual average of 35 individuals)	Winter & Spring	Year-round
*Fin	*Balaenoptera physalus*	87	Summer	Year-round
*Sei	*Balaenoptera borealis*	25	Summer	NA
*Sperm	*Physeter macrocephalus*	4	Summer & Fall	NA
Humpback	*Megaptera novaeangliae*	82	Spring & Summer	Winter December through February
Minke	*Balaenoptera acutorostrata acutorostrata*	86	Spring & Summer	October and November, with a few in Winter
Short-beaked common dolphin	*Delphinus delphis*	high densities	Summer & Fall	
Bottlenose dolphin	*Tursiops truncatus*	moderate densities high densities	Spring & Summer Fall	
Harbor porpoise [a]	*Harbor porpoise*	moderate to high densities	Spring, Fall, & Winter	
Atlantic white-sided dolphin [a]	*Lagenorhynchus acutus*	historically in relatively high numbers moderate numbers	Spring Fall	

Sources: Kraus et al. 2016; Stone et al. 2017

* = ESA-listed species; NA = not available

[a] Historically from 1976 through 2018 according to Right Whale Consortium 2018 and as shown on Figures E.5-3 and E.5-4

Table 3.4-4: Summary of Current Status for Cetaceans and Carnivora

Common Name	Scientific Name	Stock [a]	Population Estimate	Population Trend [a]	Average Annual Minimum Human-Caused Mortality Total = Fishery Entanglement (Vessel Strike) [b]	Stranding Mortalities in Massachusetts (or Specified Area) [b]	Reference
*NARW	*Eubalaena glacialis*	WNA	450	Decline from 2011-2015	5.36 = 4.55(0.81) from 2011-2015 19 mortalities during 2017–June 2018 [c]	9	Hayes et al. 2018
*Fin whale	*Balaenoptera physalus*	WNA	1,618	NA	2.65 = 1.05(1.6)	3	Hayes et al. 2018
*Sei whale	*Balaenoptera borealis*	Nova Scotia	357	NA	0.8	0	Hayes et al. 2017
*Sperm whale	*Physeter macrocephalus*	North Atlantic	2,288	NA	0.8 = 0.2(0.6)	3	Waring et al. 2015
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	823	Increasing through 2015 [d]	8.25 = 6.45(1.8)	19 [c]	Hayes et al. 2018

Common Name	Scientific Name	Stock [a]	Population Estimate	Population Trend [a]	Average Annual Minimum Human-Caused Mortality Total = Fishery Entanglement (Vessel Strike) [b]	Stranding Mortalities in Massachusetts (or Specified Area) [b]	Reference
Minke whale	*Balaenoptera acutorostrata acutorostrata*	Canadian East Coast	2,591	NA	9.15 = 7.75(1.4)	11 [c]	Hayes et al. 2018
Risso's dolphin	*Grampus griseus*	WNA	12,619	NA	43	6	Hayes et al. 2018
Long-finned pilot whale	*Globicephala melas*	WNA	5,636	NA	38	13	Hayes et al. 2017
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	WNA	48,819 [e]	NA	56	62	Hayes et al. 2018
Short-beaked common dolphin	*Delphinus delphis*	WNA	70,184	NA	409	441	Hayes et al. 2017
Bottlenose dolphin [f]	*Tursiops truncatus*	WNA offshore	77,532	NA	39.4	~1,650 between New York and Florida	Hayes et al. 2017
Harbor Porpoise	*Phocoena phocoena*	Gulf of Maine/ Bay of Fundy	79,883	NA	307	207	Hayes et al. 2018
Gray seal	*Halichoerus grypus*	WNA	27,131	NA	5,207	348	Hayes et al. 2018
Hooded seal	*Cystophora cristata*	WNA	512,000	NA	368	421	Hayes et al. 2018

*ESA-listed species
[a] NA = not available; NARW = North Atlantic right whale; WNA = Western North Atlantic
[b] Average annual mortalities and strandings based on the following date ranges for each reference: Hayes et al. 2018 = 2011 to 2015; Hayes et al. 2017 = 2010 to 2014; Waring et al. 2015 = 2009 to 2013; Waring et al. 2014 = 2008 to 2012; Waring et al. 2007 = 2001 to 2005
[c] Ongoing Unusual Mortality Event (UME)
[d] However, since January 2016 strandings have increased in the WNA at a higher rate than normal
[e] Gulf of Maine population, not the entire WNA stock
[f] There was a UME for common bottlenose dolphin stocks in the WNA during 2013–2015 (Hayes et al. 2017).

Table 3.4-5: Marine Mammal Hearing Groups

Hearing Group	Generalized Hearing Range [a]
Low-frequency cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger*, and *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

Source: NMFS 2018a

Hz = hertz

[a] Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation). The pinniped functional hearing group was modified from Southall et al. (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä et al. 2006; Kastelein et al. 2009; Reichmuth et al. 2013).

Table 3.4-6: Maximum Number of Potential Concurrent Impact Hammer Pile-Driving Days on Neighboring Projects under the Planned Action Scenario (including the Proposed Project)

Construction Year	1 Foundation per Day (2 Foundations per Day)					
	Maine	Massachusetts/ Rhode Island	New York/ New Jersey	Delaware/ Maryland	Virginia	Annual Total
2021	0	0	0	0	0	0
2022	0	0	0	11 (6)	0	11 (6)
2023	0	102 (51) [a]	0	0	0	102 (51)
2024	0	103 (52)	0	0	0	103 (52)
2025	0	0	0	0	0	0
2026	0	139 (70)	0	0	0	139 (70)
2027	0	0	0	0	0	0
2028	0	0	0	0	0	0
2029	0	0	0	0	0	0
2030+	0	0	0	0	0	0

[a] The number of days in the year 2023 includes the maximum number of days three concurrent projects, including Vineyard Wind 1, could be pile driving (90 days maximum), and the number of days only two concurrent projects could be pile driving at the same time (an additional 12 days). Three concurrent projects pile driving (e.g., Vineyard Wind 1, Revolution Wind, and Sunrise Wind) at the same time has the largest overall area impacted each day and represent the maximum case scenario.

Table 3.5-1: Summary of Activities and the Associated Impact-Producing Factors for Sea Turtles

Baseline Conditions: Sea turtles are wide-ranging and long-lived, making population estimates difficult (NMFS and USFWS 2013; NMFS and USFWS 2015; TEWG 2007).

Leatherback (*Dermochelys coriacea*): The population estimate (total number of adults) in the Atlantic is 34,000 to 94,000 (NMFS and USFWS 2013; TEWG 2007). Aside from the western Caribbean, nesting trends at all other Atlantic nesting sites are generally stable or increasing (NMFS and USFWS 2013; TEWG 2007).

Loggerhead (*Caretta caretta*): Regional abundance estimate in the Northwest Atlantic Continental Shelf in 2010 was approximately 588,000 individuals adults and juveniles of sufficient size to be identified during aerial surveys (interquartile range of 382,000 to 817,000 (NEFSC and SEFSC 2011b). While some progress has been made since publication of the 2008 Loggerhead Sea Turtle Recovery Plan, the recovery units have not met most of the critical benchmark recovery criterion (NMFS and USFWS 2019).

Kemp's ridley (*Lepidochelys kempii*): The population was severely decimated in 1985, due to intensive egg collection and fishery bycatch, with only 702 nests counted during the entire year (Bevan et al. 2016; NMFS and USFWS 2015). Recent estimates of the total population of age 2 years and older is 248,307; however, recent models indicate a persistent reduction in survival and/or recruitment to the nesting population suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015).

North Atlantic DPS of green sea turtle (*Chelonia mydas*): The primary nesting beaches are Costa Rica, Mexico, United States (Florida), and Cuba. The most recent status review for the DPS estimates the number of female nesting turtles to be approximately 167,424 individuals (NMFS 2015). According to NMFS and USFWS (2014), nesting trends are generally increasing for this DPS.

Regional, pre-existing threats to sea turtles include entanglement in fisheries gear, fisheries bycatch, and vessel strike. In addition, loggerhead, Kemp's ridley, and green sea turtles are susceptible to cold stunning. Commercial fisheries occurring in the southeastern New England region include bottom trawl, midwater trawl, dredge, gillnet, longline, and pots and traps (COP Volume III, Section 7.8; Epsilon 2020b). Commercial vessel traffic in the region is variable depending on location and vessel type. The commercial vessel types and relative density in the Project region during 2013 include cargo (low), passenger (high), tug-tow (high), and tanker (low; COP Volume III, Section 7.8; Epsilon 2020b).

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
Accidental releases: Fuel/fluids/hazmat	See Appendix A Table A.8.2-1 for a quantitative analysis of these risks. Ongoing releases are frequent and chronic. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Bembenek-Bailey et al. 2019; Camacho et al. 2013; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table 3.3-1).	See Appendix A Table A.8.2-1 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka 2010; Wallace et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Bembenek-Bailey et al. 2019; Camacho et al. 2013; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table 3.3-1).	Similar to future non-offshore wind activities, accidental releases from offshore vessel usage, spills, and releases associated with vessel traffic resulting from future offshore wind development will likely continue on a similar trend as described under Ongoing Activities. Impacts resulting from accidental releases may pose a long-term risk to sea turtles and could potentially lead to mortality and sublethal impacts on individuals present in the vicinity of the spill, but the potential for exposure would be limited given the isolated nature of these accidental releases and the patchy distribution of sea turtles in the geographic analysis area.	Given that vessel discharges would be limited to uncontaminated or treated liquids, impacts on water quality, and thus to sea turtles, would not be expected to occur. As described in the FEIS, the mostly likely type of accidental release of hazmat would range from 90 to 440 gallons (Bejarano 2013) and result in localized, temporary **negligible** impacts on sea turtles. Impacts on individual sea turtles, including decreased fitness, health effects, and mortality, may occur if present in the vicinity of the spill, but accidental releases are expected to be rare, and injury or mortality would not be expected to occur. Further, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on sea turtles resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012).	See Appendix A Table A.8.2-1 on water quality for a quantitative analysis of these risks. The Proposed Action could lead to an increased potential for a release that may result in localized and temporary **negligible** impacts, including individual mortality, decreased individual fitness, and health effects. However, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills minimizing effects on sea turtles resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012). The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and impacts on sea turtles, including mortality, health effects, and decreased fitness due to fuel/fluid/hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. In the context of reasonably foreseeable trends, the combined impacts on sea turtles from ongoing and planned actions, including the Proposed Action, are expected to be localized, temporary, and **negligible** due to the likely limited extent and duration of a release.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, cables, lines, and pipeline laying, as well as debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct ingestion of plastic fragments is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuylar et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam™, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Thomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Potential ingestion of marine debris varies among species and life history stages due to differing feeding strategies (Nelms et al. 2016). Ingestion of plastics and other marine debris can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal effects may include dietary dilution, chemical contamination, depressed immune system function, poor body condition, as well as reduced growth rates, fecundity, and reproductive success. However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Ingestion of plastic fragments and other marine debris is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Gregory 2009; Hoarau et al. 2014; Nelms et al. 2016; Schuylar et al. 2014; Thomás et al. 2002). Ingestion can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).	Trash and debris may be released by vessels associated with offshore wind development during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases will be employed by vessels and port operations associated with future offshore wind development, it is likely that some debris could be lost overboard during construction, maintenance, and decommissioning activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, low-probability event in the vicinity of WDAs.	Trash and debris may be released by Project vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with the Project, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, localized event in the vicinity of the WDA, likely resulting in non-measurable **negligible** impacts, if any. Further, proposed BMPs for waste management and mitigation as well as marine debris awareness and elimination training for Vineyard Wind 1 Project personnel would be required, reducing the likelihood of an accidental release.	The Proposed Action could lead to non-measurable **negligible** impacts on sea turtles, ranging from decreased fitness to mortality. However, proposed BMPs for waste management and mitigation, and marine debris training and awareness for Project personnel would be required, which would reduce the likelihood of occurrence to a very low risk. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but would involve a greater spatial and temporal extent. Future offshore wind activities would likely result in much more accidental trash and debris releases relative to the Proposed Action, but the overall risk would still be considered low. In the context of reasonably foreseeable trends, the combined impacts on sea turtles through this IPF from ongoing and planned actions, including the Proposed Action, are expected to be **negligible**, with the Proposed Action having little to no influence on overall impacts through this sub-IPF.
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. In the geographic analysis area, there are six existing power cables connecting Martha's Vineyard and Nantucket to the mainland. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4,000 µT for loggerhead turtles, and 29.3 to 200 µT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). Juvenile or adult sea turtles foraging on benthic organisms may be able to detect magnetic fields while they are foraging on the bottom near the cables and potentially up to 82 feet (25 meters) in the water column above the cable. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). However, any potential impacts from AC cables on turtle navigation or orientation would likely be undetectable under natural	During operations, future new cables would produce EMF. Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels (Section 5.2.7 of the MMS [2007] Final Programmatic EIS). EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Further, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.	In the expanded planned action scenario, up to 5,947 miles (9,571 km^2) of cable would be added in the geographic analysis area for sea turtles, producing EMF in the immediate vicinity of each cable during operations. Sea turtles have the potential to react to submarine cable EMF; however, impacts, if any, would likely be difficult to detect, if they occur at all. Further, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.	EMF would emanate from any active cable during operations. The proposed shielding and burial depths would minimize EMF intensity and extent. Given the extremely small area where exposure to this IPF would occur and the proposed burial depth of the submarine cable, no measurable impacts such as changes in swimming direction and altered migration routes would be expected. These effects on sea turtles are more likely to occur with DC cables than with AC cables (Normandeau et al. 2011). Because AC cables have been proposed for the Vineyard Wind 1 Project and the WDA represents an extremely small area within the coastal waters used by migrating sea turtles, BOEM expects non-measurable **negligible** impacts, if any, on migratory behavior of sea turtles.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this IPF due to the localized nature of EMF along Project cables near the seafloor, the wide ranges of sea turtles, and the appropriate shielding and burial depth. Ongoing and future non-offshore wind activities may have similar effects. Future offshore wind activities would likely result in the same type of impacts, but with a greater spatial extent than ongoing activities. In the context of reasonably foreseeable trends, combined impacts on sea turtles through this IPF from ongoing and planned actions, including the Proposed Action, are expected to be long-term, highly localized, and **negligible**, with the Proposed Action having little to no influence on overall impacts through this IPF.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
	conditions, and thus would be insignificant (Normandeau et al. 2011).				
Light: Vessels	Ocean vessels such as ongoing commercial vessel traffic, recreational and fishing activity, scientific and academic research traffic have an array of lights including navigational, deck lights, and interior lights. Such lights have some limited potential to attract sea turtles, although the impacts, if any, are expected to be localized and temporary.	Construction, operations, and decommissioning vessels associated with non-offshore wind activities produce temporary and localized light sources that could result in the attraction or avoidance behavior of sea turtles. These short-term impacts are expected to be of low intensity and occur infrequently.	Similar to non-offshore wind activities, vessel traffic associated with project construction, operations, and decommissioning would be expected to result in short-term, intermittent impacts, but would not be expected to measurably contribute to this sub-IPF.	Like future offshore wind development, vessel traffic associated with the Project may result in some behavioral responses. These impacts, if any, would be expected to be **negligible**, as any responses to passing vessels would be short-term, temporary, and dissipate once the vessel or turtle has left the area.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this sub-IPF due to the localized, short-term, and temporary nature of the impacts. Future activities, including both non-offshore wind and offshore wind activities would be expected to result in similar impacts. In the context of reasonably foreseeable trends, combined impacts on sea turtles through this IPF from ongoing and planned actions, including the Proposed Action, are expected to be short-term, localized, and **negligible**; with the Proposed Action having little to no influence on overall impacts through this sub-IPF.
Light: Structures	Artificial lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles. Artificial lighting on the OCS does not appear to have the same potential for effects. Decades of oil and gas platform operation in the Gulf of Mexico, that can have considerably more lighting than offshore WTGs, has not resulted in any known impacts on sea turtles (BOEM 2019a).	Non-offshore wind activities would not be expected to appreciably contribute to this sub-IPF. As such, no impact on sea turtles would be expected.	BOEM assumes that offshore wind projects will be sited offshore, away from nesting beaches and would not disorient nesting females or hatchling sea turtles. Up to 2,021 turbines and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030, on the OCS where few lighted structures currently exist. These would have minimal yellow flashing navigational lighting and red flashing FAA hazard lighting in accordance with BOEM's (2019c) lighting and marking guidelines which would not present a continuous light source and would not be expected to result in disorientation of adults or juvenile sea turtles (Orr et al. 2013). Although some turtles could possibly be temporarily attracted to WTGs, the potential effects on sea turtles from lighting would not be expected to result in individual fitness or population-level effects.	The Proposed Action's incremental contribution would be lighting of up to 100 WTGs and two ESPs, all of which would be lit with navigational and FAA hazard lighting. Per BOEM guidance (2019c) and outlined in the COP Section 3.1.1 (Volume I; Epsilon 2020a), each WTG would be lit with two FAA "L-864" aviation red flashing obstruction lights on top of the nacelle, adding up to 200 new red flashing lights. Additionally, marine navigation lighting would consist of multiple flashing yellow lights on each WTG and on the corners of each ESP. Orr et al. (2013) indicated that lights on WTGs that flash, i.e., do not present a continuous light source, do not appear to cause disorientation in adult and juvenile sea turtles. Based on the best available information, the potential attraction of sea turtles to WTG lighting is anticipated to result in **negligible** impacts, if any, on individual sea turtles. Further, the Vineyard Wind 1 Project would use the ADLS, which would reduce the use of FAA lighting to approximately 10% of the time.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this sub-IPF due to the distance from nesting beaches and the current apparent lack of any known impacts. Future offshore wind activities would be expected to result in similar impacts, but over a greater spatial extent. In the context of reasonably foreseeable trends, combined impacts on sea turtles through this IPF from ongoing and planned actions, including the Proposed Action, are expected to be **negligible**.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be too small to be detected (NOAA 2020e). Sea turtles would be expected to swim away from the sediment plume. Elevated turbidity is most likely to affect sea turtles if a plume causes a barrier to normal behaviors, but no impacts would be expected due to swimming through the plume (NOAA 2020e). Turbidity associated with increased sedimentation may result in short-term, temporary impacts on sea turtle prey species (Table 3.3-1).	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. The impact on water quality from sediment suspension during cable emplacement is short-term and temporary. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on some sea turtle prey species (Table 3.3-1).	Future offshore wind development will require new cabling to bring generated electricity onshore, and would result in sea floor disturbance and elevated levels of suspended sediment. Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited. Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term impacts on individual sea turtles could occur in the immediate vicinity of installation activities. The total area of seafloor disturbance is estimated to be up to 8,156 acres (33.0 km^2). These disturbances would be local and generally limited to the emplacement corridor. Further, suspended sediment concentrations in Nantucket Sound under natural	Installation of submarine cable would mostly be done by jet or mechanical plow. The Proposed Action's incremental contribution of up to 328 acres (1.3 km^2) of seafloor disturbance by cable installation and up to 69 acres (0.3 km^2) affected by dredging prior to cable installation would result in turbidity effects that have the potential to have temporary **minor to moderate** impacts on some sea turtle prey species, including benthic mollusks, crustaceans, sponges, sea pens, and crabs. The modeled resultant plume is predicted to stay in the lower portion of the water column (bottom 9.8 feet). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet from the route centerline but could extend up to 1.2 miles. Modeling showed sediment concentrations	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term, **negligible** impacts on sea turtles due to displacement, although no biologically significant impacts would be expected. Ongoing and future non-offshore wind activities may cause similar local, short-term impacts. Future offshore wind activities other than the proposed Project would disturb up to 8,156 acres (33.0 km^2), although similar localized, short-term impacts would not be expected to be biologically significant. No measurable overall impacts on sea turtles through this IPF would be attributed to the Proposed Action. Some non-measurable **negligible** overall impacts arising from future development, including future offshore wind could occur if impacts

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
			conditions are 45-71 mg/L. Suspended sediment concentrations due to jet plow are within the range of natural variability for this area. The impact on water quality from sediment suspension during cable laying activities would be short-term and temporary. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on some sea turtle prey species (Table 3.3-1).	greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours, but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Epsilon 2018b). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018b). Attachment C of Epsilon 2018b depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, the sediment no longer affects water quality once it has settled. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary. Because the period of sediment suspension is very short-term and localized and the use of dredging is restricted, non-measurable **negligible** impacts, if any, would be expected.	occur in close temporal and spatial proximity; however, these impacts would not be expected to be biologically significant (NOAA 2020e).
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for sea turtles. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from sea turtles. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.	Future low altitude aircraft activities such as survey activities and navy training operations could result in short-term responses of sea turtles to aircraft noise. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.	Future offshore wind development may require the use of helicopters to supplement crew transport during construction and operations. BOEM expects that helicopters transiting to the offshore WDAs would fly at altitudes above those that would cause behavioral responses from sea turtles except when flying low to inspect WTGs, or take off and land on the Service Operation Vessel (SOV). While helicopter traffic may cause some short-term and temporary behavioral reactions in sea turtles while helicopters move to a safe distance, BOEM does not expect this activity to cause injury.	Vineyard Wind may use helicopters to supplement crew transport and for Proposed Action support during both construction and operations (COP Volume I, Section 4.2.4; Epsilon 2020a), which may cause behavioral changes to sea turtles, if present in the vicinity. Aircraft operations may ensonify areas, albeit for short periods at any one location while in transit. BOEM expects that helicopters transiting to the WDA would fly at altitudes above those that would cause behavioral responses from sea turtles except when flying low to inspect WTGs, or to take off and land on the SOV. While helicopter traffic may cause some short-term and **negligible** behavioral reactions in sea turtles while helicopters move to a safe distance, BOEM expects these impacts, if any, to be short-term, temporary and **negligible,** resulting in minimal energy expenditure.	The Proposed Action may result in non-measurable **negligible** behavioral responses, including startle responses (diving or swimming away), altered submergence patterns, or temporary stress responses through this sub-IPF. Aircraft operations associated with the Vineyard Wind 1 Project are not expected to occur in great numbers, but could possibly occur during operations and mitigation-related surveys during construction. Impacts resulting from ongoing and future offshore development would be limited to rescue operations and would be expected to result in similar impacts on sea turtles. Future offshore wind activities would likely result in much more aircraft flights than the Proposed Action, but the overall impacts on individuals would still be considered low, and non-biologically significant impacts would be expected. In the context of reasonably foreseeable trends, combined impacts on sea turtles through this sub-IPF from ongoing and planned actions, including the Proposed Action, are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. Proposes Action would have little to no influence on overall impacts through this sub-IPF.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in some impacts including potential auditory injuries, short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating leatherback sea turtles and possibly loggerheads, if present within the ensonified area (NSF and USGS 2011). The potential for PTS and TTS is considered possible in proximity to G&G surveys, but impacts are unlikely as turtles would be expected to avoid such exposure and survey vessels would pass quickly (NSF and USGS 2011). No significant impacts would be expected at the population level. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise that penetrates deep into the seabed. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise that penetrates deep into the seabed. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Site characterization surveys for offshore wind facilities would create intermittent, high-intensity impulsive noise around sites of investigation over a 2- to 10-year period. Sound sources used during G&G activities have the potential to produce auditory injuries, although considered unlikely given the small impact zone, as well as short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating leatherback, loggerhead, Kemp's ridley and green sea turtles, if present within the ensonified area (NSF and USGS 2011). Seismic surveys can extend over a time scale of months, as do construction and installation of offshore wind structures. However, identifying the locations and schedules of offshore wind G&G and construction or installation activities could avoid overlapping noise impacts by scheduling activities to avoid impacts on sea turtles. BOEM concluded that disturbance of sea turtles from underwater noise generated by site characterization and site assessment activities would likely result in temporary displacement or other behavioral or non-biologically significant physiological consequences (BOEM 2019b); impacts on sea turtles would not result in stock or population level effects.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. Higher frequency HRG survey noise resulting from cable route surveys may be less intense than G&G noise from site investigation surveys in WDAs. Due to the higher frequency, a few HRG sources (sub-bottom profilers, boomers, and sparkers) may be detectable by sea turtles (BOEM 2018); however, **negligible** impacts, if any would be expected as turtles would be avoid exposure and survey vessels would pass quickly (NSF and USGS 2011). Additionally, because HRG surveys are lower energy and operate in smaller areas, the associated ensonified area is smaller; however, impacts on sea turtles could occur at close ranges (within 200 meters). No injury to individuals would be expected as these sound sources have been shown to diminish rapidly with distance from the source (BOEM 2018). Impacts, if any, are anticipated to be temporary and **negligible**.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts, including non-biologically significant behavioral and physiological effects along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts over an unknown extent. Future offshore wind activities, would likely affect a much greater area than the Proposed Action would, but sea turtles would be expected to avoid injurious exposure and survey vessels would pass quickly (NSF and USGS 2011). In the context of reasonably foreseeable trends, combined impacts on sea turtles through this sub-IPF from ongoing and planned actions, including the Proposed Action, are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have little to no influence on overall impacts through this sub-IPF.
Noise: Turbines	Sea turtles would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base (Miller and Potty 2017). Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from the WTG foundations. Furthermore, no information suggests that such noise would affect turtles (NMFS 2020).	This sub-IPF does not apply to future non-offshore wind development.	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1µPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of a WDA, if sound levels at the WDA are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 11µPa in the 70.8– 224 Hz frequency band at the Block Island Wind Facility study area during 50% of the recording time between November 2011 and March 2015 (Kraus et al. 2016). Based on the results from Thomsen et al. (2015) and Kraus et al. (2016), the received SPLs generated by the project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from WTG bases, no measurable impacts from this sub-IPF would be expected to occur.	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1 µPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of the WDA, if sound levels at the WDA are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 11µPa in the 70.8 to 224 Hz frequency band at the study area during 50% of the recording time between November 2011 and March 2015 (Kraus et al. 2016). Based on the results from Thomsen et al. (2015) and Kraus et al. (2016), the received SPLs generated by the Project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from WTG bases, non-measurable, **negligible** impacts, if any, would be expected to occur.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this sub-IPF due to the assumption that operational turbine noise would be similar to ambient noise levels within 164 feet (50 meters) of the WTG foundations (Miller and Potty 2017). No impacts would occur from ongoing and future non-offshore wind development. Future offshore wind (other than the Proposed Action) would be expected to result in similar impacts, but across a greater spatial scale. **Negligible** impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, if any, would be expected due to operational turbine noise given the assumption that operational turbine noise would be similar to ambient levels within a short distance (164 feet [50 meters]) of WTG bases.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high intensity, low exposure levels, and long-term, but localized intermittent risk to sea turtles. Impacts, potentially including behavioral responses, masking, TTS, and PTS, would be localized in nearshore waters. Data regarding threshold levels for impacts on sea turtles from sound exposure during pile driving are very limited, and no regulatory threshold criteria have been established for sea turtles. BOEM and NMFS have adopted the following thresholds based on current literature: • Potential mortal injury: 210 dB cumulative SPL or greater than 207 dB peak SPL (Popper et al. 2014; NMFS 2020) • Behavioral disturbance: 166 dB referenced to 1 μPa RMS	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Noise from pile driving would occur intermittently during installation of offshore structures for 4 to 6 hours per day over a 6- to 12-year period. Under the expanded planned action scenario, up to 2,021 WTGs and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030. Sea turtles would be displaced up to 1.6 miles (2.7 kilometers) for up to 6 hours per day during monopile installation and up to 14 hours per day during jacket installation. Thus, foraging disruptions, if any, would be temporary and are not expected to last longer than a day. This displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on sea turtles. Although information is lacking, construction activities could temporarily displace animals into areas that have a lower foraging quality, or result in higher risk of interactions with ships or fishing gear. Potential impacts on sea turtles from multiple construction activities within the same calendar year could affect migration, feeding, breeding, and individual fitness. Intermittent, long-term impacts may be high intensity and high exposure level. The magnitude of these impacts would be dependent upon the locations of concurrent construction operations, as well as the number of hours per day, the number of days that pile driving would occur, and the time of year in which pile driving occurs. Individuals repeatedly exposed to pile driving over a season, year, or life stage may incur energetic costs that have the potential to lead to long-term consequences (Navy 2018). However, individuals may become habituated to repeated exposures over time and ignore a stimulus that was not accompanied by an overt threat (Hazel et al. 2007). Individuals have been shown to retain this habitation even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018).	There is a potential risk of PTS and behavioral disturbance to sea turtles from pile driving due to the large radial distance to this threshold and maximum impact over the total of 102 days that pile driving may occur. BOEM anticipates unavoidable, temporary, **moderate** impacts on individual sea turtles from pile driving, given that pile-driving activities would occur over the course of a year. However, these moderate effects are expected to occur only in a very small number of turtles, and the population would likely recover after pile-driving activity has ceased. There are known occurrences of mortalities associated with pile driving, but sea turtle anatomy may make them resistant to percussive shock waves (Madin 2009). Based on the low densities of sea turtles in the Proposed Action area, the use of soft-starts to allow turtles to leave the area before injurious levels are received, and the implementation of monitoring zones and clearance zones, mortal injury would not be expected.	Pile-driving noise associate with the Proposed Action may result in temporary **moderate** impacts, including behavioral and physiological effects and minor auditory injury, during pile-driving activities. Given that pile-driving activities would be conducted in accordance with voluntary measures such as the use of soft start procedures and PSOs, impacts on sea turtles through this sub-IPF would be expected to be reduced. Pile driving associated with ongoing, future non-offshore wind, would be expected to result in similar impacts on sea turtles. In the context of reasonably foreseeable trends, the combined impacts on sea turtles through this IPF from ongoing and planned actions, including the Proposed Action, are expected to be **moderate.** Pile driving would incrementally be added to existing noise levels beginning in 2022 and continuing through 2030. Once pile driving stops, this sub-IPF would be removed from the environment and sea turtle behavior would return to normal. However, the effects of PTS may be permanent. Although permanent hearing impairment could occur, hearing ability is not believed to be critical to sea turtles completing essential life history requirements. Affected individuals would not have to adjust their life history strategies in response to PTS.
Noise: Cable laying/trenching	NA	Cable laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects.	Noise associated with cable laying would be produced during route identification, trenching, backfilling, jet plow embedment, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Modeling using *in situ* data collected during cable laying operations in Europe estimate that underwater noise would remain above 120 dB re 1 μPa in an area of 400 km² around the source (Bald et al. 2015; Nedwell and	Noise associated with cable laying would be produced during route identification, trenching, backfilling, jet plow embedment, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Model results from DP thruster operation for the Deepwater Wind Project (NMFS 2015) indicated that the average ensonified area at the 120 dB RMS isopleth extends 2.95 miles (4.75 kilometers) from the source, with the total	The Proposed Action is expected to result in **negligible** impacts on sea turtles through this sub-IPF, with sea turtles resuming normal behaviors once individuals are outside the ensonified area. Future non-offshore wind development would be expected to result in similar localized and temporary impacts, but across a smaller geographic scale. Cable laying impacts associated with future offshore wind development would also result in similar localized and temporary impacts, but on a larger temporal and spatial scale. In the context of reasonably foreseeable trends, combined impacts, if any, on sea turtles through this IPF from ongoing and planned

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
			Howell 2004, Taormina et al. 2018). Data regarding threshold levels for impacts on sea turtles from sound exposure during construction are very limited, and no regulatory threshold criteria have been established for sea turtles (see the Noise: Pile driving sub-IPF above for more information). If cable-laying activities occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, and the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015) and it is unlikely that the sound exposure related to cable laying activities would result in impacts on sea turtles.	size of the area experiencing noise of 120 dB RMS or greater ranging from 8.9 square miles (23 km^2) along the offshore export route to 9.7 square miles (25.1 km^2) along the inter-array cable route. If cable-laying activities are assumed to occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, and the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015). Given that sea turtles would avoid injurious exposure to cable laying noise (see Noise: G&G above), non-measurable **negligible** impacts, if any, would be expected.	actions, including the Proposed Action, would be negligible. Little spatial and/or temporal overlap from the Proposed Action and future activities would be expected. A portion of BSW's Export Cable 2 (as it approaches landfall) may be near enough to the OECC that the areas of potential effects from these cables may overlap (assuming a 10-mile [16.1-kilometer] radius around both cables) (see the BSW Project Overview map in Evans 2018). Other than the BSW Project, all noise related to cable installation would be separated in space and time, and as such, **negligible** impacts, if any, relative to this sub-IPF would be expected.
Noise: Vessels	The frequency range for vessel noise (10 to 1,000 Hz; MMS 2007) overlaps with sea turtles' known hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol. 1994) and would therefore be audible. However, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach and/or noise with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (2005) indicated that vessel noise could have an effect on sea turtle behavior, especially their submergence patterns.	See Section 3.13. Any offshore projects that require the use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles and no stock or population level effects would be expected.	Future offshore wind development would require the use of ocean vessels and could potentially result in moderate intensity, long-term, infrequent impacts on sea turtles, Based on the vessel traffic generated by the Proposed Action, it is assumed that construction of each individual offshore wind project (estimated to last 2 years per project) would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for sea turtles at any given time. This increase in vessel traffic and associated noise impacts would be at its peak in 2023to 2024, when at least four offshore wind projects (other than the Proposed Action) would be under simultaneous construction along the East Coast—i.e., a total of approximately 125 to 230 vessels in the analysis area at any given time during peak construction.[1] Additional information regarding the expected increase in vessel traffic is provided in Section 3.13. This increased offshore wind-related vessel traffic during construction, and associated noise impacts, could result in repeated intermittent, short-term, localized, impacts on sea turtles and result in brief behavioral responses that would be expected to dissipate once the vessel or the turtle has left the area. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy sea turtle distribution, and no stock or population level effects would be expected.	According to the Navigation Risk Assessment (COP Volume III, Appendix III-I; Epsilon 2020b), current vessel traffic in the WDA and surrounding waters is relatively high, and vessel traffic within the Vineyard Wind Lease Area is relatively moderate (Section 3.13). The NRA for the WDA indicates that the maximum number of vessels during construction would be 46 per day (with an average of 25 per day) (COP Volume III, Appendix III-I; Epsilon 2020b). This volume of traffic would vary monthly depending on weather and Proposed Action activities. During the period of maximum activity, Proposed Action construction would generate an average of 18 construction vessel trips per day in or out of construction ports. In maximum conditions, this could theoretically include up to 46 trips in a single day—including up to 4 trips per day to or from secondary ports, with the remainder originating or terminating at the New Bedford MCT, compared to the current 25 daily vessel trips measured via AIS in 2011 (COP Volume III, Appendix III-I; Epsilon 2020b). Potential behavioral impacts on sea turtles from Proposed Action-related vessel traffic noise would be intermittent and temporary as animals and vessels pass near each other. During construction, impacts are anticipated to be **minor**, with sea turtle populations fully recovering following construction.	The Proposed Action is expected to result in **minor** impacts on sea turtles through this sub-IPF. Ongoing and future non-offshore wind activities would be expected to result in similar impacts on sea turtles, but would have a much larger impact given the volume of vessel traffic associated with these activities. Future offshore wind would also have similar impacts on sea turtles, but with a larger spatial extent than the Proposed Action. In the context of reasonably foreseeable trends, combined impacts on sea turtles through this IPF from ongoing and planned actions including the Proposed Action, would be expected to contribute **minor** impacts on sea turtles. However, the Proposed Action and other future offshore wind development would contribute only a small portion of the overall vessel traffic in the region (BOEM 2019b).

[1] As specified in Section 1.7 and Appendix A of this FEIS, BOEM's analysis of expanded planned action scenario assumes the potential vessel availability and supply chain challenges will be overcome and projects will advance.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in short-term, temporary impacts, if any, on sea turtles. Vessel noise may affect sea turtles, but response would likely be short-term and temporary (see the Vessels: Noise sub-IPF above). The impact on water quality from sediment suspension during port expansion activities is short-term and temporary, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. However, the existing suspended sediment concentrations in Nantucket Sound are already 45 to 71 mg/L, which is fairly high. Impacts from vessel traffic are likely to be masked by the natural variability. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strikes could also occur (see the Traffic: Vessel collisions sub-IPF below).	At least two proposed offshore wind projects are contemplating port expansion/modification, in Vineyard Haven and in Montauk. Other ports would likely be upgraded along the East Coast, and some of this may be attributable to supporting the offshore wind industry. This would increase the total amount of disturbed benthic habitat, potentially resulting in impacts on some sea turtle prey species. However, this will likely be a small percentage of available benthic habitat overall. Increases in port utilization due to other offshore wind projects will lead to increased vessel traffic. This increase would be at its peak during construction activities and would decrease during operations, but would increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased turbidity in the coastal waters. Impacts associated with increased turbidity are not expected to be biologically significant (NOAA 2020e).	No port expansion is proposed for the Project.	Given that no port expansion is proposed, the Vineyard Wind 1 Project would not be expected to contribute to this sub-IPF or overall impacts on sea turtles. Port expansion as a result of ongoing and non-offshore wind activities may have some temporary water quality impacts as well as long-term impacts related to increased potential for vessel collisions as a result of increased vessel traffic. Port modifications, if contemplated, would most likely occur in areas that are already industrialized, have a high level of anthropogenic activity, and have previously been altered. Port expansion associated with future offshore wind development may result in similar impacts, but the incremental increase from offshore wind development would be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind development (DOE 2014). In the context of reasonably foreseeable trends, combined impacts on sea turtles through this IPF from ongoing and planned actions are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have no influence on overall impacts through this sub-IPF.
Presence of structures: Entanglement or ingestion of lost fishing gear	The Mid-Atlantic region has more than 130 artificial reefs. This sub-IPF may result in long-term, high intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of sea turtles encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014) if present nearshore where these structures are located. There are very few, if any, areas on the OCS geographic analysis area for sea turtles that would serve to concentrate recreational fishing and increase the likelihood that sea turtles would encounter lost fishing gear.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. Approximately 1,723 acres (7 km^2) of hard protection atop cables, 1,221 acres (5 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on sea turtles over an assumed 6- to 10-year period. The presence of structures and the anticipated reef effect has the potential to lead to increased recreational fishing within the WDAs, which would result in moderate exposure, high intensity risk of interactions with fishing gear such as hooking, abrasions, loss of limbs, and increased drag. These interactions could result in injury, mortality, reduced foraging efficiency,	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations and scour/cable protection would remain for the life of the Project (30 years). Interactions with lost fishing gear around WTG foundations is a potential long-term risk and may be high intensity, resulting in hooking, entanglement, ingestion, injury, and death (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Exposure level would be considered low due to up to 102 foundations in the WDA, but would pose a long-term risk. As part of the Vineyard Wind 1 Project design, annual monitoring, reporting, and cleanup of fishing gear around the base of the WTGs would be conducted. This would remove any identified	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. With the annual removal of fishing gear, impacts due to the Proposed Action would be **negligible**. Ongoing entanglement and gear loss/damage at existing structures would periodically result in similar localized, short-term impacts on sea turtles. Future offshore wind activities, other than the Proposed Action, would add approximately 2,944 acres (12 km^2) of scour/cable protection and the vertical surfaces of up to 2,066 new foundations. In the context of reasonably foreseeable trends, combined impacts of up to 2,066 foundations and 2,944 acres (12 km^2) of scour/cable protection form ongoing and planned actions, including the Proposed Action, would increase the risk of highly localized, periodic, short-term impacts that may be **moderate**.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
			and ability to avoid predators (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014).	fishing gear and reduce the potential for impacts on sea turtles to **negligible** levels.	Both the Proposed Action and other future offshore wind development would be expected to contribute to overall impacts on sea turtles. The contribution of the maximum of 100 WTGs and 151 acres of scour protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) acres of scour/cable protection that are part of the expanded planned action scenario in the region.
Presence of structures: Habitat conversion and prey aggregation	The Mid-Atlantic region has more than 130 artificial reefs. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (NMFS 2015; Taormina et al. 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for sea turtles compared to the surrounding soft bottoms.	The presence of structures associated with non-offshore wind development in nearshore coastal waters has the potential to provide habitat for sea turtles as well as preferred prey species. This reef effect has the potential to result in long-term, low-intensity beneficial impacts. Bridge foundations will continue to provide foraging opportunities for sea turtles with measurable benefits to some individuals.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. Approximately 2,944 acres (12 km^2) of hard protection and the vertical surfaces of up to 2,066 new foundations can create artificial reefs, thus inducing the reef effect (Causon and Gill 2018; Taormina et al. 2018). In the Gulf of Mexico, loggerhead, leatherback, green, Kemp's ridley, and hawksbill (*Eretmochelys imbricate*) sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Herczeg 1994; Gitschlag and Renauld 1989; Hastings et al. 1976, Rosman et al. 1987). Sea turtles would be expected to use the habitat between and around structures for feeding, breeding, resting, and migration.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Foundations may provide foraging and sheltering opportunities for sea turtles. The Proposed Action could also result in increased primary production and zooplankton abundance, which could serve as food for some sea turtle species as well as some sea turtle prey species. There may be measurable long-term, **minor beneficial** impacts from the presence of foundations.	The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations may serve as foraging opportunities for sea turtles, with anticipated long-term, **minor beneficial** impacts from the presence of foundations. Ongoing and future non-offshore wind activities would be expected to result in similar impacts, but on a smaller geographic scale, and would be limited to nearshore habitat. Future offshore wind development would also be expected to result in similar impacts, but on a larger spatial scale, given the addition of 2,066 structures and 2,944 acres (12 km^2) of hard protection. In the context of reasonably foreseeable trends, combined impacts on sea turtles through this IPF from ongoing and planned actions, including the Proposed Action, would be expected to result in long-term, **moderate beneficial** impacts on sea turtles due to the large number of structures. However, these beneficial impacts may be masked by adverse impacts resulting from increased interactions with recreational fishing gear (see the Presence of structures: Entanglement or ingestion of lost fishing gear sub-IPF above). The contribution of the maximum of 100 WTGs and 151 acres of scour protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) acres of scour/cable protection that are part of the full planned action scenario in the region.
Presence of structures: Avoidance/ displacement	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. An estimated 2,066 structures would be added on the OCS over a 6- to 10-year period beginning in 2022, and they would remain until decommissioning of each facility is complete (30 years). Although 2,066 structures are anticipated, spacing would be sufficient to allow unobstructed access within wind facilities and between wind facility projects. Avoidance of WDAs due to the presence of new structures is possible. However, in the Gulf of Mexico, loggerhead, leatherback, green, Kemp's ridley, and hawksbill sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Herczeg 1994; Gitschlag and Renauld 1989;	The Proposed Action is expected to add up to 102 foundations on the OCS. The proposed spacing between structures is expected to be sufficient to allow unimpeded access within the WDA. Based on the best available information, non-measurable **negligible** impacts, if any, are anticipated. However, temporary displacement from the WDA during Project construction may occur. This could displace individuals into areas with higher risk of interactions with fishing and commercial vessels (see the Traffic: Vessel collisions sub-IPF below).	The Proposed Action is expected to result in non-measurable **negligible** impacts on sea turtles through this sub-IPF. Additional impacts could occur if individuals are displaced into areas with increased risk of vessel interactions (see the Traffic: Vessel collisions sub-IPF below) if displacement occurs during construction. Ongoing and future non-offshore wind activities would not be expected to result in any impact on sea turtles. Future offshore wind activities would be expected to result in similar impacts, but over a greater spatial and temporal scale. However, the proposed spacing between structures would be sufficient to allow unimpeded access between offshore wind facilities and between individual WTGs. In the context of reasonably foreseeable trends, combined impacts related to avoidance/displacement associated from ongoing and planned actions, including the Proposed Action, as a result of 2,066 novel structures on the OCS would likely be **negligible**. However, additional impacts may

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
			Hastings et al. 1976, Rosman et al. 1987). As such, sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations.		occur if individuals are displaced into areas with a higher risk of vessel and/or fisheries interactions (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although 2,066 structures are anticipated, spacing would be sufficient to allow unimpeded access among WTGs within wind facilities and between wind facility projects. Sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed during migrations, the presence of structures are not expected to result in noticeable changes to overall migratory patterns in sea turtles.	It is not likely that sea turtles would avoid the WDA due to sea turtle size relative to turbine spacing, and to documented use of structures in the offshore environment (Gitschlag and Herczeg 1994; Gitschlag and Renauld 1989; Hastings et al. 1976, Rosman et al. 1987). Sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed during migrations, the presence of structures are not expected to result in noticeable changes to overall migratory patterns in sea turtles. As such, non-measurable, **negligible** impacts, if any, would be expected.	Although an estimated 2,066 new foundations are anticipated, spacing would be sufficient to allow unimpeded access within the Proposed Action, and **negligible** impacts, if any, would be expected. No ongoing or non-offshore wind activities would contribute to this sub-IPF. Future offshore wind development would be expected to result in similar impacts, but over a greater geographic extent. In the context of reasonably foreseeable trends, combined impacts related to disruptions of breeding and migration from ongoing and planned actions, including the Proposed Action, as a result of 2,066 novel structures on the OCS would likely be **negligible**.
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although construction activities would likely temporarily displace animals into areas that have a higher risk of interactions with ships or fishing gear, the operations phase may or may not result in any displacement. The 1-nautical-mile grid spacing and low operational noise levels allow unobstructed access to habitat in wind facility areas. Some level of sea turtle displacement from the lease areas into areas with a higher potential for interactions with ships or fishing gear during the construction phases of future offshore wind development may occur (Section 3.13). Given the use of structures in the Gulf of Mexico, as described above, no long-term displacement would be expected. Changes in the area of fishing effort are not anticipated with the proposed WTG spacing, but could potentially occur if fisheries choose to operate outside future offshore wind projects. If the area of effort were to change to areas adjacent to offshore wind projects, increased risk could be expected than currently exists within wind facility areas. If gear changes were to result from the presence of offshore WTG foundations, additional impacts on sea turtles could occur. However, no new gear types or configurations that could be used have been identified that	If sea turtles avoid the WDA during construction, they may be at increased risk of interactions with potentially high vessel traffic including fisheries vessels and fisheries gear. Given the use of structures in the Gulf of Mexico, no long-term displacement would be expected.	Although construction activities for Proposed Action and other offshore wind projects would likely temporarily displace animals into areas that have a higher risk of interactions with ships or fishing gear, and have the potential to result in **minor** impacts on sea turtles, the operations phase may or may not result in any displacement. Ongoing and future non-offshore wind activities would be expected to result in similar impacts, but on a smaller geographic scale. Future offshore wind activities would also be expected to result in similar impacts, but on a greater temporal and spatial scale. However, the 1-nautical-mile grid spacing and low operational noise levels allow unobstructed access to habitat in wind facility areas. Changes in the area of fishing effort is not anticipated with the proposed WTG spacing, but could potentially occur if fisheries choose to operate outside future offshore wind projects. If the area of effort were to change to areas adjacent to offshore wind projects, increased risk could be expected than currently exists within wind facility areas. If gear changes were to result from the presence of offshore WTG foundations, additional impacts on sea turtles could occur. However, the presence of these new structures is not expected to result in new gear types or configurations to be utilized in the WDA, and overall impacts are expected to be **minor**.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
			could result from the presence of these structures.		
Traffic: Vessel collisions	Current activities contributing to this sub-IPF include port traffic levels, fairways, traffic separation schemes, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Propeller and collision injuries from boats and ships are common in sea turtles. Vessel strike is an increasing concern for sea turtles, especially in the southeastern United States, where development along the coast is likely to result in increased recreational boat traffic. In the United States, the percentage of strandings of loggerhead sea turtles that were attributed to vessel strikes increased from approximately 10% in the 1980s to a record high of 20.5% in 2004 (NMFS and USFWS 2007). Sea turtles are most susceptible to vessel collisions in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and those vessels traveling at greater than 10 knots would pose the greatest threat to sea turtles.	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. Sea turtles are most susceptible to vessel collisions in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and those vessels traveling at greater than 10 knots would pose the greatest threat to sea turtles.	Based on the vessel traffic generated by the proposed Project, it is assumed that construction of each individual offshore wind project (estimated to last 2 years per project) would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for sea turtles at any given time. This increase in vessel traffic and associated collision risk would be at its peak in 2023 to 2024, when at least four offshore wind projects (other than the Proposed Action) would be under simultaneous construction along the East Coast—i.e., a total of approximately 125 to 230 vessels in the geographic analysis area at any given time during peak construction.[2] Additional information regarding the expected increase in vessel traffic is provided in Section 3.13. Offshore wind will result in a small incremental increase in vessel traffic volume relative to ongoing and future non-offshore wind activities (BOEM 2019b). This increased collision risk has the potential to result in injury or mortality to individuals, but would not be expected to have stock or population-level impacts on sea turtles given their patchy distribution within the geographic analysis area. Further, implementation of the following BMP (Appendix A Table A-5) would reduce the potential for impacts relative to this sub-IPF during offshore wind development: Vessels related to project planning, construction, and operation shall travel at reduced speeds when assemblages of cetaceans are observed and maintain a reasonable distance from whales, small cetaceans, and sea turtles as determined during site-specific consultations.	The increase in vessel traffic associated with the Project would be greatest during construction, with an estimated maximum of 46 vessels operating in the WDA daily. Given the mobility of sea turtles, the use of PSOs and voluntary mitigation measures such as vessel speed restrictions and the implementation of monitoring zones and clearance zones, interactions with Vineyard Wind vessels and sea turtles would not be expected to occur. Although vessel strike is a major source of human-caused sea turtle mortality, the above measures reduce the probability of a Project-related strike. The Project would have a period of peak vessel activity lasting approximately 2 years (during construction). The projected 4.7, 1.6, and 4% annual increases in vessel traffic during construction, operations, and decommissioning, respectively (NMFS 2020 is likely to increase the relative risk of vessel strike for sea turtles. However, the vessel strike avoidance measures that Pyć et al. (2018) outline are designed to avoid vessel strikes on sea turtles by reducing vessel speed and maintaining a distance of 49.2 feet (15 meters) or greater from sighted turtles. The additional measure of training personnel to watch for and report sea turtles would further increase vigilance to avoid striking sea turtles. Due to the implementation of these measures, BOEM anticipates that the impacts on sea turtles would be low. As discussed in the BO, an estimated take of 39 sea turtles is expected over the life of the proposed Project; therefore, potential temporary effects of vessel traffic due to construction and installation vessels are anticipated to be **minor.**	While some increase in vessel traffic associated with the Proposed Action would occur, the incremental increase would be very small relative to current vessel traffic in the area. Because measures such as the use of PSO, PAM, and vessel speed restrictions would be implemented, impacts on sea turtles through this sub-IPF would likely be **minor**. Ongoing and future non-offshore wind activities have the potential to result in sea turtle mortality throughout the geographic analysis area for sea turtles, but impacts would be concentrated in shipping lanes and other areas regularly traversed by vessels (Appendix B Table 3.11-1). Future offshore wind activities may also pose a significant risk to sea turtles through this sub-IPF, particularly if BOEM and NMFS measures are not included. The relative risk of vessel strikes from wind industry vessels is dependent upon the stage of development, time of year, number of vessels, and speed of vessels during each stage. In the context of reasonably foreseeable trends, combined impacts on sea turtles related to vessel collisions on the OCS from ongoing and planned actions, including the Proposed Action, would likely be **moderate,** given the level of vessel traffic involved during peak construction. The contribution of Proposed Action is relatively small when compared to the number of vessel trips associated with future offshore wind development and would contribute only a small portion 4.7%, 1.6%, and 4% annual increases in vessel traffic during construction, operations, and decommissioning, respectively (NMFS 2020) of the overall vessel traffic in the region (BOEM 2019b).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could lead to long-term, high-consequence impacts on sea turtle onshore beach nesting habitat, including changes to nesting periods, changes in sex ratios of nestlings, drowned nests, and loss or degradation of nesting beaches. Offshore impacts, including sedimentation of nearshore hard-bottom habitats have the potential to result in long-term, high consequence changes to foraging habitat availability for green turtles.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to increased energetic costs and reduced fitness of individual sea turtles. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the overall contribution of these activities to climate change.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of some sea turtle prey species. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed

[2] As specified in Section 1.7 and Appendix A of this FEIS, BOEM's analysis of the expanded planned action scenario assumes the potential vessel availability and supply chain challenges will be overcome and projects will advance.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
					Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtles by influencing distributions of sea turtles and/or prey resources. This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle breeding, foraging, and sheltering habitat use.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to changes in the distribution and availability of breeding, sheltering, and/or foraging habitat as well as migration disruptions. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle habitat use and migratory patterns.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to changes in habitat use and seasonal migration timing and patterns. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of sea turtles such as fibropapillomatosis.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to the incidence, prevalence, and severity of diseases in sea turtle populations. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence impacts on sea turtle nesting by eliminating or precluding access to potentially suitable nesting habitat or access to potentially suitable habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to impacts on sea turtles, and has the potential to degrade, eliminate, or preclude access to currently suitable nesting habitat. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.
Climate change: Warming and sea level rise, storm severity, frequency, sediment erosion, deposition	Sediment erosion and/or deposition in coastal waters have the potential to result in long-term, high-consequence impacts on green sea turtle foraging habitat. Additionally, sediment erosion has the potential to result in the degradation or loss of potentially suitable nesting habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to impacts on green turtle foraging habitat, and has the potential to degrade or eliminate currently suitable nesting habitat. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.

μPa = micropascal; μT = microtesla; AC = alternating current; ADLS = Aircraft Detection Light System; AIS = Automatic Identification System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; BSW = Bay State Wind; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; dB = decibel; dB re 1 μPa = decibels relative to one micropascal; dB RMS = decibel root mean squared; DC = direct current; DP = dynamic positioning; DPS = distinct population segment; EIS = Environmental Impact Statement; EMF = electromagnetic field; ESP = electrical service platform; FAA = Federal Aviation Administration; FCC = Federal Communications Commission; G&G = Geological and Geophysical; hazmat = hazardous materials; HRG = high resolution geophysical; Hz = hertz; IPF = impact-producing factor; km^2 = square kilometers; m^2 = square meters; MCT = Marine Commerce Terminal; met = meteorological; mg/L = milligrams per liter; NA = not applicable; NMFS = National Marine Fisheries Service; NRA = Navigational Risk Assessment; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; PAM = passive acoustic monitoring; PSO = protected species observer; PTS = permanent threshold shift; RMS = root mean squared; SOV = service operations vessel; SPL = sound pressure level; TTS = temporary threshold shift; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.5-2: Summary of Sea Turtles Likely to Occur in the Coastal Waters off Rhode Island and Massachusetts

Common Name	Scientific Name	DPS/Population	ESA Status (Massachusetts ESA Status)	Relative Occurrence in the WDA and Surrounding Waters [a]
Leatherback	*Dermochelys coriacea*	Atlantic	E (E)	Common [b]
Loggerhead	*Caretta caretta*	Northwest Atlantic DPS	T (T)	Common [b]
Kemp's ridley	*Lepidochelys kempii*	NA	E (E)	Regular [b]
Green	*Chelonia mydas*	North Atlantic DPS	T (T)	Rare [b]

Source: Adapted from COP Volume III (Epsilon 2020b); Kenney and Vigness-Raposa 2010

DPS = distinct population segments; E = Endangered; ESA = Endangered Species Act; T = Threatened; WDA = Wind Development Area; NA = not applicable

[a] Common > 100 turtles; Regular = 10 to 100 turtles; Rare < 10 turtles. Although historical sightings records suggest rare occurrence of Kemp's ridley sea turtles, the most recent (2007–2017) stranding records indicate regular occurrence in the area.

[b] Wellfleet Bay Wildlife Sanctuary strandings data also indicate same relative occurrence as Kenney and Vigness-Raposa (2010). Data are not available for leatherback sea turtles since they are not susceptible to cold stunning. Kemp's ridley strandings have been more common in recent years.

Table 3.5-3: Sea Turtle Density Estimates for the WDA

Common Name	Scientific Name	Density [a]			
		Spring	Summer	Fall	Winter
Leatherback sea turtle	*Dermochelys coriacea*	0.0274	0.0274	0.0274	0.0274
Loggerhead sea turtle	*Caretta caretta*	0.1117	0.1192	0.1111	0.1111
Kemp's ridley sea turtle	*Lepidochelys kempii*	0.0105	0.0105	0.0105	0.0105

Source: Pyć et al. 2018; NMFS 2020

[a] Animals/100 km^2 (38.6 square miles)

Table 3.5-4: Sea Turtle Incidental Hooking and/or Entanglement with Recreational Fishing Gear from 2016 to 2018

State	Loggerhead Sea Turtle (*Caretta caretta*)	Green Sea Turtle (*Chelonia mydas*)	Leatherback Sea Turtle (*Dermochelys coriacea*)	Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	Unknown	State Total
Delaware	-	-	-	1		**1**
Massachusetts	-	-	1	-		**1**
New Jersey	1	-	-	1		**2**
New York	3	-	-	-		**3**
Virginia	32	2	-	120	25	**179**
Total	**36**	**2**	**1**	**122**	**25**	**186**

Table 3.5-5: Sea Turtle Hearing Range

Sea Turtle Species	Scientific Name	Hearing Range (hertz)	Most Sensitive Hearing Range (hertz)	Reference
Loggerhead	*Caretta*	100–1130 [a] 50–800 [b]	200–400 (110 dB re 1 μPa) 100 (98 dB re 1 μPa)	Martin et al. 2012
Kemp's ridley	*Lepidochelys kempi*	100–500	100–200	Bartol and Ketten 2006
Green (juvenile)	*Chelonia mydas*	50–1,600	600–700	Piniak et al. 2016
Leatherback	*Dermochelys coriacea*	50–1,200	100–400	Dow Piniak et al. 2012

dB re 1 μPa = decibels relative to 1 micropascal

[a] Auditory evoked potential

[b] Behavioral testing

Table 3.5-6: Mean Radial Distance (R95% in meters) to Threshold Criteria for Sea Turtles during Impact Hammering with 6 dB Attenuation System [a,b]

Foundation/Hammer Type	Injury 210 dB L_E [c]	Injury Unweighted 180 dB SPL [d]	Behavioral Harassment Unweighted 166 dB SPL [d]
10.3-meter monopole/ IHC S-4000 hammer	477	773	2,739
Jacket (four 3-meter piles)/ IHC S-2500 hammer	530	243	1,944

Source: Pyć et al. 2018

dB = decibel; L_E = cumulative sound exposures; SPL = sound pressure level
[a] Mean of two measured positions within the WDA
[b] The R95% for a given sound level is the radial distance centered at a pile-driving location, encompassing 95 percent of the largest distances within the sound pressure levels above a given threshold.
[c] Source: Popper et al. 2014
[d] Source: NMFS 2016

Table 3.5-7: Estimated Number of Sea Turtles Exposed to the Injury Threshold and the Behavioral Harassment Threshold for Scenario 1 with Two Piles per Day Using 6 dB of Attenuation [a]

Common Name	Scientific Name	Injury [b] SPL (L_p)	Behavioral Harassment [b] SPL (L_p)
Kemp's ridley	*Lepidochelys kempii*	0.03	0.18
Leatherback	*Dermochelys coriacea*	0.04	0.24
Loggerhead	*Caretta caretta*	0.33	1.96

Source: Pyć et al. 2018

dB = decibel; L_p = sound pressure; SPL = sound pressure level
[a] Evaluated for NMFS Level A and Level B harassment and Popper et al. (2014) Level A harassment.
[b] Source: NMFS 2016

Table 3.6-1: Summary of Activities and the Associated Impact-Producing Factors for Demographics, Employment, and Economics

Baseline Conditions: The geographic analysis area for demographics, employment, and economics includes the counties where proposed onshore infrastructure and port cities supporting offshore wind energy projects are located, as well as counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island). These counties are the most likely to experience beneficial or adverse economic impacts from the Proposed Action.

Barnstable, Dukes, and Nantucket counties are highly dependent on tourism and visitors, and have a high proportion of seasonally occupied homes (another indication of recreational and tourist use). The economies of Martha's Vineyard and Nantucket are also less diverse than the mainland jurisdictions. BOEM anticipates Dukes, Barnstable, and Nantucket counties to continue to be heavily dependent on tourism and recreation, which accounts for 96, 87, and 99 percent of the overall Ocean Economy GDP of those respective counties (NOAA 2020c).

While median income, housing values, and employment rates vary, the mainland study area generally displays strong and diverse economic activity. In Bristol, Providence, and Washington counties, ocean economy sectors would continue to be more diverse, with a higher proportion of shipping and commercial fishing, while also constituting a smaller proportion of the local economy. Bristol County contains the Port of New Bedford, the highest-grossing commercial fishing port in the United States. Washington County contains Port Judith, a center of the Rhode Island and regional fishing industry.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Energy generation/ security	In 2017, Massachusetts energy production totaled 125.2 trillion Btu, of which 72.4 trillion Btu were from renewable sources, including geothermal, hydroelectric, wind, solar, and biomass (U.S. Energy Information Administration 2018).	Ongoing development of onshore solar and wind energy would provide diversified, small-scale energy generation. State and regional energy markets would require additional peaker plants and energy storage to meet the electricity needs when utility scale renewables are not producing.	Once built, offshore wind energy projects could produce energy at long-term fixed costs, which could provide a hedge against fossil fuel price volatility. A greater share of electricity produced by offshore wind for a given market would result in a greater need for energy storage and peaker generation (U.S. Energy Information Administration 2018). Approximately 9.4 GW of capacity is estimated to occur in the Rhode Island/Massachusetts offshore areas.	Operation of the Proposed Action would produce up to 800 MW of electricity, or 3.6% of the estimated 22 GW of reasonably foreseeable offshore wind generation potential for the U.S. East Coast. Between 8 and 9 GW of this capacity is estimated to occur in the Rhode Island and Massachusetts offshore areas. This would have regional, long-term, **minor beneficial** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this IPF under the Proposed Action would include a long-term contribution to energy security and resiliency, providing economic benefit through a stable supply of energy and predictable energy prices. This would have long-term, regional, **minor beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would continue existing energy generation and energy security concerns. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In the context of reasonably foreseeable trends, combined energy generation/security impacts on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be regional (if not national), long-term, and **minor beneficial**, due to the substantial increase in renewable energy generation.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	In accordance with the assumptions in Appendix A, as well as USCG and Federal Aviation Administration requirements, aviation hazard lighting from up to 709 WTGs (out of 775 assumed as part of the No Action Alternative) could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Nighttime views of lights on offshore wind energy structures could affect decisions of visitors in selecting coastal locations to visit or potential residents selecting residences. These lights would be incrementally added over the 6- to 10-year construction period, and would be visible for the assumed 30-year operating life of the No Action Alternative projects. Visibility would depend on distance from shore, topography, and atmospheric conditions. ADLS, if implemented, would reduce the amount of time that WTG lighting is visible, thus reducing impacts on demographics, employment, and economics associated with lighting.	Aviation hazard lighting from all the Proposed Action's WTGs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions, for the duration of the Proposed Action's 30-year operational life. When illuminated, lighting on WTGs would be visible from higher elevations and some locations along the coastline of Martha's Vineyard and Nantucket, possibly affecting visitor decisions on which locations to visit. Vineyard Wind has committed to implement ADLS as a voluntarily measure, which would activate the Proposed Action's WTG lighting when aircraft approach the WTGs, which is expected to occur less than 0.1% of annual nighttime hours. This would have localized, long-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would result from impacts on businesses serving the recreation and tourism industry caused by the visibility of aviation hazard lighting for the Proposed Action's WTGs from some beaches and coastal locations on Martha's Vineyard and Nantucket. The presence of these lights could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have localized, long-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would add widespread lighting on onshore structures, along with minimal offshore lighting. Impacts from future offshore wind activities would be similar to those of the Proposed Action, due to aviation hazard lighting from 709 total WTGs (including the Proposed Action) visible from the same locations as the Proposed Action, as well as additional coastal locations in Massachusetts and Rhode Island. In the context of reasonably foreseeable trends, combined structure lighting impacts on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action would be localized, long-term, constant, and **negligible** to **minor**, specifically in locations where lighting from more than one project is visible, along with onshore lighting. Onshore lighting from ongoing activities would be closer to onshore viewers (who would thus perceive onshore lighting as more intense), and onshore lighting would generally contribute the largest part of the impact of lighting on structures, except in cases where minimal onshore lighting is present. ADLS, if implemented on offshore wind projects other than the Proposed Action, would reduce impacts to **negligible.**

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	See Section 3.11.1 and Table 3.11-1. Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.	Lighting for construction or maintenance vessels would be needed during early morning, dusk, or nighttime transit or work activities. Concurrent construction of up to four offshore wind projects could occur, all potentially contributing to nighttime vessel traffic. Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction.	Lighting for vessels in transit and in the offshore work area would occur when Project construction or maintenance takes place during early morning, dusk, or nighttime hours. Short-term vessel lighting is not anticipated to discourage tourist-related business activities and would not affect other businesses; therefore, lighting would have localized, intermittent, short-term, **negligible** impacts.	Vessel lighting from the Proposed Action construction or maintenance would have short-term, **negligible** impacts on demographics, employment, and economics. Vessel lighting from ongoing activities and future non-offshore wind vessel traffic would likely grow modestly. Future offshore wind activities could result in short-term increases in nighttime vessel transits and offshore work depending on the extent of nighttime construction work. The increased volume of vessel lights may be visible from coastal accommodations and tourist-serving businesses, but is not anticipated to discourage tourist business. Therefore, in the context of reasonably foreseeable trends, combined vessel lighting impacts on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action would be localized, intermittent, short-term, and **negligible**.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for demographics, employment, and economics there are six existing power cables. See Appendix A, Table A-5 for details.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables, perhaps including those connecting Martha's Vineyard and/or Nantucket to the mainland, would disturb the seafloor and cause temporary increases in suspended sediment resulting in infrequent, localized, short-term impacts over the next 30 years.	Cable installation for each project could temporarily impact commercial/for-hire fishing businesses by reducing income and increasing costs during installation due to the need to relocate away from work areas, the disruption of fish stocks. Cable emplacement would have larger impacts on fixed-gear fisheries because they are highly territorial. It would be far more difficult for fixed-gear operators to adapt to removal of gear during cable installation. About 3,398 acres (13.8 km^2) of seafloor disturbance would occur, resulting in fishing vessels not likely having access to affected areas during active construction. Concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers/dredgers over the long term. See Section 3.10.	Cable installation could temporarily impact commercial/for-hire fishing businesses by reducing income and increasing costs during installation due to the need to relocate away from the 61 mile (98 kilometers) OECC work area, approximately 233 acres (0.9 km^2) of seafloor disturbance, the disruption of fish stocks, and the prevention of fixed gear deployment in the work area. Concrete mattresses covering cables in hard-bottom areas (estimated to be less than 10% of OECC and inter-array cable route length—Section 2.1.1) could hinder commercial trawlers/dredgers over the long term. Installation would have localized, short-term, and **minor** impacts on demographics, employment, and economics, while maintenance would have isolated, long-term, **negligible** impacts.	The impacts on demographics, employment, and economics from this IPF under the Proposed Action would include temporary, localized hindrances to commercial/for-hire fishing businesses during cable emplacement; periodic disturbance of commercial fishing when maintenance is needed; and long-term prevention of commercial trawlers/dredgers where concrete mattresses are used to cover cable. Installation would have localized, short-term, **minor** impacts on demographics, employment, and economics, while maintenance would have isolated, long-term, **negligible** impacts. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts, especially along the routes of potential cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In the context of reasonably foreseeable trends, combined cable emplacement impacts on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be temporary and localized, except for long-term impacts on commercial trawlers and dredgers in areas where concrete mattresses are used, and would be **minor**.
Noise: O&M	None	Not applicable	Economic impacts on commercial fishing businesses and recreational businesses could result from impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (Sections 3.2 through 3.5); and noise from maintenance and repair operations that make the wind energy facilities less attractive to fishing operators and recreational boaters.	Economic impacts on commercial fishing businesses and recreational businesses could result from impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities within the WDA (Sections 3.2 through 3.5); and noise from maintenance and repair operations that make the wind energy facilities less attractive to fishing operators and recreational boaters. This would have, localized, intermittent, long-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary, periodic noise from maintenance that may affect businesses due to the impact on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing. This would have localized, intermittent, long-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would only occur where operational maintenance and repair noise from the Proposed Action and the South Fork Wind Project was simultaneously audible, and would therefore be localized, intermittent, long-term, and **negligible**.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the geographic analysis area for demographics, employment, and economics other than ongoing activities.	Noise from pile driving from offshore wind activities could result in temporary impacts on employment and economics due to the impact on commercial fishing and marine recreational businesses. Pile-driving noise would affect commercial and for-hire fishing businesses due to the impacts on fish populations. The Revolution Wind and Sunrise Wind Projects are the other projects that could potentially generate pile-driving noise at the same time as the Vineyard Wind 1 Project.	See Sections 3.3 and 3.10. Noise from pile driving for the Proposed Action could result in temporary impacts on employment and economics due to the impact on commercial fishing and marine recreational businesses. Pile-driving noise would affect commercial and for-hire fishing businesses due to the impacts on fish populations. This would have localized, short-term, intermittent, **negligible**, impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary noise that may affect businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing. This would have localized, intermittent, short-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts in nearshore areas. Future offshore wind activities would not contribute to this sub-IPF. In the context of reasonably foreseeable trends, combined pile-driving noise impacts on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would also be **negligible** because pile-driving noise from the Proposed Action and ongoing activities would not be simultaneously audible due to the distance between the Proposed Action and other potential pile-driving locations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Cable laying/trenching	Infrequent trenching for pipeline and cable laying activities emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 30 years for repair or new installation of underground infrastructure.	Offshore and onshore trenching would occur during construction (installation of offshore and onshore cables) and rarely during operations (maintenance and repair). Noise from onshore cable installation could temporarily disrupt business operations. The South Fork Wind Project is the only other project that could potentially generate noise from trenching and cable laying at the same time as the Vineyard Wind 1 Project.	See Sections 3.3 and 3.10. Noise from trenching for the Proposed Action could result in temporary impacts on employment and economics due to the impact on commercial fishing, marine recreational businesses, and onshore recreational businesses. Trenching noise would affect commercial and for-hire fishing businesses due to the impacts on fish populations, and would affect onshore recreational businesses due to noise near public beaches, parks, residences, and offices. This would have localized, intermittent, short-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include: • Temporary offshore noise that may affect businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing • Temporary onshore noise that would inconvenience beach visitors, residents, and workers This would have localized, intermittent, short-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would infrequently contribute similar types of impacts as the Proposed Action. Future offshore wind activities (limited to the South Fork Wind Project) and onshore wind activities would have similar contributions as the Proposed Action. Offshore impacts from this sub-IPF from more than one action or project at a time would not occur, because trenching noise from the Proposed Action and the South Fork Wind Project would not be simultaneously audible due to the distance between the projects and construction timing. Onshore impacts from more than one action or project at a time would only occur if multiple onshore trenching activities are simultaneously audible. In the context of reasonably foreseeable trends, combined trenching noise impacts on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action are expected to be rare, localized, intermittent, and short-term, with **negligible** impact.
Noise: Vessels	See Section 3.11. Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.	Vessel traffic noise would be generated for installation, maintenance, and repair. Economic impacts on commercial fishing businesses and marine recreational businesses could result from vessel noise impacts on recreational boaters and on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities. Vessel traffic would occur over the life of each wind energy facility and would be variable in all phases.	See Sections 3.3 and 3.10. Vessel noise from the Proposed Action could result in temporary impacts on employment and economics due to the impact on commercial fishing, marine recreational businesses, and onshore recreational businesses. Vessel noise would affect commercial and for-hire fishing businesses, due to the impacts on fish populations, and would affect onshore recreational businesses due to noise near the Port of New Bedford staging area, other ports used for staging during construction, and the Vineyard Haven harbor for operations. This would have intermittent, short-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary offshore noise that may affect businesses due to impacts on commercial fishing, recreational fishing, and marine sightseeing. This would have short-term, intermittent, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts as the Proposed Action, especially near ports and docks. Future offshore wind activities would have similar contributions as the Proposed Action. Impacts on demographics, employment, and economics from more than one project at the same time would most frequently occur near ports used to support offshore wind energy project construction, and occasionally farther offshore where vessels associated with multiple projects are simultaneously audible. In the context of reasonably foreseeable trends, combined vessel noise impacts on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action would be continuous, long-term, and **negligible**.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The Marine Commerce Terminal at the Port of New Bedford was upgraded by the port specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports and to be able to host larger deep-draft vessels as they continue to increase in size.	Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would support port investment and employment, and would also support jobs and businesses in supporting industries and commerce. A recent report by the American Wind Energy Association (AWEA 2020) lists over $1.3 billion in announced investments in wind energy manufacturing facilities, ports, and vessel construction in Atlantic states. Offshore wind energy development could support $14.2 to 25.4 billion in output, $7 to 12.5 billion in value added, and 45,500 to 82,500 jobs by 2030 (concentrated in Atlantic states but also including other areas of the United States).	The Proposed Action has committed to using the Marine Commerce Terminal at the Port of New Bedford for staging and loadout. Port expansion for offshore wind has been completed. The Proposed Action would provide an economic return for the port's investment and would support jobs and businesses in downtown New Bedford. Construction would also provide commerce for other ports within the study area. Operation of the Proposed Action facility would provide business for the harbor marine support businesses near Vineyard Haven, where the operations center would be located, as well as the Port of New Bedford. This would have long-term, **minor beneficial** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include greater economic activity and increased employment at the Port of New Bedford (and to a lesser degree, near Vineyard Haven), due to the demand for ship maintenance services and related supplies, vessel berthing, loading and unloading, warehousing, and fabrication facilities for offshore wind components and other related business activity related to offshore wind. This would have long-term, **minor beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts as the Proposed Action at numerous ports. Future offshore wind activities would also have similar contributions as the Proposed Action, but in a wider range of ports. Impacts on demographics, employment, and economics from the Proposed Action plus other offshore wind projects at the same time would most frequently occur near the Port of New Bedford, which was upgraded specifically to support the offshore wind energy industry, but also at other ports in the geographic analysis area for demographics, employment, and economics. Port utilization and a trained and skilled workforce for the offshore wind industry would contribute to beneficial economic activity in port communities and in the region as a whole, and would constitute a long-term, **moderate beneficial** impact.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Port utilization: Maintenance/ dredging	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. As ports expand, maintenance dredging of shipping channels is expected to increase.	Ports would need to perform maintenance and upgrades over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.	Maintenance and dredging to support offshore wind development would be beneficial to port usage and economic activity. The South Fork Wind Project would like to dredge the O&M facility to be established on Long Island. Risk would increase during maintenance over the 30-year period.	The Proposed Action is not considering maintenance dredging at this time; therefore, there would be no impacts.	The Proposed Action would not contribute to impacts on demographics, employment, and economics from this sub-IPF. Ongoing activities and future non-offshore wind activities that lead to maintenance dredging would contribute increased economic activity due to improved port access for commercial shipping, passenger vessels, and commercial fishing. Future offshore wind activities would have similar contributions as ongoing non-wind activities in ports used to support the offshore wind industry. Because the Proposed Action would not contribute impacts, there would be no collective impacts on demographics, employment, and economics from combined ongoing and planned actions including the Proposed Action for this sub-IPF.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Wind energy project structures would add up to 775 WTGs and 20 ESPs, increasing the potential for vessels to allide with structures, which would affect the businesses that operate commercial or for-hire fishing vessels and commercial recreation vessels such as tour boats. Vessel operators may take longer routes to navigate around or through offshore wind facilities to avoid allision, which would affect their fuel costs, operating time, and revenue. The impacts would increase as additional wind energy projects limit the ocean surface available for transiting and fishing, and would become constant once all potential wind energy projects are in operation.	The Proposed Action would add up to 57 WTGs and 2 ESPs, increasing the potential for vessels to allide with structures, which would affect the businesses that operate commercial or for-hire fishing vessels and commercial recreation vessels such as tour boats. Vessel operators may take longer routes to navigate around or through offshore wind facilities to avoid allision, which would affect their fuel costs, operating time, and revenue. This would have continuous, long-term, and **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include a long-term increased risk of allision for vessels in the WDA due to the presence of up to 59 offshore wind energy structures. Allisions with a WTG or an ESP could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have continuous, long-term, **minor** impacts on demographics, employment, and economics. Allision risks associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would also increase the risk of allision at a larger scale than the Proposed Action due to the potential for up to 774 WTGs and 20 ESPs. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, and would thus be continuous, long-term, and **moderate**.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are costs for gear owners, and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	The presence of up to 775 WTGs and 20 ESP foundations, along with hard cover for scour and cable protection add up to 1,029 acres (4.2 km^2) of hard coverage which would increase the risk of gear loss connected with cable mattresses and structures along the East Coast, which would increase economic impacts on the commercial and for-hire recreational fishing industries.	The presence of up to 57 WTGs, 2 ESPs, and approximately 109 acres (0.4 km^2) of hard coverage associated with the Proposed Action would increase the risk of gear loss connected with cable mattresses and structures along the East Coast, which would increase economic impacts on the commercial and for-hire recreational fishing industries. This would have intermittent, short-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include periodic, long-term, economic impacts resulting from impacts on the commercial fishing industry from gear loss and entanglement with the Proposed Action's 59 offshore structures and use of concrete mattresses to cover some cable segments. This would have intermittent, short-term, **negligible** impacts on demographics, employment, and economics. Impacts from gear loss and entanglement associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would also increase the risk of gear loss and entanglement, at a larger scale than the Proposed Action, due to the potential for up to 775 WTGs and 20 ESPs and additional use of concrete mattresses. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be continuous, long-term, and **moderate**.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations, which may be known as fish aggregating devices (FADs). Recreational and commercial fishing can occur near the FADs, although recreational fishing is more popular	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Up to 413 acres (1.7 km^2) of hard coverage for future offshore wind foundations could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels. These structures would be less likely to attract commercial fishing vessels, due to differences in fishing techniques. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities, but could potentially result in broad changes in recreational fishing practices if fish attraction and reef effects are widespread enough to encourage more participants to travel farther from shore.	Approximately 109 acres (0.4 km^2) of hard coverage for the Proposed Action's WTGs and ESPs and cable protection could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels from the proposed 59 foundations. These structures would be less likely to attract commercial fishing vessels due to differences in fishing techniques. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include limited increases in recreational fishing activity (and associated economic activity) associated with fish aggregation and reef effects that could occur at some of the Proposed Action's 59 offshore structures. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action but on a larger scale. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be long-term with **minor beneficial** impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	because commercial mobile fishing gear is more likely to snag on FADs.				
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Up to 413 acres (1.7 km^2) of hard coverage for future offshore wind foundations could create foraging opportunities for seals and small odontocetes (toothed whales), possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase economic activity associated with offshore sightseeing. New structures would be added intermittently over an assumed 6- to 10-year period and could benefit structure-oriented species as long as the structures remain.	Approximately 109 acres (0.4 km^2) of hard coverage for the Proposed Action's WTGs and ESPs and cable protection could create foraging opportunities for seals, small odontocetes, and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase economic activity associated with offshore sightseeing. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include increased sightseeing vessel activity (and associated economic activity) in the WDA if marine mammals were attracted to any reef-like habitats created by WTG and ESP foundations. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be long-term with **minor beneficial** impacts.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.	Increased navigational complexity of navigating through offshore wind facilities (totaling up to 775 WTGs and 20 ESPs) would affect marine businesses, adding time, fuel costs, and risk and requiring adequate technological aids and trained personnel for safe navigation. Impacts would increase as each facility is built and completed starting in 2022 and continuing through 2030.	See Section 3.11. Increased navigational complexity of navigating through the Proposed Action's 57 WTGs and 2 ESPs would affect marine businesses, adding time, fuel costs, and risk and requiring adequate technological aids and trained personnel for safe navigation. This would have continuous, long-term, **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include increased expenditures on training and increased travel time for commercial/for-hire fishing businesses, tour boats, and other marine businesses that must transit through or operate within the WDA. This would have continuous, long-term, **minor** impacts on demographics, employment, and economics. Impacts from navigation hazards associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry with up to 795 foundations, and would thus be long-term and **moderate**.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy structures could affect established sailboat races (including, but not limited to, the Transatlantic Race and the Marion to Bermuda Race), HMS (highly migratory species) fishing, tour boat routes, for-hire recreational boating and fishing, and commercial fishing locations and techniques. The geographic analysis area of impacts would increase as additional wind energy facilities are completed.	The Proposed Action's WTGs and ESPs could affect established sailboat races (including, but not limited to, the Transatlantic Race and the Marion to Bermuda Race), tour boat routes, for-hire recreational boating and fishing, HMS fishing, and commercial fishing locations and techniques. This would have long-term, **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include increased travel time and associated expenditures for commercial/for-hire fishing businesses, tour boats, and other marine businesses seeking new operating areas and transit routes due to the presence of the Proposed Action's structures. This would have long-term, **minor** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be long-term and **moderate**.
Presence of structures: Viewshed	No existing offshore structures are within the viewshed of the WDA except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Section 3.9. Economic impact would result from impacts on businesses serving the recreation and tourism industry; these would be permanent impacts over 30 years. With full build-out of the RI and MA Lease Areas, portions of up to 775 WTGs could potentially be visible from parts of the mainland, Block Island, Martha's Vineyard, and Nantucket, depending on atmospheric conditions and viewing location. The Block Island Wind facility has resulted in businesses offering boat tours for visitors and	See Section 3.9. Economic impacts of the Proposed Action would result from impacts on businesses serving the recreation and tourism industry. Portions of all of the Proposed Action's WTGs could potentially be visible on the horizon from certain beaches and coastal locations on Martha's Vineyard, Nantucket, and Cape Cod, depending on atmospheric conditions and viewing location. WTGs would be visible to recreational boaters, but boaters could choose their route to avoid waters where the WTGs are visible,	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would result from impacts on businesses serving the recreation and tourism industry caused by the possible visibility of portions or all of the Proposed Action's WTGs and associated nighttime lighting from some beaches and coastal locations on Martha's Vineyard, Nantucket, and Cape Cod. The presence of these structures could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have continuous, long-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute (or would contribute imperceptibly) to this sub-IPF. Impacts from future offshore wind activities would be similar to those of the Proposed Action, due to the possible visibility of portions of up to 775 WTGs visible from the same locations as the Proposed Action, as well as

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			local residents desiring a close-up view of the wind turbines.	if desired. The Proposed Action construction could prompt boat tours, similar to those available for the Block Island Wind facility. This would have continuous, long-term, **negligible** impacts on demographics, employment, and economics.	additional coastal locations in Massachusetts and Rhode Island. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease areas and would remain continuous, long-term, and **negligible**.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Additional communication cables run between the U.S. East Coast and European countries along the eastern Atlantic.	See Table 3.12-1. No known proposed structures not associated with offshore wind development are reasonably foreseeable.	Installation of offshore cables for each offshore wind energy facility would require temporary rerouting of all vessels away from areas of active construction. These activities would temporarily affect the commercial fishing, recreation, tourism, and marine shipping industries due to temporary displacement of economic activity. During operations, periodic maintenance could have similar impacts, although these activities would be less frequent and extensive than installation. Permanent impacts would be limited to possible hindrances to certain commercial fishing methods based on offshore cable coverage methods. Onshore cable installation could require rerouting of vehicular traffic or could briefly affect access to businesses (similar to other utility installations) resulting in temporary inconvenience.	Economic impact from the Proposed Action would result from impacts on commercial fishing, recreation, tourism, and marine shipping industries. Vessel traffic would need to temporarily avoid the portions of the OECC route undergoing active construction. Onshore cable installation would result in temporary road delays and temporary disturbance of public beach during landfall installation. During operations, vessels would need to avoid areas of temporary maintenance and repair. For onshore cable, occasional road disturbance would result from repairs and maintenance. This would have localized, short-term, **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary disruptions of shipping traffic, commercial fishing, ferries, and recreational and tourist-related vessels in the installation or maintenance/repair area and a temporary reduction in economic activity near onshore installation sites, including beaches and roads along the onshore cable route. This would have localized, short-term, **minor** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action along cable routes associated with individual offshore wind energy facilities. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be localized, short-term, and **minor**.
Traffic: Vessels	See Section 3.11. Study area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the study area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the study area economy.	Substantial, beneficial economic activity would result from the demand for vessels, crews, berths, and related support businesses. Offshore wind development would support ports and shipping-related industries and businesses. Business would increase during development, and a lower level of activity would be sustained during operations.	Short-term, **minor beneficial** economic activity would result from the demand for vessels, crews, berths, and related support businesses for the Proposed Action construction, supporting the port and marine businesses at New Bedford. Long-term, **negligible beneficial** economic activity would result from operations at New Bedford and Vineyard Haven.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include new, short-term, **minor beneficial** economic activity during construction and long-term, **negligible beneficial** economic activity during operations for ports, marine transportation, and supporting businesses, specifically in New Bedford and Vineyard Haven. Ongoing activities and future non-offshore wind activities such as proposed barge routes and dredging would also contribute new economic activity. Future offshore wind activities would have similar contributions as the Proposed Action, but in a wider range of ports. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those for the Proposed Action, and would occur at ports used to support wind energy projects throughout the geographic analysis area for demographics, employment, and economics, and would thus have **minor to moderate beneficial** impacts.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	No substantial changes anticipated.	Offshore wind activity could result in vessel traffic congestion, with increased risk of collisions at ports used to support offshore wind development. Collisions could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills, which could have adverse economic impact.	Increased vessel traffic at the Port of New Bedford (and to a lesser degree in open ocean between New Bedford and the WDA) during construction could increase risk of collisions. Vessel traffic during operations would be modest in volume. Collisions could have adverse economic impact. This would have localized, short-term, **minor** impacts on demographics, employment, and economics during construction and decommissioning, and localized, long-term, **negligible** impacts during operation.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include a long-term increased risk of collisions for vessels in the WDA due to the presence of up to 59 offshore wind energy structures and the need for corresponding maneuvers to avoid these structures. Collisions could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, short-term, **minor** impacts on demographics, employment, and economics during construction and decommissioning, and localized, long-term, **negligible** impacts during operation. Collision risks associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would also increase the risk of collision at a larger scale than the Proposed Action due to the installation of wind energy structures throughout the RI and MA Lease Areas. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action, would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, and would be localized, short-term, and **minor** during construction and decommissioning, and localized, long-term, and **negligible** during operation.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Land disturbance: Onshore construction	Onshore development activities support local population growth, employment, and economies. Disturbances can cause temporary, localized traffic delays and restricted access to adjacent properties. The rate of onshore land disturbance is expected to continue at or near current rates.	Onshore development projects would be ongoing in accordance with local government land use plans and regulations.	Offshore wind development would result in onshore cable installation and substation construction or expansion. In addition, potential improvements or expansions at ports within the geographic analysis area are planned to support multiple wind energy projects.	Temporary road and beach disturbance would result from the Proposed Action onshore cabling construction. The substation is in an industrial area and construction would not affect other businesses or roads. Land disturbance would have localized, short-term, **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary disturbance of businesses adjacent to roads where the onshore cable would be installed, as well as increased economic activity for local businesses that participate in construction. This would have localized, short-term, **minor** impacts on demographics, employment, and economics. Impacts associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would have similar contributions as the Proposed Action, but in a wider range of onshore installation locations. In the context of reasonably foreseeable trends, combined impacts from this sub-IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action would only occur if onshore construction of multiple projects occurs simultaneously and in a similar location, and would be localized, short-term, and **minor**. Such impacts are most likely to occur near the Marine Commerce Terminal or other study area ports, if multiple wind energy projects require port upgrade or expansion.
Climate change: Warming and sea level rise, storm severity/ frequency, property and infrastructure damage	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries and other natural resources, increased disease frequency, and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.	Increased storm severity and frequency would result in potential property loss or damage to property and infrastructure, increased insurance costs, and reduced economic viability of coastal communities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of storm severity/frequency.	The Proposed Action would provide a small contribution to reduction of emissions, resulting in a long-term, **negligible beneficial** impact on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this IPF under the Proposed Action would include a small reduction in or avoidance of emissions from power generation resulting in a long-term, **negligible beneficial** impact on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would have ongoing impacts. Future offshore wind activities would have similar contributions as the Proposed Action, but at a larger scale. In the context of reasonably foreseeable trends, combined impacts from this IPF on demographics, employment, and economics from ongoing and planned actions, including the Proposed Action would be the same as the Proposed Action, but at a greater scale, due to the combined impacts of the Proposed Action, ongoing activities and non-offshore wind activities, and other future offshore wind activities, and would thus have long-term, **minor beneficial** impacts.
Climate change: Ocean acidification			Increased ocean acidification would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of ocean acidification.		
Climate change: Warming and sea level rise, altered habitat/ecology			Altered habitats and ecology would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of altered habitats and ecology.		
Climate change: Warming and sea level rise, altered migration patterns			Altered migration patterns would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of altered migration patterns.		

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Warming and sea level rise, increased disease frequency			Increased disease frequency in marine species would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of increased disease frequency.		
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)			Sea level rise and increased storm severity and frequency would result in the need for additional protective measures. Construction of barriers and sea walls would generate employment, but would require substantial public funding. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the need for public spending on protective measures.		
Climate change: Warming and sea level rise, storm severity, frequency, sediment erosion, deposition			Erosion and deposition could damage infrastructure, buildings, beaches, and coastal land, leading to increased insurance costs, adverse impacts on recreation and tourism, and reduced economic viability of coastal communities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce economic impacts associated with sediment erosion and deposition.		

ADLS = Aircraft Detection Light System; BOEM = Bureau of Ocean Energy Management; Btu = British thermal unit; ESP = electrical service platform; FADs = fish aggregating devices; FCC = Federal Communications Commission; GDP = gross domestic product; GW = gigawatts; HMS = Highly Migratory Species; IPF = impact-producing factors; km^2 = square kilometers; MA = Massachusetts; MW = megawatt; NA = not applicable; NOAA = National Oceanic and Atmospheric Administration; O&M = operations and maintenance; OECC = Offshore Export Cable Corridor(s); RI = Rhode Island; SAR = search and rescue; USCG = United States Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.6-2: Rhode Island Seafood Industry Employment and Sales 2016

Category	Number of Firms	Sales, Million $	Number of Employees
Commercial fishing	150	88.39	1,711
Charter	75	19.99	182
Seafood processing	11	67.05	215
Retail seafood dealers	26	11.57	136
Tackle shops, service and supplies, professional services	70	105.08	287
Wholesalers (includes seafood importers)	96	246.26	617
Total	428	538.33	3,147

Source: Sproul and Michaud 2018

Table 3.6-3: Vineyard Wind's Projected Jobs and Expenditures during Preconstruction, Construction, and Installation (Base Case)

		Massachusetts Statewide	Southeastern Massachusetts
Jobs (FTE) [a]	Direct	1,100	1,071
	Indirect	373	215
	Induced	898	666
	Total	2,371	1,952
Direct labor income (thousands)		$114,858,283	$91,502
Direct expenditures other than payroll (thousands) [b]		$177,363	$104,850

Source: Borges et al. 2017a, available in COP Volume III, Appendix III-L; Epsilon 2020b

[a] One FTE (full-time equivalent) 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. Only those jobs that Vineyard Wind would perform in the designated area are included. Borges et al. (2017a) considers a local worker one who moves to the region to work on the Proposed Action and then moves on when the Proposed Action is over.

[b] Amount to be spent procuring materials and services from suppliers in the designated area to support the development and construction of the wind facility

Table 3.6-4: Projected Tax Revenues during Development, Construction, and First Year Operations and Maintenance (Base Case)

Type of Tax	Estimated Revenue
Personal income taxes	$4,133,000
Other personal taxes	$547,000
Payroll taxes [a]	$67,000
Sales taxes	$3,019,000
Property taxes	$5,178,000
Corporate income taxes	$1,231,000
Fees and other taxes	$500,000
Total	$14,674,000

Source: Borges et al. 2017a, available in COP Volume III, Appendix III-L; Epsilon 2020b

[a] Includes both employee and employer paid payroll taxes

Table 3.6-5: Jobs and Economic Impacts during Operations and Maintenance (Base Case)

		Massachusetts Statewide	Southeastern Massachusetts
Jobs (FTE) annually [a]	Direct	80	80
	Indirect and induced	89	89
	Total	169	169
Annual labor income (thousands)	Direct	$8,151	$8,151
	Indirect and induced	$6,356	$4,047
	Total	$14,507	$12,198
Annual expenditures (thousands) [b]	Direct	$5,215	$4,606
	Indirect and induced	$6,199	$5,079
	Total	$11,414	$9,684
Annual added economic value (thousands) [c]	Direct	$3,846	$2,388
	Indirect and induced	$9,937	$6,469
	Total	$13,783	$8,857

Source: Borges et al. 2017a, available in COP Volume III, Appendix III-L; Epsilon 2020b

[a] One FTE (full-time equivalent) 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. Only those jobs performed in the designated area are included in Borges et al. (2017a). Borges et al. (2017a) considers a local worker one who moves to the region to work on the Proposed Action and then moves on when the Proposed Action is over.

[b] Amount to be spent procuring materials and services from suppliers in the designated area to support the operations and maintenance of the offshore wind facility, excluding labor costs

[c] Economic value generated by operations and maintenance of the Proposed Action, excluding direct expenditures

Table 3.7-1: Summary of Activities and the Associated Impact-Producing Factors for Environmental Justice

Baseline Conditions: The area of analysis for impacts on environmental justice includes counties where proposed Project onshore infrastructure and potential ports are located as well as counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island) (Appendix A, Figure A.7-7).

Environmental justice communities that meet both USEPA and statewide criteria occur in counties where the proposed Project facilities would be located, as well as in or near the communities where impacts associated with construction and installation, operations and maintenance, and decommissioning activities may occur. Appendix F.2 of the FEIS provides maps of environmental justice communities in these areas. The environmental justice communities in the screened Massachusetts counties are most commonly clustered around larger cities and towns, including Hyannis, New Bedford, and Fall River. Environmental justice communities are present on Nantucket near the communities of Cisco, and near the airport and on Martha's Vineyard in Vineyard Haven and near Aquinnah. Additional environmental justice communities occur in Cape Cod and scattered throughout southeastern Massachusetts. Outside Massachusetts, environmental justice communities are found clustered around Providence and Newport, Rhode Island.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Air emissions: Construction/ decommissioning	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.	Increased port activity during construction would generate short-term, variable increases in air emissions from engines (vessels, trucks, equipment) that could have disproportionate impacts on environmental justice communities. Several of the ports within the analysis area that could be used for offshore wind staging and shipping (the ports of New Bedford, Providence, and Quonset-Davisville) are within or close to environmental justice communities.	Construction of the Proposed Action would primarily use the MCT in the Port of New Bedford and could also use the ports of Providence and Quonset-Davisville, which are within or near environmental justice communities. Increased short-term and variable emissions from Proposed Action construction operations would have **negligible** disproportionate adverse impacts on these communities near the ports. In New Bedford, existing and planned land uses buffer residential neighborhoods from port impacts.	The impacts on environmental justice communities from this sub-IPF under the Proposed Action would include short-term, variable air emissions from the Port of New Bedford that would have **negligible** impacts on environmental justice populations due to distance from, and buffers for, the neighborhoods closest to the port. Ongoing activities and future non-offshore wind activities would result in increased air emissions, which may disproportionately affect environmental justice communities. Future offshore wind activities would have similar contributions to the Proposed Action, but for additional neighborhoods near other ports used to support wind energy facility development. In context of reasonably foreseeable environmental trends, combined impacts from this sub-IPF on environmental justice communities from ongoing and planned actions, including the Proposed Action would be, variable, **negligible** to **minor** impacts, with the higher impacts occurring if multiple projects generate air emissions at the same ports near environmental justice neighborhoods.
Air emissions: Operations and maintenance	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.	See Section A.8.1 and Table A.8.1-1 in Appendix A. Increased port activity during operations would generate long-term, variable increases in air emissions from engines (vessels, trucks, equipment); however, the volume of vessel traffic and port activity related to operations are anticipated to be low, and the offshore wind industry may replace other industries no longer operating near ports. Several of the ports within the analysis area that could be used for vessel traffic related to operations are within or near environmental justice communities.	The Proposed Action operations would use the ports of Vineyard Haven on Martha's Vineyard and the Port of New Bedford. Both are near environmental justice communities. Vessel trips and portside work related to operations are anticipated to be low in frequency, and air emissions would not be substantially different from the background levels of port activity. Air emissions would have **negligible** adverse impacts on environmental justice communities.	The Proposed Action would have **negligible** impacts on environmental justice communities from this sub-IPF. Ongoing activities and future non-offshore wind activities would result in increased air emissions, which could disproportionately affect environmental justice communities. Future offshore wind activities would have similar contributions as the Proposed Action, and thus would not contribute disproportionate impacts on environmental justice communities from this sub-IPF. Because the air emissions during operations and maintenance would be low, **negligible** impacts on environmental justice communities are anticipated from this sub-IPF the context of reasonably foreseeable trends, from ongoing and planned actions including the Proposed Action.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	The view of nighttime lighting on offshore structures could affect the decisions of potential tourists or visitors in selecting coastal locations to visit. Impacts on tourism-related businesses, if any, are anticipated to be localized, not industry-wide, so would have little long-term, detrimental impact on the recreation and tourism industry as a whole, and the low-income employees of these businesses. Lighting on WTGs could also affect cultural and historic resources, including views of night sky and the ocean that are important to Native American tribes. The number of visible lights would increase	Vineyard Wind has voluntarily committed to implementing ADLS (as described in Section 3.9.2), which would activate the Proposed Action's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. When illuminated, lights from all of the Proposed Action's WTGs would be visible from certain coastlines and overlooks on Nantucket, Martha's Vineyard, and Cape Cod, depending on atmospheric conditions and exact viewing location. The visibility of nighttime lighting from certain locations could affect decisions of potential tourists or visitors in selecting coastal locations to visit. Impacts on tourism-related businesses, if any, would not be anticipated to result in a long-term, detrimental impact on the	The impacts on environmental justice populations from this sub-IPF under the Proposed Action would result from effects on low-income workers in businesses serving the tourism industry and the effect on views from cultural and historic resources important to Native American tribes. With the use of ADLS, the Proposed Action's WTG lighting would have long-term, localized, **negligible** impacts on environmental justice populations. Ongoing activities and future non-offshore wind activities would generate increased onshore and nearshore lighting. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. In context of reasonably foreseeable environmental trends, combined lighting impacts on environmental justice populations from ongoing and planned actions, including Alternative A, would likely be continuous, long-term and **moderate**, resulting from the anticipated disproportionate impacts on cultural

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			during construction as additional structures are commissioned, resulting in lights from up to 709 WTGs visible from shorelines in the analysis area for environmental justice. With use of ADLS, nighttime offshore lighting would be intermittent and occasional rather than continual.	recreation and tourism industry within the study area as a whole, and therefore would be unlikely to have disproportionate impacts on the low-income employees of these businesses. Lighting on WTGs would also affect cultural and historic resources, including the Gay Head Cliffs on the southwestern coast of Martha's Vineyard and the Chappaquiddick Island TCP, that are important to Native American tribes. With the use of ADLS, the Proposed Action would have a continuous, long-term, **negligible** adverse impact on environmental justice communities.	resources important to Native American tribes. However, if implemented for projects other than the Proposed Action, ADLS would reduce the impacts on environmental justice communities associated with WTG lighting to **negligible**.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. Six existing power cables are in the analysis area. Refer to Appendix A for details.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables, perhaps including those connecting Martha's Vineyard and/or Nantucket to the mainland, would disturb the seafloor and cause temporary increases in suspended sediment, resulting in infrequent, localized, short-term impacts over the next 30 years.	Cable installation for each project could result in short-term impacts on low-income employees of commercial/for-hire fishing businesses by reducing revenue and increasing costs for these businesses during installation due to the need to relocate away from work areas, the disruption of fish stocks, and the prevention of fixed gear deployment in work areas (Section 3.10).These effects could also result in short-term impacts on subsistence fishing. In addition, cable emplacement could damage submerged ancient landforms that may have cultural significance to Native American tribes as part of ancient and ongoing tribal practices, and as portions of a landscape occupied by their ancestors (Section 3.8).	See Sections 3.9.2 and 3.10.2. Cable installation could have short-term impacts on low-income employees of commercial/for-hire fishing businesses by reducing income and increasing costs during installation. Marine operators would need to relocate away from the 61- to 69-mile (depending on the landfall location selected) Vineyard Wind 1 Project OECC work area. Cable installation would disrupt fish stocks and prevent fixed gear deployment in the work area. Installation would have short-term, **minor**, localized, adverse impacts on environmental justice populations that rely on subsistence fishing or employment/income from marine businesses. Maintenance of offshore cables would have long-term, isolated, **negligible** impacts. Cable emplacement would disrupt and damage 19 submerged ancient landforms that hold cultural significance for Native American tribes, threatening the value of these resources as potential repositories of archaeological knowledge and cultural significance to tribes. As a result, cable emplacement would result in **major** environmental justice impacts on the Native American tribes that consider the submerged landscapes to be part of their tribal practices. The state-recognized Chappaquiddick Wampanoag Tribe raised concerns regarding sediment and coastal erosion along Chappaquiddick Island from cable installation, which could impact traditional hunting, fishing, and shellfishing. The cable route for the Proposed Action would be at least 1,900 meters (6,230 feet) offshore from the shoreline. Section 3.1 concludes that sediment deposition greater than 0.04 inch (1 millimeter) would be mostly limited to within approximately 328 feet (100 meters) of the cable centerline. Accordingly, cable emplacement would have a **negligible** impact on fishing and shellfishing practices of the state-recognized Chappaquiddick Wampanoag Tribe due to coastal erosion and sediment deposition.	The impacts on environmental justice from this IPF under the Proposed Action would include impacts on subsistence fishing and low-income workers due to temporary, localized hindrances to commercial/for-hire fishing businesses during cable emplacement and periodic disturbance of commercial fishing when maintenance is needed, resulting in **minor**, localized, and short- term impacts on environmental justice populations. Additionally, this IPF would result in disproportionately adverse, **major** impacts on Native American tribes due to permanent damage to submerged ancient landforms, and **negligible** impacts on the state-recognized Chappaquiddick Wampanoag Tribe due to impacts of sediment and coastal erosion on Chappaquiddick Island's coastline. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts, especially along the potential routes of cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland. Future offshore wind activities would have similar contributions as the Proposed Action on marine businesses that support jobs for low income employees, but on a larger scale. As with the Proposed Action, future offshore wind projects would likely be unable to avoid impacts on all submerged landforms, but BOEM would work with tribes and consulting parties to develop project-specific treatment plans. In context of reasonably foreseeable trends, the combined cable emplacement impacts on environmental justice populations from ongoing and planned actions, including Alternative A, would be **minor** with respect to subsistence fishing and employees of marine businesses; and **major** with respect to permanent damage to submerged ancient landforms.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Operations and maintenance	Offshore operations and maintenance of existing wind energy projects generates negligible amounts of noise.	There are no reasonably foreseeable offshore facilities that would generate noise from operations/maintenance.	See Sections 3.6.1, 3.9.1, and 3.10.1. Operational noise is not anticipated to affect businesses or economic activity. Vessel activity at ports may increase slightly due to operations and maintenance, with a proportional increase in noise in the vicinity of environmental justice communities.	See Sections 3.6.2, 3.9.2, and 3.10.2. Operational noise is not anticipated to impact businesses or economic activity. Specific noise contributions due to port activity at the Port of New Bedford, Providence, and Quonset-Davisville on environmental justice communities are anticipated to be negligible.	The Proposed Action would contribute **negligible** impacts on environmental justice communities from this sub-IPF because operational noise would not be extensive or intense enough to disproportionately affect environmental justice communities or industries that employ low-income community members. Ongoing activities and future non-offshore wind activities generate negligible amounts of offshore noise. Future offshore wind activities would have similar impacts as the Proposed Action: possible noise at ports, with impacts on environmental justice communities, and insufficient noise to affect industries that employ low-income community members. The Proposed Action and future offshore wind activities would have **negligible** impacts on businesses and environmental justice communities near ports.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the analysis area other than ongoing activities.	See Sections 3.6.1, 3.9.1, and 3.10.1. To the degree that noise affects offshore businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.), and subsistence activities, these impacts could disproportionately affect low-income residents, employees of marine-dependent businesses, and members of Native American tribes who engage in cultural practices related to fishing, shellfishing, or marine mammals.	See Sections 3.6.2, 3.9.2, and 3.101.2. To the degree that noise from the Proposed Action affects offshore businesses (commercial and for-hire recreational fishing, boating, sightseeing, etc.) and subsistence activities, these impacts could disproportionately affect low-income residents, employees of marine-dependent businesses, and members of Native American tribes who engage in cultural practices related to fishing, shellfishing, or marine mammals. The Proposed Action is anticipated to have short-term, **negligible** impacts on the members of environmental justice populations who rely on subsistence fishing, employment, and income from marine businesses, or cultural practices related to fishing, shellfishing, or marine mammals.	Noise from pile driving could temporarily affect fish and marine mammal populations, hindering fishing and sightseeing near construction activity within the WDA, which could discourage some businesses from operating in these areas during pile driving. This would result in a localized, short-term, **negligible** impact on low-income jobs supported by these businesses, as well as on subsistence fishing and cultural practices related to fishing, shellfishing, or marine mammals. Ongoing activities and future non-offshore wind activities would occasionally generate additional pile-driving noise near ports and marinas, some of which may be near environmental justice communities. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. In context of reasonably foreseeable trends, the combined pile driving impacts on environmental justice populations from ongoing and planned actions, including the Proposed Action, would be **negligible to minor**, based on the assessment of potential impacts of pile-driving on boating, fisheries and marine mammals (Sections 3.4 and 3.10).
Noise: Trenching	Infrequent trenching for pipeline and cable laying activities emits noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 30 years for repair or new installation of underground infrastructure.	See Sections 3.6.1, 3.90.1, and 3.101.1. To the degree that trenching noise for installation of offshore or onshore cables affects onshore or offshore businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.) and subsistence activities, these impacts could disproportionately affect low-income residents, employees of businesses near onshore construction areas and marine-dependent businesses, and members of Native American tribes who engage in cultural practices related to fishing, shellfishing, or marine mammals.	See Sections 3.6.2, 3.9.2, and 3.10.2. To the degree that trenching noise for installation of the Proposed Action's offshore or onshore cables affects onshore or offshore businesses (commercial and for-hire recreational fishing, boating, sightseeing, etc.) and subsistence activities, these impacts could disproportionately affect low-income residents, employees of businesses near onshore construction areas, employees of marine-dependent businesses, and members of Native American tribes who engage in cultural practices related to fishing, shellfishing, or marine mammals. Significant impacts on onshore and marine businesses are not anticipated during the brief cable installation period. Short term, **negligible** impacts on low-income residents, employees, and Native American tribes are anticipated.	The Proposed Action would contribute short-term, **negligible** impacts on environmental justice communities from this sub-IPF. Noise from trenching could temporarily hinder commercial and recreational fishing, subsistence fishing, and recreational boating near construction activity within the WDA and along the OECC route, which could discourage some businesses from operating in these areas during trenching. This would result in a short-term, localized impact on the low-income jobs supported by these industries and subsistence fishing. Ongoing activities and future non-offshore wind activities generate additional offshore trenching noise associated with sand and gravel deposits and other offshore cables. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. Disproportionate impacts would occur if trenching noise from the Proposed Action and other projects hinder commercial and recreational fishing and business activities to the point where employment for low-income community members is reduced, or if this noise reduces subsistence fishing production. In context of reasonably foreseeable trends, the combined trenching impacts on environmental justice communities from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels (Section 3.11).	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.	See Sections 3.6.1, 3.9.1, and 3.10.1. Vessel noise is not anticipated to disproportionately affect environmental justice communities near ports, or marine businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.), and subsistence activities. Vessel noise would be more common during construction and decommissioning, would decrease as projects are completed or decommissioned, and would remain low and variable during the operational life of proposed projects.	See Sections 3.6.2, 3.9.2, and 3.10.2. Installation would generate the most intensive vessel traffic with attendant noise at the New Bedford Port and between New Bedford and the WDA. Vineyard Wind 1 Project construction would generate an average of 7 to 18 vessel trips per day from New Bedford or other ports to the WDA, as well as the noise at the MCT from construction staging and loading. Noise from construction vessel traffic is not anticipated to affect environmental justice communities near the port or commercial fishing and recreational fishing/boating/boat tours. Overall, vessel noise is anticipated to have short-term, variable, **negligible** impacts on environmental justice communities near the ports and low-income employees of marine businesses.	The Proposed Action would have variable, primarily short-term, **negligible** impacts on environmental justice communities from this sub-IPF. Vessel noise is not anticipated to affect environmental justice communities near the New Bedford Port during construction due to the buffers between the port and residential neighborhoods. Vessel noise would have negligible impacts on commercial and recreational fishing and boating in the vicinity of vessel routes to and within the RI and MA Lease Areas, and near offshore cable installation sites. Interruptions would be temporary, variable, and localized. Vessel noise from ongoing activities and future non-offshore wind activities would continue at current levels. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. In context of reasonably foreseeable trends, the combined vessel noise impacts on environmental justice communities from ongoing and planned actions, including the Proposed Action, would likely be **negligible**.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT at the Port of New Bedford is a completed facility developed by the port specifically to support the construction of offshore wind facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.	The Ports of New Bedford, Providence, and Quonset-Davisville Port are within or near neighborhoods with a high proportion of low income and/or minority residents. Other ports in the northeast that could support increased offshore wind energy activity may also be near environmental justice communities. Port expansion or increased activity within existing ports to accommodate offshore wind development could potentially have both beneficial impacts (through increased job availability), and negative impacts, if port expansion or increased activity leads to increased air emissions and noise.	Vineyard Wind has committed to using the MCT at the Port of New Bedford for staging and shipping project components; the terminal was built to support offshore wind. The city has established land use patterns to buffer nearby residential neighborhoods, including environmental justice populations, from the intensive port activity. Operation of the Vineyard Wind 1 Project would modestly increase vessel traffic near environmental justice populations in the vicinity of Vineyard Haven on Martha's Vineyard and the Port of New Bedford. No port expansion would occur as part of the Proposed Action. Negative impacts are noted above in the IPFs for air emissions and vessel noise.	The Proposed Action is not anticipated to contribute disproportionate impacts on environmental justice communities from this sub-IPF during construction and operation based on activity levels at the Port of New Bedford and Vineyard Haven Harbor. Negative impacts are noted above in the IPFs for air emissions and noise. Ongoing activities and future non-offshore wind activities could result in disproportionate impacts on environmental justice (also through impacts such as air pollution or noise) at multiple ports in Massachusetts and Rhode Island. Future offshore wind activities would have similar contributions as ongoing activities and non-offshore wind activities. In context of reasonably foreseeable environmental trends, combined vessel noise and air emissions impacts on environmental justice communities from ongoing and planned actions, including the Proposed Action, are noted above in the IPFs for air emissions and vessel noise.
Presence of structures: Entanglement, gear loss/ damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are costs for gear owners, and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Sections 3.67.1, 3.9.1, and 3.10.1. The presence of scour protection and cable mattresses from multiple wind energy facilities would increase the risk of gear loss connected with cable mattresses and scour protection structures along the east coast, which would increase economic impacts on the commercial and for-hire recreational fishing industries. Impacts on recreational and commercial fishing businesses could have disproportionate impacts on the low-income workers in those industries.	See Sections 3.6.2, 3.9.2, and 3.101.2. Vineyard Wind's 100 WTG and 2 ESP foundations and 152 acres of scour/cable protection would increase the local risk of gear loss/damage and the ensuing impacts on recreational and commercial fishing. Impacts on recreational and commercial fishing businesses could have **minor** impacts on the low-income workers in those industries or subsistence fishing by low-income residents.	The Proposed Action would contribute **minor** impacts on environmental justice communities from this sub-IPF, if WTGs, ESPs, and concrete mattresses cause gear loss or damage that results in meaningful reductions in employment or earnings for low-income employees of commercial and recreational fishing businesses, or reduced productivity of subsistence fisheries. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, over a wider area. In context of reasonably foreseeable environmental trends, combined impact from this sub-IPF on environmental justice communities from ongoing and planned actions, including the Proposed Action would be **minor** and would occur if entanglement and gear loss from multiple projects result in meaningful reductions in employment or earnings for low-income employees of commercial and recreational fishing businesses, or reduced productivity of subsistence fisheries.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure, and each other.	Vessel traffic is generally not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.	See Sections 3.9.1 and 3.10.1. Operation of up to 775 WTGs and 20 ESPs could create navigation hazards for vessels. To the degree that these hazards affect offshore businesses and subsistence activities, these impacts could disproportionately affect low-income residents and employees of marine-dependent businesses.	See Sections 3.9.2 and 3.10.2. Operation of the Proposed Action and its 100 WTGs and 2 ESPs would result in navigational hazards for recreational boaters and commercial or for-hire fishing throughout the Proposed Action's 30-year operating life. The risk of collisions or allisions could discourage mariners from traveling to and through the proposed Project area. Although the likelihood of such events would remain small, the risk of such events could affect the navigational decisions of some commercial fishing businesses that are accustomed to fishing within or	The Proposed Action would contribute **minor** impacts on environmental justice communities from this sub-IPF due to the necessary changes in navigation patterns to avoid hazards (including structures and vessels), if those changes are significant enough to meaningfully affect subsistence fishing or the employment or income of low-income community members (e.g., due to increased fuel use or travel time). The navigational hazards generated by ongoing activities and future non-offshore wind activities would remain constant over the next 30 years. Future offshore wind activities would have similar contributions as the Proposed Action, over a wider area. In the context of reasonably foreseeable trends, **minor**

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				travelling through the RI and MA Lease Areas, with resulting **minor** impacts on the low-income workers in the marine recreation and commercial fishing industries or subsistence fishing by low-income residents.	impacts on environmental justice communities would occur as structures installed by the Proposed Action and planned actions increase navigational complexity and hazards, if those changes are significant enough to meaningfully affect subsistence fishing or the employment or income of low-income community members.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Sections 3.6.1, 3.9.1, and 3.10.1. Space conflicts created by displacement of vessels from the RI and MA Lease Areas could affect offshore activities (most likely commercial fishing, but also recreational fishing and boating, especially businesses associated with sailboat races and HMS fishing) and subsistence activities. If these impacts hinder business activities, this could disproportionately affect low-income residents and employees of marine-dependent businesses.	See Sections 3.6.2, 3.9.2, and 3.10.2. Space conflicts created by displacement of vessels from the proposed Project area could affect offshore activities (most likely commercial fishing, but also recreational fishing and boating, especially businesses associated with sailboat races and HMS fishing) and subsistence activities throughout the Proposed Action's 30-year operating life. If these impacts hinder business activities, this could result in **minor** impacts on low-income residents and employees of marine-dependent businesses.	The Proposed Action would contribute **minor** impacts on environmental justice communities from this sub-IPF if the presence of WTGs and ESPs displace vessels from the proposed Project area, and if the resulting competition for space (i.e., for commercial or recreational fishing or sightseeing) meaningfully affects the employment or income of low-income community members (e.g., due to increased fuel use, travel time, or lost wages or revenue). Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. **Minor** impacts on environmental justice communities would likely occur as a result of the Proposed Action in the context of reasonably foreseeable trends when combined with planned actions due to space use conflicts caused by the presence of the Proposed Action and other projects, which could displace fishing and sightseeing vessels, and affect the employment or income of low-income community members (e.g., due to increased fuel use or travel time, or lost revenue).
Presence of structures: Viewshed	There are no existing offshore structures within the viewshed of the WDA except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Sections 3.6.1 and 3.9.1. The potential view of up to 775 offshore WTGs from locations in Massachusetts and Rhode Island would affect ocean views from locations with cultural and historic significance to Native American tribes, resulting in disproportionately adverse impacts on members of these tribes. Views of WTGs could also affect the decisions of potential tourists or visitors in selecting coastal locations to visit, but impacts on tourism-related businesses, if any, would not result in a long-term, detrimental impact on the recreation and tourism industry as a whole, and therefore would be unlikely to disproportionately affect the low-income employees of the industry. Impacts for each project could vary depending upon location and visibility.	See Sections 3.6.2 and 3.9.2. All of the Proposed Action's WTGs could potentially be visible from certain coastlines and overlooks on Nantucket, Martha's Vineyard, and Cape Cod throughout the Proposed Action's operating life, depending on atmospheric conditions and exact viewing location. Views of WTGs would have disproportionate impacts on certain Native American tribes, due to the cultural significance of certain ocean views. Visual impacts on sites with cultural significance to Native American tribes are addressed in detail through the NHPA Section 106 consultation (Section 3.8 and Appendix C). Based on the analysis in the Historic Properties Visual Impact Assessment for the Proposed Action, the presence of WTGs would adversely affect views from the Gay Head Cliffs and the Chappaquiddick Island TCP, resources with historic and cultural significance for the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) and the state-recognized Chappaquiddick Wampanoag Tribe, respectively. The visibility from certain locations could affect decisions of potential tourists or visitors in selecting coastal locations to visit, but impacts on tourism-related businesses, if any, would not result in a long-term, detrimental impact on the recreation and tourism industry within the study area as a whole, and would be unlikely to have disproportionate impacts on the low-income employees of these businesses. The impact on environmental justice populations would be **moderate,** based upon the visual impact on cultural resources with significance for Native American tribes.	The Proposed Action would contribute **moderate** impacts on environmental justice communities from this sub-IPF based on the impact of visible WTGs on cultural resources with significance for Native American tribes. Ongoing activities and future non-offshore wind activities do not contribute to this sub-IPF. Other future offshore wind projects would result in a greater number of visible WTGs (see Section 3.8.2), although visibility would also be limited by distance and influenced by the factors such as atmospheric conditions, sea spray, wave height, and vegetation. In context of reasonably foreseeable environmental trends, combined visual impacts on environmental justice populations, specifically Native American tribes including the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) and the state-recognized Chappaquiddick Wampanoag Tribe, from ongoing and planned actions including Alternative A, would likely be long-term, continuous, and **moderate**. Impacts would be l localized, due to the limited coastal viewing area for offshore WTGs.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Transmission cable infrastructure	Two subsea cables that cross the far western portion of OCS-A 0487. These cables are associated with a larger network of subsea cables south of the lease areas and make landfall near Charlestown, Massachusetts. These cables are located near the Block Island Wind Farm and cross the Block Island Wind Farm export cable.	Existing cable operation and maintenance activities would continue within and offshore from the analysis area.	See Sections 3.9.1 and 3.10.1. The presence of cables after installation would affect marine activities where concrete cable mattresses or scour protection make anchoring difficult for small vessels and affect some commercial and subsistence fishing methods. Impacts would be limited in area and may disproportionately affect low-income residents and employees of marine-dependent businesses. Onshore impacts would depend on the exact location of onshore transmission cables.	See Sections 3.9.2 and 3.10.2, and Tables 3.9-1 and 3.10-1. The presence of cables would have long-term, localized, **minor** impacts on environmental justice populations, resulting from limitations on marine activities (anchoring and some commercial fishing methods) where concrete cable mattresses are used, with resulting impacts on marine businesses and subsistence fishing. This impact would be limited in area. Vessels would occasionally need to avoid areas of temporary cable maintenance and repair. For onshore cable, occasional road disturbance would result from repairs/maintenance, with short-term, infrequent, **negligible** impacts on environmental justice communities.	The Proposed Action would contribute localized, **minor** impacts on environmental justice communities from this sub-IPF, due to limits on anchoring and fishing methods in areas with hard-cover protection over cables, as well as occasional disruption for repairs, and the resulting impacts on subsistence fishing, or on low-income employees of commercial or for-hire recreational fishing businesses. Cable infrastructure impacts from ongoing activities and future offshore wind activities would continue at current intensities. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. In context of reasonably foreseeable trends, the combined cable infrastructure impacts on environmental justice populations as a result of ongoing and planned actions including the Proposed Action, would be localized and **minor**, resulting from impacts on subsistence fishing, marine businesses and their low-income workers.
Traffic: Vessels	Study area ports and marine traffic related to shipping, fishing and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes (Section 3.11).	New vessel traffic near the study area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the study area employment.	See Section 3.11.1. The volume of vessel traffic during construction would complicate navigation in offshore construction areas and create potential for vessel congestion and reduced capacity within and near the ports that support offshore construction. The temporary impacts on commercial fishing or recreational boating would affect all local boaters, with impacts of greater magnitude on members of environmental justice communities who depend on subsistence fishing or jobs in commercial/for-hire fishing or marine recreation. Simultaneous development of multiple offshore wind energy projects could increase vessel congestion. Impacts could be reduced by appropriate port planning and preparation.	See Section 3.11.2. Construction would generate vessel traffic within and near the Port of New Bedford, and possibly the ports of Providence and Quonset-Davisville, near environmental justice communities. Vessel traffic during construction is likely to have a short-term, **minor** impact on members of environmental justice communities who rely on subsistence fishing or employment and income from commercial fishing and marine recreation, due to increased vessel traffic near ports and potential displacement from berths and docks. Modest levels of vessel traffic during operations would have **negligible** impacts on environmental justice communities.	During construction, the impacts on environmental justice populations from this sub-IPF under the Proposed Action would include short-term, variable, **minor** impacts on low-income residents involved in the commercial fishing industry or subsistence fishing. Vessel traffic would have a long-term, **negligible** impact on environmental justice communities during Proposed Action operations. Ongoing activities and future non-offshore wind activities such as proposed barge routes and dredging would contribute modestly to vessel traffic. Future offshore wind activities would have similar contributions as the Proposed Action, but in a wider range of ports and more intensively in and near ports supporting more than one offshore wind project. In context of reasonably foreseeable trends, combined vessel traffic impacts on environmental justice communities from ongoing and planned actions including the Proposed Action, would occur at ports used to support wind energy projects throughout the analysis area, and would thus have **minor** adverse impacts during construction and **negligible** impacts during operations due to the impact on marine businesses and subsistence fishing.
Land disturbance: Erosion and sedimentation	Potential erosion and sedimentation from development and construction is controlled by local and state development regulations.	New development activities would be subject to erosion and sedimentation regulations.	Installation of onshore landfall equipment, cables, and substations would be subject to local and state regulations to control erosion and sedimentation. Specific impacts would depend upon location and compliance with management practices.	Installation of onshore landfall equipment, cables, and substations would be subject to local and state regulations to control erosion and sedimentation. Onshore installations, including the substation, and a majority of the cable route for the Covell's Beach landfall site, would be adjacent to neighborhoods that meet environmental justice criteria. Sediment and erosion resulting from OECR installation would have short-term, **negligible** impacts on environmental justice communities.	The Proposed Action would contribute **negligible** impacts on environmental justice communities from this sub-IPF. Ongoing activities and future offshore wind activities would affect environmental justice communities if inadequately controlled erosion and sedimentation disproportionately affect individual environmental justice communities, or if such activities affect businesses to the point where employment or earnings for low-income employees are reduced. Future offshore wind activities would have similar contributions as ongoing activities. In context of reasonably foreseeable trends, combined impacts on environmental justice communities from this sub-IPF from ongoing and planned actions including the Proposed Action, would be **negligible**, assuming erosion and sedimentation control measures are implemented.
Land disturbance: Onshore construction	Onshore development supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.	Onshore construction for each project would be analyzed for possible disproportionate impacts of onshore construction on low income or minority populations.	Onshore installations, including the substation and a majority of the cable route for the Covell's Beach landfall site would be adjacent to communities that meet environmental justice criteria. Construction of the OECR would temporarily disturb neighboring land uses through construction noise, vibration, dust, and delays in travel along the affected roads, but would have only short-term, variable, **negligible** impacts on environmental justice communities.	The Proposed Action would contribute **negligible** impacts on environmental justice communities from this sub-IPF. Ongoing activities and future offshore wind activities would affect environmental justice communities if land disturbance during onshore construction disproportionately affects individual environmental justice communities, or if such activities affect businesses to the point where employment or earnings for low-income employees are reduced. Future offshore wind activities would have similar contributions as ongoing activities. In context of reasonably foreseeable trends, combined impacts on environmental justice communities under this sub-IPF from ongoing and

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
					planned actions including the Proposed Action, would be **negligible**, because onshore development would not overlap in geographic location.
Land disturbance: Onshore, land use changes	Onshore development would result in changes in land use in accordance with local government land use plans and regulations.	Development of onshore solar and wind energy would provide diversified, small-scale energy generation.	See Section A.8.6.1 in Appendix A. If new substations or other aboveground utility infrastructure were located in an area of low-income or minority populations, these components could potentially have disproportionate impacts on environmental justice communities, depending on site design, buffers, and arrangement of land uses. There is no regional impact; an analysis is needed for each individual site location.	See Section A.8.6.2 in Appendix A. The Project would not change any land uses. The location of the proposed substation adjacent to an existing substation, within an existing industrial area, would avoid displacement of or impacts on homes or businesses. Cables would be underground and existing ports would be used.	The Proposed Action would have **no impact** on environmental justice communities from this sub-IPF because there would be no land use changes. Ongoing activities and future offshore wind activities would not contribute disproportionate impacts on environmental justice communities, assuming land development occurs in accordance with local government land use plans and regulations. Future offshore wind activities would not generate disproportionate impacts if uses are located in accordance with land use plans and regulations and do not displace or adversely impact existing land uses in environmental justice communities (e.g., through reduced property value or reduced revenue for businesses that employ low-income workers). There would be no impact for the Proposed Action in the context of reasonably foreseeable trends and planned actions under this sub-IPF, because the Proposed Action would not generate impacts on environmental justice communities.

ADLS = Aircraft Detection Light System; ESP = electrical service platform; FCC = Federal Communications Commission; G&G = Geological and Geophysical; HMS = Highly Migratory Species; IPF = impact-producing factors; MA/RI = Massachusetts/Rhode Island; MCT = New Bedford Marine Commerce Terminal; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); OECR = Onshore Export Cable Route; RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; USEPA = U.S. Environmental Protection Agency; WDA = Wind Development Area; WTG = wind turbine generator

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Table 3.7-2: State and County Minority and Low-Income Status

	Non-White Population Percentage			Percentage of Population below the Federal Poverty Level		
Jurisdiction	**2000**	**2010**	**2018**	**2000**	**2010**	**2018**
Commonwealth of Massachusetts	15.5%	19.6%	21.5%	9.3%	10.5%	10.8%
Barnstable County	5.8%	7.3%	8.1%	6.9%	7.2%	7.0%
Bristol County	9.0%	11.6%	15.4%	10.0%	11.3%	11.5%
Dukes County	9.3%	12.4%	11.5%	7.3%	8.6%	8.0%
Nantucket County	12.2%	12.4%	12.4%	7.5%	7.2%	8.6%
State of Rhode Island	15.0%	18.6%	19.1%	11.9%	12.2%	13.1%
Providence County	21.6%	26.6%	26.6%	15.5%	15.4%	16.2%
Washington County	5.2%	6.2%	7.0%	7.3%	7.4%	9.4%

Sources: U.S. Census Bureau 2007a, 2007b, 2010, 2012, 2020

Table 3.7-3: Employment and Wages for Ocean Economy Living Resource Industries (2017)

	Ocean Economy Living Resources Sector				All Industry Sectors	
	Company Employees		Self-Employed Workers		All Workers	
County	**Number**	**Average Wage [a]**	**Number**	**Average Gross Receipts [b]**	**Total Employment**	**Average Wage**
Massachusetts						
Barnstable	353	$42,130	822	$52,391	97,262	$46,454
Bristol	1,608	$95,866	741	$100,027	226,304	$49,364
Dukes	36	$59,333	103	$30,340	8,985	$50,640
Nantucket	7	$25,714	55	$37,945	7,371	$56,306
Rhode Island						
Providence	85	$29,765	119	$22,345	285,569	$55,514
Washington	263	$72,449	529	$76,456	52,874	$45,298
New York						
Suffolk	662	$34,264	709	$43,017	660,084	$59,320
Total	3,014	$71,536	3,078	$63,678	1,293,064	$57,200

Sources: NOAA 2020b, 2020c, 2020d

[a] Average wage is calculated as total wages divided by total number of employees.
[b] Average gross receipts are calculated as total gross receipts divided by number of self-employed workers.

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Table 3.8-1: Summary of Activities and the Associated Impact-Producing Factors for Cultural Resources

Baseline Conditions: Cultural resource investigations in the northeast United States have identified a wide variety of archaeological resources, historic structures, and Traditional Cultural Properties (TCPs). Previously identified onshore archaeological resources include pre-Contact period Native American sites and colonial period through 20th Century European-American sites. Offshore archaeological resources include submerged landform features that have the potential to contain pre-Contact period Native American sites dating to before the end of the last glacial maximum, as well as historic period shipwrecks, downed aircraft, and debris fields associated with colonial through 20th Century maritime activities. Offshore submerged landform features are also considered to be significant cultural resources to Native American tribes as the landscape formerly occupied by their ancestors. Submerged landform resources are considered contributing elements to one or more TCPs due to their associations with the cultural practices, traditions, and beliefs of Native American tribes. Historic structures found across the northeastern United States include a wide variety of residential, commercial, and industrial buildings, structures, and infrastructure that date from the 16th through 20th centuries. Potential TCPs in the northeastern United States include a wide variety of locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, and/or social institution of Native American, European-American, and other living communities across the region.

Historic and modern residential, agricultural, commercial, industrial, and infrastructure activities and/or development across the northeastern United States have resulted in impacts on cultural resources. Any type of onshore or offshore ground/seafloor-disturbing activity (trenching, grading, excavation, plowing, anchoring, etc.) has the potential to damage or destroy onshore or offshore archaeological and TCP resources. Redevelopment of historic areas can result in physical damage or the destruction of historic structures. Construction of new, modern structures can cause physical impacts on historic structures and TCP resources through the introduction of intrusive visual (new buildings, structures, etc.) or auditory (i.e., noises) elements that affect the resources' historic, scientific, religious, and/or cultural significance/importance.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/hazmat	See Table A.8.2-1 for Water Quality for a quantitative analysis of these risks. Accidental releases of fuel/fluids/hazmat occur during vessel use for recreational, fisheries, marine transportation, or military purposes, and other ongoing activities. Both released fluids and cleanup activities that require the removal of contaminated soils and/or seafloor sediments can cause impacts on cultural resources because resources are impacted by the released chemicals as well as the ensuing cleanup activities.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases within the geographic analysis area for cultural resources, increasing the frequency of small releases. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or the complete removal of terrestrial and marine cultural resources. In addition, the accidentally released materials in deep water settings could settle on seafloor cultural resources such as wreck sites, accelerating their decomposition and/or covering them and making them inaccessible/unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale impacts on cultural resources.	In the expanded planned action scenario, there would be a low risk of a leak of fuel, fluids, or hazmat from any of the approximately 775 WTGs and 20 ESPs. These structures would store a total of approximately 5.3 million gallons (20 million liters) of such fluids within the geographic analysis area for cultural resources. Accidental release of hazmat and trash/debris, if any, may pose a long-term, infrequent risk to cultural resources. The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils. The number of accidental releases from the future offshore wind projects, the volume of released material, and the associated need for cleanup activities would be limited due to the low probability of occurrence, the low volumes of material released in individual incidents, the low persistence time, standard BMPs to prevent releases, and the localized nature of such events. As such, the majority of individual accidental releases from future offshore wind development would not be expected to result in measurable impacts on cultural resources.	Accidental release of hazmat and trash/debris, if any, could affect cultural resources. The 59 WTG and ESP foundations for the Proposed Action would include storage for up to 24,157 gallons (93,715 liters) of coolants, 341,869 gallons (1.3 million liters) of oils and lubricants, and 50,897 gallons (192,666 liters) of diesel fuel. The volume of materials released is unlikely to require cleanup operations that would permanently impact cultural resources. As a result, the impacts of accidental releases from the Proposed Action on cultural resources would be localized, short-term, and **negligible**.	The impacts on cultural resources from this sub-IPF under the Proposed Action are unlikely to occur and would be localized, short-term, and **negligible**. Ongoing activities and future non-offshore wind activities would likely cause a gradual increase in the frequency and amount of accidental releases. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. In context of reasonably foreseeable trends, the combined impacts from this sub-IPF on cultural resources from ongoing and planned actions, including the Proposed Action, would therefore be localized, short-term, and **minor**.
Accidental releases: Trash and debris	Accidental releases of trash and debris occur during vessel use for recreational, fisheries, marine transportation, or military purposes and other ongoing activities. While the released trash and debris can directly affect cultural resources, the majority of impacts associated with accidental releases occur during cleanup activities, especially if soil or sediment removed during cleanup affect known and undiscovered archaeological resources. In addition, the presence of large amounts of trash on shorelines or the ocean surface can impact the cultural value of TCPs for stakeholders. State and federal laws prohibiting large releases of trash would limit the size of any individual release, and ongoing local, state, and federal efforts to clean up trash on beaches and waterways	Future activities with the potential to result in accidental releases include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications). Accidental releases would continue at current rates along the northeast Atlantic coast.	Construction of offshore wind projects would increase the likelihood of accidental releases of trash; however, the volume of trash released would be unlikely to necessitate a cleanup action substantial enough to affect cultural resources.	Construction of the Proposed Action would increase the potential for accidental releases of trash; however, the small volume of released material would not require a cleanup action substantial enough to affect cultural resources. As a result, the Proposed Action would have localized, short-term, **negligible** impacts on cultural resources.	The impacts on cultural resources from this sub-IPF under the Proposed Action would be localized, short-term, and **negligible**. It is unlikely that released material would require cleanup that would affect cultural resources. Ongoing activities and future non-offshore wind activities would likely cause a gradual increase in the accidental release of trash due to the gradual increase in commercial and recreational activities off the coast of southern New England. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. In context of reasonably foreseeable trends, the combined impacts from this sub-IPF on cultural resources from

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	would continue to mitigate the effects of small-scale accidental releases of trash.				ongoing and planned actions, including the Proposed Action, would therefore be localized, short-term, and **minor**.
Anchoring	The use of vessel anchoring and gear (i.e., wire ropes, cables, chain, and sweep on the seafloor) that disturbs the seafloor, such as bottom trawls and anchors, by military, recreational, industrial, and commercial vessels can impact cultural resources by physically damaging maritime archaeological resources such as shipwrecks and debris fields.	Future activities with the potential to result in anchoring/gear utilization include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); military use; marine transportation; fisheries use and management; and oil and gas activities. These activities are likely to continue to occur at current rates along the entire coast of the eastern United States.	Anchoring, gear utilization, and dredging activities would increase during the construction, maintenance, and eventual decommissioning of offshore wind energy facilities. The expanded planned action scenario could result in up to 126 acres of seafloor in the geographic analysis area affected by anchoring that could potentially impact cultural resources. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb shipwreck and debris field resources, as well as, submerged landform features on or just below the seafloor surface, resulting in permanent and irreversible loss of scientific or cultural value. BOEM and relevant SHPOs would continue to require offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas as part of NEPA and NHPA Section 106 compliance activities to identify shipwreck and debris field resources and submerged landform features, and implement plans to avoid these resources.	Vineyard Wind's geophysical marine archaeological surveys within the WDA and along the OECC route identified two shipwrecks and five potential shipwrecks/debris fields, which Vineyard Wind has committed to avoiding during construction, maintenance, and decommissioning activities. The Proposed Action would be unable to avoid 19 submerged landform features due to design constraints (i.e., the submerged landform feature crosses the entire OECC), engineering, and/or environmental constraints. The severity of effects would depend on the horizontal and vertical extent of effects relative to the size of the intact submerged relict landform. Other undiscovered resources could potentially be impacted. As a result, the Proposed Action would have localized, long-term, **major** impacts on cultural resources under this IPF.	The impacts on cultural resources from this IPF under the Proposed Action would be localized, long-term, and **negligible** due to Vineyard Wind's commitment to avoiding shipwrecks and debris field resources within the WDA. The Proposed Action would be unable to avoid 19 submerged landform features due to design constraints (i.e., the submerged landform feature crosses the entire OECC), engineering, and/or environmental constraints. The severity of effects would depend on the horizontal and vertical extent of effects relative to the size of the intact submerged relict landform. Other undiscovered resources could potentially be impacted. As a result, the Proposed Action would have localized, long-term, **major**. Ongoing activities and future non-offshore wind activities could cause a gradual increase in the frequency and scale of impacts on marine cultural resources from vessel anchoring and gear utilization. BOEM anticipates that lead federal agencies and relevant SHPOs would require the applicants for other offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. As a result, impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. In context of reasonably foreseeable trends, the combined impacts from this sub-IPF on cultural resources from ongoing and planned actions, including the Proposed Action, on shipwreck and debris field resources, as well as submerged landform features, would be long-term, localized, and **moderate** to **major**, unless previously undiscovered resources are affected.
Gear utilization: Dredging	Activities associated with dredge operations and activities could damage marine archaeological resources. Ongoing activities identified by BOEM with the potential to result in dredging impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities.	Dredging activities would gradually increase through time as new offshore infrastructure is built, such as gas pipelines and electrical lines, and as ports and harbors are expanded or maintained.	Development of the offshore wind industry would require additional dredging, which could impact cultural and archaeological resources buried beneath the seafloor. BOEM and relevant SHPOs would continue to require offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas as part of NEPA and NHPA Section 106 compliance activities to identify and avoid and/or mitigate impacts on identified marine archaeological resources.	The Proposed Action's dredging operations could impact cultural and archaeological resources buried beneath the seafloor. Vineyard Wind's geophysical marine archaeological surveys within the WDA and along the OECC route identified two shipwrecks and five potential shipwrecks/debris fields, which Vineyard Wind has committed to avoiding during construction, maintenance, and decommissioning activities. The Proposed Action would be unable to avoid 19 submerged landform features due to design constraints (i.e., the submerged	The impacts on cultural resources from this sub-IPF under the Proposed Action would be localized, long-term, and **negligible** due to Vineyard Wind's commitment to avoiding shipwrecks and debris field resources within the WDA. Ongoing activities and future non-offshore wind activities would likely cause a gradual increase in the frequency and scale of impacts on marine cultural resources from dredging. BOEM anticipates that lead federal agencies and relevant state historic preservation offices would require the applicants for other offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				landform feature crosses the entire OECC), engineering, and/or environmental constraints. The severity of effects would depend on the horizontal and vertical extent of effects relative to the size of the intact submerged relict landform. Other undiscovered resources could potentially be impacted. As a result, the Proposed Action would have localized, long-term, **major** impacts on cultural resources under this IPF.	and NHPA Section 106 compliance activities. As a result, impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. In context of reasonably foreseeable trends, the combined impacts from this sub-IPF on shipwreck and debris field resources, as well as submerged landform features from ongoing and planned actions, including the Proposed Action, would be long-term, localized, and **moderate** to **major**, unless previously undiscovered resources are affected.
Light: Vessels	Light associated with military, commercial, or construction vessel traffic can temporarily affect coastal historic structures and TCP resources when the addition of intrusive, modern lighting changes the physical environment ("setting") of cultural resources. The impacts of construction and operations lighting would be limited to cultural resources on the southern shores of Martha’s Vineyard, Nantucket, and possibly portions of Cape Cod, for which a nighttime sky is a contributing element to historical integrity. This excludes resources that are closed to stakeholders at night, such as historic buildings, lighthouses, and battlefields, and resources that generate their own nighttime light, such as historic districts. Offshore construction activities that require increased vessel traffic, construction vessels stationed offshore, and construction area lighting for prolonged periods can cause more sustained and significant visual impacts on coastal historic structure and TCP resources.	Future activities with the potential to result in vessel lighting impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Light pollution from vessel traffic would continue at the current intensity along the northeast coast, with a slight increase due to population increase and development over time.	Development of the offshore wind industry would increase the amount of offshore anthropogenic light from vessels and area lighting during the construction and decommissioning of projects (to the degree that construction occurs at night). Construction of 775 WTGs and 20 ESPs would be constructed from 2022 through 2030 across 12 different lease areas with up to 4 projects simultaneously under construction in 2024 (Table A-6). Some of these offshore wind projects could require nighttime construction lighting. Construction lighting from any project would be temporary, lasting only during nighttime construction, and could be visible from shorelines and elevated locations, although such light sources would be limited to individual WTG or ESP sites, rather than the entire RI and MA Lease Areas. Lighting impacts would be mitigated by the distance between the light source and the resources, as well as atmospheric and environmental factors such as clouds, fog, and wave action. In addition, impacts would also be geographically limited to southern views from these resources. The significance of impacts on individual cultural resources would be determined on a resource-specific basis.	The Proposed Action may require nighttime vessel and construction area lighting during offshore construction. The lighting impacts would be short-term as they would be limited to the construction phase of the Proposed Action. The intensity of nighttime construction lighting from the Proposed Action would be limited to the individual or small number of WTGs and/or ESPS under construction at any given time. Impacts would be further reduced by the distance between the nearest construction area (i.e., the closest line of WTGs) and the nearest cultural resources on Martha’s Vineyard and Nantucket. USCG navigation warning lights would be mounted near the top of the foundation on each WTG and ESP. The lighting is relatively low intensity and would be visible up to 5 nautical miles (COP Volume III, Appendix III.H.b; Epsilon 2020d). This lighting could be visible to mariners at sea but would not be visible from coastal vantage points. The perceived intensity of nighttime construction lighting would also decrease with distance from shore, and would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. Impacts would be limited to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity and/or resources used by stakeholders at night, limiting the scale of impacts on cultural resources. As a result, nighttime vessel and construction area lighting from the Proposed Action would have short-term, low intensity impacts on a limited number of resources, resulting in **minor** impacts on cultural resources.	Construction of the Proposed Action may require nighttime vessel and construction area lighting during the construction of 57 WTGs and 2 ESPs within the WDA, resulting in short-term, low intensity impacts on a limited number of resources, and thus **minor** impacts on cultural resources. Development of the offshore wind industry would require the construction of 775 WTGs and 20 ESPs from 2022 through 2030 across 12 different lease areas with up to five projects simultaneously in 2024. Some of these offshore wind projects could require nighttime construction lighting. Nighttime construction and decommissioning lighting associated with these projects would have long-term, low-intensity impacts on a limited number of resources, resulting in **minor** impacts on cultural resources. In context of reasonably foreseeable trends, the combined impacts from this sub-IPF on cultural resources from ongoing and planned actions, including the Proposed Action, would be localized, long-term, and **minor**.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Light: Structures	The construction of new structures that introduce new light sources into the setting of historic standing structures or TCPs can result in impacts, particularly if the historic and/or cultural significance of the resource is associated with uninterrupted nighttime skies or periods of darkness. Any tall structure (e.g., commercial building, radio antenna, large satellite dishes) requiring nighttime hazard lighting to prevent aircraft collision can cause these types of impacts.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	Required aviation warning lighting would be visible from up to 709 of the 775 WTGs assumed under the No Action Alternative. Resources impacted by structure lighting would include those for which a dark nighttime sky is a contributing element to historic integrity, including the Nantucket NHL and Nantucket Sound TCP, the Chappaquiddick Island TCP, and the Vineyard Sound and Moshup's Bridge TCP. Lighting impacts would be mitigated by the distance between the light source and the resources, as well as atmospheric and environmental factors such as clouds, fog, and wave action that would further reduce the intensity of impacts. Visible lighting on the No Action Alternative's WTGs would result in long-term, continuous impacts on the cultural resources listed above. An ADLS, if implemented, would reduce the amount of time that WTG lighting is visible, thus resulting in long-term, intermittent (rather than continuous), impacts on cultural resources.	The use of standard aviation warning lights on the Proposed Action WTGs would result in long-term, continuous, **moderate** impacts on cultural resources. Vineyard Wind has committed, however, to using an ADLS as a voluntary measure to reduce operations phase nighttime lighting impacts. ADLS would activate the required FAA aviation lighting on the WTGs and ESPs prior to an aircraft reaching 3 nautical miles (5.6 kilometers) from within 1,000 vertical feet (305 meters) of any wind turbine pursuant to with FAA Advisory Circular 70/7460-1L (FAA 2015). Due to the likely speed of the traveling aircraft and size of the WDA, the resulting appearance of the lights would be limited to a few minutes in each instance. For the Proposed Action, this was estimated to occur 235 times during the year, illuminating less than 0.1 percent of nighttime hours per year (Section 3.9). The use of ADLS by the Proposed Action would result in intermittent (rather than continuous), low-intensity, **minor** impacts on cultural resources.	The use of ADLS by the Proposed Action would result in intermittent, low-intensity, **minor** impacts on cultural resources. Light from ongoing activities and future non-offshore wind activities would likely continue at current rates. Future offshore wind projects would result in aviation warning lights visible on up to 709 of the 775 WTGs assumed under the No Action Alternative (including the Proposed Action). Operational lighting from ongoing and planned actions including the Proposed Action would have a long-term, continuous, **moderate** impacts on cultural resources. An ADLS, if implemented for future offshore wind projects, would result in intermittent (rather than continuous), **minor** overall impacts on cultural resources.
Port utilization: Expansion	Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT was upgraded by the Port of New Bedford specifically to support the construction of offshore wind facilities. Expansion of port facilities can introduce large, modern port infrastructure into the viewsheds of nearby historic properties, impacting their setting and historical significance.	Future activities with the potential to result in port expansion impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects).	The Massachusetts Clean Energy Center identified 18 waterfront sites in Massachusetts that could be available and suitable for use by the offshore wind industry (MassCEC 2017a, b). Orsted has committed to improvements to Rhode Island ports in support of the Revolution Wind Project (Kuffner 2018). These port modification and expansion projects could affect historic structures and/or archaeological sites within or near port facilities. Future channel deepening by dredging that may be required to accommodate larger vessels required to carry WTG components and/or increased vessel traffic associated with offshore wind projects could affect marine cultural resources in or near ports. Due to state and federal requirements to identify and assess impacts on cultural resources as part of NEPA and the NHPA and the requirements to avoid, minimize, and/or mitigate impacts on cultural resources, these impacts would be long-term and isolated to a limited number of cultural resources that cannot be avoided, or that were previously undocumented.	The Proposed Action would not require expansion of any port, but would make use of expansions and improvements at the MCT at the Port of New Bedford and at Vineyard Haven that were undertaken to support the wind industry overall. As a result, the Proposed Action would not contribute impacts on cultural resources that occurred or would occur due to these expansions.	The Proposed Action would not contribute impacts on cultural resources due to expansion and upgrades at the Port of New Bedford and at Vineyard Haven that were undertaken to support the wind industry overall. Ongoing and future non-offshore wind activities would include ongoing maintenance for numerous harbors within the geographic analysis area that are important for recreation and tourism. BOEM assumes that any port expansions necessitated by other offshore wind projects would also adhere to applicable regulations for evaluating and addressing impacts on cultural resources. Because the Proposed Action would have no impacts under this sub-IPF, there would be no combined impacts.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures	The only existing offshore structures within the viewshed of the geographic analysis area are minor features such as buoys.	Non-offshore wind structures that could be viewed would be limited to meteorological towers. Marine activity would also occur within the marine viewshed of the geographic analysis area.	Portions of up to 651 of the 775 WTGs assumed under the No Action Alternative (including the Proposed Action) could potentially be visible from the four historic properties in the area of intervisibility between the Proposed Action and the future offshore wind projects: the Gay Head Light, Chappaquiddick Island TCP, the Nantucket NHL, and the Vineyard Sound and Moshup's Bridge TCP—resources for which a sea view free of modern visual elements is a contributing factor to NRHP eligibility. The WTGs would appear relatively small to an observer at these resources, and the visibility of WTGs would be further reduced by environmental and atmospheric factors such as cloud cover, haze, sea spray, vegetation, and wave height. Nonetheless, the visibility of these modern structures would have long-term, continuous impacts on the cultural resources listed above.	A Historic Properties Visual Impact Assessment for the Proposed Action determined that the construction of the proposed Project's WTGs would affect the Gay Head Light, Chappaquiddick Island TCP, the Nantucket NHL, and the Vineyard Sound and Moshup's Bridge TCP, although these impacts would be partially mitigated by environmental and atmospheric factors such as clouds, haze, fog, sea spray, vegetation, and wave height that would partially or fully screen the WTGs from view during various times throughout the year (COP Volume III, Appendix III-H.b; Epsilon 2020d). The Proposed Action would further mitigate viewshed impacts by avoiding use of the three turbine locations in the northwest corner of the WDA, use of an ADLS, using non-reflective pure white and light grey paint on offshore structures, and funding a mitigation plan to resolve impacts on the Gay Head Light. Vineyard Wind has also committed to fund specific mitigation projects on the Nantucket NHL, an ethnographic study and NRHP nomination for the Chappaquiddick Island TCP, and an ethnographic study and NRHP nomination for the Vineyard Sound and Moshup's Bridge TCP. Nonetheless, an uninterrupted sea view free of modern visual elements is a contributing element to NRHP eligibility of the resources listed above. As a result, the presence of visible WTGs from the Proposed Action structures would have long-term, continuous, widespread, **moderate** impacts on the Gay Head Light, the Chappaquiddick Island TCP, the Nantucket NHL, and the Vineyard Sound and Moshup's Bridge TCP.	The visible presence of 57 of the Proposed Action's WTGs would have long-term, continuous, widespread, **moderate** impacts on the Gay Head Light, Chappaquiddick Island TCP, Nantucket NHL, and the Vineyard Sound and Moshup's Bridge TCP. Other ongoing and non-offshore wind activity would not contribute to this IPF. Up to 651 WTGs from the No Action Alternative (including the Proposed Action) could potentially be visible from select, high elevations at each of these resources. While mitigating factors would limit the intensity of impacts, the presence of visible WTGs from ongoing and planned actions, including the Proposed Action, would have long-term, continuous, and **moderate** impacts on the four historic properties listed above.
New cable emplacement/ maintenance	Current offshore construction activity is limited to subsea fiber optic and electrical transmission cables, including six existing power cables in the geographic analysis area.	Future activities with the potential to result in seafloor disturbances similar to offshore impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; and oil and gas activities. Such activities could cause impacts on submerged archaeological resources including shipwrecks and formerly subaerially exposed pre-Contact Native American archaeological sites.	Offshore wind projects would result in the construction of 775 WTGs and 20 ESPs, as well as inter-array cable systems, and OECCs (3,398 acres [13,751 m^2] of seabed disturbance. BOEM studies suggest that the RI and MA Lease Areas contain shipwreck sites and a large number of submerged landform resources (TRC 2012). Impacts on shipwreck resources can typically be avoided through project design. The number, extent, and dispersed character of the submerged landform features make avoidance difficult, while the depth of these resources makes mitigative excavations/studies difficult and expensive. It is	The marine geophysical and geotechnical studies conducted for the Proposed Action identified two shipwrecks, five potentially significant debris fields, and 35 submerged landform features that may represent cultural resources. The Proposed Action would avoid the shipwrecks and debris fields, resulting in no impacts on these resources. The Proposed Action would be unable to avoid 19 of 35 previously identified submerged landform features in the WDA and OECC. Vineyard Wind has	The Proposed Action would have localized, long-term, continuous, **negligible**, impacts on shipwreck and debris field resources, and widespread, **moderate** impacts on submerged landform features. Ongoing activities and future non-offshore wind activities would likely follow state and federal requirements to identify and avoid or mitigate impacts on marine cultural resources. Future offshore wind development would have similar impacts as the Proposed Action over a wider area. As a result, in context of reasonably foreseeable trends, the combined impacts from this sub-IPF on cultural resources from ongoing and planned actions,

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			unlikely that offshore wind projects would be able to avoid all of these resources. BOEM has committed to working with Applicants, consulting parties, Native American tribes, and the MHC to develop specific treatment plans to address effects on submerged landform features that cannot be avoided by proposed offshore wind development projects. Implementation of these plans would reduce the extent, intensity, and scale of impacts on submerged landform features.	committed to working with the consulting parties, Native American tribes, BOEM, and the MHC to develop a specific treatment plan for mitigating impacts on unavoidable submerged landform features. As a result, the Proposed Action would have long-term, continuous, localized, **negligible**, impacts on shipwreck and debris field resources, and widespread, **moderate** impacts on submerged landform features.	including the Proposed Action, would be localized, long-term, continuous, and **moderate**. Development and implementation of treatment plans for unavoidable submerged landform features developed by BOEM, applicants, consulting parties, Native American tribes, and the MHC would reduce the magnitude of impacts on submerged landform features from **major** to **moderate**, but even with mitigations, the resource would not recover resulting in **moderate** impacts.
Land disturbance: Onshore construction	Onshore construction activities can impact archaeological resources by damaging and/or removing resources.	Future activities that could result in terrestrial land disturbance impacts include onshore residential, commercial, industrial, and military development activities in central Cape Cod, particularly those proximate to OECRs and interconnection facilities. Onshore construction would continue at current rates.	The construction of onshore components associated with future offshore wind projects, such as electrical export cables and onshore substations, could result in impacts on known and undiscovered cultural resources. Ground-disturbing construction activities could affect undiscovered archaeological sites. Ground-disturbing construction activities could affect TCPs, if present. The number of cultural resources and/or historic properties impacted, the scale and extent of impacts, and the severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources. State and federal requirements to identify, assess, avoid, and/or mitigate impacts on cultural resources as part of NEPA and the NHPA would limit the extent and scale of impacts on cultural resources.	Vineyard Wind's onshore cultural resource investigations determined that the Proposed Action would not impact any terrestrial cultural resources. Vineyard Wind has committed to conducting archaeological monitoring during construction in areas previously determined to have a moderate to high potential for undiscovered archaeological resources. BOEM anticipates that if these investigations identify any significant cultural resources, Vineyard Wind would implement plans to avoid, minimize, and/or mitigate impacts aligned with Massachusetts state requirements and the NHPA requirements. As a result, and considering the possible presence of undiscovered resources, onshore construction of the Proposed Action would have localized, long-term, **minor** impacts on terrestrial cultural resources.	The impacts on cultural resources from this sub-IPF under the Proposed Action would primarily occur due to effects on undiscovered cultural resources, because the Proposed Action would not affect any known terrestrial cultural resources. As a result, the impacts of the Proposed Action under this sub-IPF would be localized, long-term, and **minor**. Ongoing activities and non-offshore wind activities would continue to impact terrestrial cultural resources through land disturbance. Future offshore wind development could impact known historic structures and TCPs, but would follow existing federal and state requirements to identify cultural resources, assess impacts, and implement measures to avoid, minimize, and/or mitigate impacts. As a result, overall impacts on cultural resources under this sub-IPF would be localized, long-term, and **minor**.
Climate change: Warming and sea level rise, storm severity/frequency	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, historic structural, and TCP resources. Increased storm frequency and severity would also result in damage to and/or destruction of historic structures. Sea level rise would increase erosion-related impacts on archaeological and historic structural resources, while sea level rise would inundate archaeological, historic structural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.	The effect of future offshore wind projects on slowing or arresting global warming and climate change (as causes of sea level rise, storm severity, and frequency; changes to habitats and ecology; changing migration patterns; damage to property and infrastructure; factors generating demand for coastal protective measures; and factors causing marine transgression/scouring) would result in limited to no impacts and could result in a beneficial impacts on cultural resources.	The contribution of the Proposed Action on slowing or arresting global warming and climate change (as causes of sea level rise, storm severity, and frequency; changes to habitats and ecology; changing migration patterns; damage to property and infrastructure; factors generating demand for coastal protective measures; and factors causing marine transgression/scouring) would result in **negligible** to **minor beneficial** impacts on cultural resources.	The Proposed Action would incrementally contribute to arresting global warming and associated sea level rise and increased storm severity/frequency, thus helping to avoid impacts on cultural resources, and resulting in long-term, widespread, **negligible** to **minor beneficial** impacts. Ongoing activities and non-offshore wind activities could contribute both beneficially (i.e., through onshore wind or solar energy projects) and adversely to climate change (i.e., through continued or increased emission of greenhouse gases). Other offshore wind activities would have similar effects as the Proposed Action, at a larger scale. As a result, the overall impacts on cultural resources would be long-term, widespread, **negligible** to **minor**, and **beneficial**.
Climate change: Warming and sea level rise, altered habitat/ecology	Altered habitat/ecology related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to habitats/ecology would increase as a result of climate change.			
Climate change: Warming and sea level rise, altered migration patterns	Altered migration patterns related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to migratory animal patterns would increase as a result of climate change.			
Climate change: Warming and sea level rise, property/	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, historic structural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction	The rate of property and infrastructure damage would increase as a result of climate change.			

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
infrastructure damage	of historic structures. Sea level rise would increase erosion-related impacts on archaeological and historic structural resources, while sea level rise would inundate archaeological, historical structure, and TCP resources.				
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The installation of protective measures such as barriers and sea walls would impact archaeological resources during associated ground-disturbing activities. Construction of these modern protective structures would alter the viewsheds from historic properties and/or TCPs, resulting in impacts on the historic and/or cultural significance of resources.	The installation of coastal protective measures would increase as a result of climate change.			
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, historical structure, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of historic structures. Sea level rise would increase erosion related impacts on archaeological and historic structure resources while sea level rise would inundate archaeological, historic structure, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.			

ADLS = Aircraft Detection Light System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; COP = Constructions and Operations Plan; hazmat = hazardous materials; ESP = electrical service platform; IFP = impact-producing factor; m^2 = square meter; MCT = New Bedford Marine Commerce Terminal; MHC = Massachusetts Historical Commission; NEPA = National Environmental Policy Act; NHL = National Historic Landmark; NHPA = National Historic Preservation Act; NRHP = National Register of Historic Places; OECC = Offshore Export Cable Corridor; OECR = Onshore Export Cable Route; RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; SHPO = state historic preservation office; TCP = Traditional Cultural Property; USCG = U.S. Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

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Table 3.8-2: Summary of Southern New England Prehistoric and Historic Context

Period		Description
Pre-Contact Period	Paleoindian (12,500–10,000 B.P.)	Earliest scientifically documented human occupation of southern New England. Small highly nomadic family groups of hunter-gatherers inhabited the region during this period. At this time, much of Nantucket Sound was exposed land due to lower sea levels associated with the last Ice Age and likely occupied by Paleoindian groups.
	Archaic (10,000–3,000 B.P.)	Archaeologists typically divided the Archaic Period into three sub-periods: Early (10,000–8,000 B.P.), Middle (8,000–6,000 B.P.), and Late (6,000–3,000 B.P.) Archaic. During the Early Archaic, the population of southern New England continued to practice a highly mobile, nomadic hunter-gather lifestyle adapted to the warming conditions and changing environment. By the Late Archaic, populations developed a more locally focused subsistence economy and a semi-sedentary lifestyle.
	Woodland (3,000–400 B.P.)	Archaeologists typically divided the Woodland Period into three sub-periods: Early (3,000–2,000 B.P.), Middle (2,000–1,000 B.P.), and Late (1,000–400 B.P.) Woodland. The Woodland Period is marked by the appearance of the first ceramic vessel technology in southern New England. The population of southern New England became increasingly sedentary throughout the Woodland Period. By the end of the Late Woodland period, populations lived in settled, agricultural villages.
Post-Contact Period	European Exploration (A.D. 1000–1620)	This period began with the arrival of European explorers and anglers in New England during the 16th century. John Smith explored the Southern New England coastline in 1614–1615 and Puritan colonists establish the Plymouth Colony in 1620.
	European Settlement (A.D. 1620–1720)	During the 17th and early 18th centuries, both trade and conflict grew between Native American groups and European colonists. Europeans colonized Martha’s Vineyard in 1641–1642 with the establishment of Edgartown. Thomas Macy and family colonized Nantucket in the winter of 1659–1660. The earliest records of shore-based whaling on Nantucket by European colonists date to this period. European colonists founded the towns of Barnstable and Yarmouth during this period in the late 17th century.
	European Colonialism and Early Nationalism (A.D. 1720–1815)	During the 18th and early 19th centuries, trade between Europe and New England increased, leading to the growth of commercial cities along the Southern New England coast. Colonization of interior New England progressed throughout the period, leading to the removal, forced migration, and/or extermination of Native American populations. European colonial powers fought numerous wars in North America during the 18th century, culminating in the Seven Years’ War between England, France, and their respective colonies. Near the end of the period, the American Revolution (1775-1783) ended English colonial rule in southern New England and led to the founding of the United States of America. After the war, the maritime economy of southern New England, including fishing and whaling, continued to grow. Near the end of the period, the United States and England fought a second war, the War of 1812 (1812-1814), which significantly affected the maritime economy of southern New England. As the 19th century began, industrial mill towns began to appear throughout New England.
	Early Industrialization (A.D. 1815–1865)	The 19th century was a period of population growth and rapid industrialization across New England as well as the growth of shipbuilding, fishing, trade, and whaling industries. The 19th century was also the “Golden Age” of Southern New England whaling industry on Nantucket and coastal cities such as New Bedford and New London. During the United States Civil War (1861–1865), thousands of men from southern New England fought in campaigns across the southern United States of America.

Period		Description
	Late 19th Century–Early 20th Century (A.D. 1865–1950s)	The late 19th and early 20th centuries saw a marked decline in the merchant marine and whaling industries across Southern New England. In addition, American westward expansion and the rise of mid-west industrial centers also contributed to a general decline in the population of New England. The tourism industry on Martha's Vineyard, Nantucket, Cape Cod, and across southern New England, including the recreational fishing industry and maritime tourism, expanded rapidly during the early and mid-20th century.

A.D. = anno Domini; B.P. = before present

Table 3.8-3: Summary of Cultural Resource Investigations and Cultural Resources for the Proposed Project

Please note not all reports are not publicly available due to sensitive information.

Project Area/APE	Studies	Summary of Findings
Onshore	Upland Cabling Routes: Archaeological Due Diligence Report (PAL 2017)	• Vineyard Wind's cultural resources consultant performed a desktop-based review of known archaeological sites within 0.5 mile (0.8 kilometer) of the Preferred and Notice Alternative Upland Cable Routes, as well as six variants and one substation parcel, in Barnstable and Yarmouth. • Previous cultural resource investigations identified 29 pre-Contact and two post-Contact period archaeological sites within 0.5 mile (0.8 kilometer) of the studied routes; one archaeological site (19-BN-829) was previously identified within and/or adjacent to the western routes, and six archaeological sites (19-BN-670, 19BN-74, 19-BN853, 19BN959, 19BN960, and 19-BN-961) were previously identified within and/or adjacent to the eastern routes.
Onshore	Archaeological Reconnaissance Survey: Vineyard Wind Upland Cabling Project (Ritchie 2018a)	• Vineyard Wind's cultural resources consultant performed an archaeological reconnaissance survey of the proposed Vineyard Wind Upland Cabling Preferred Route), the Noticed Alternative Route, four Preferred Route variants (Variants 1, 2, 3, and 5), one Noticed Alternative variant (Variant 1), and a substation. • Zones of high archaeological sensitivity were identified in the southern ends of the Preferred Route and of the Noticed Alternative Route in Barnstable and West Yarmouth. • Archaeological monitoring of Project construction activities was recommended within the identified zones of high and moderate archaeological sensitivity along existing roads in the Project area. The consultant also recommended an intensive archaeological survey for the proposed substation at the Barnstable Switching Station.
Onshore	Intensive Archaeological Survey: Proposed Substation Vineyard Wind Upland Cabling Project (Ritchie 2018b)	• Vineyard Wind's cultural resources consultant performed an intensive archaeological survey within the proposed 6.35-acre (25,697.6 m^2) substation adjacent to the existing Eversource 115 kV Barnstable Switching Station. • Two isolated archaeological finds were identified: a small stemmed point is of Late to Transitional Archaic (5,000-2,500 B.P.) or Early Woodland Period (2,500-1,600 B.P.) and a piece of quartz chipping debris. Close interval (8.2 feet [2.5 meter]) sampling around these find spots did not yield any other pre-Contact cultural material and the finds are not considered to be potentially significant cultural resources. No additional archaeological investigations of the proposed substation location were recommended.

Project Area/APE	Studies	Summary of Findings
Offshore	Marine Archaeological Services Report (Epsilon 2019c)	• Vineyard Wind's cultural resources consultant performed desktop study/analysis and marine remote sensing surveys of portions of the WDA and OECCs. • In 2016, the marine remote sensing surveys covered over 497 miles (1,800 kilometers) of linear transects within the lease area. In 2017, surveys covered approximately 180 miles (290 kilometers) of linear transects along the OECCs. In 2018, survey tracklines covered approximately 2,989 miles (4,810 kilometers) in the WDA and 3,312 miles (5,330 kilometers) within the OECC. • The surveys identified two shipwreck sites in the WDA, which were recommended for avoidance. The proposed OECC crosses the seabed of the Nantucket Sound TCP.
Offshore	Marine Archaeological Services Support of the Vineyard Wind Offshore Wind Energy Project Construction and Operations Plan for Lease Area OCS-A 0501 and Offshore Export Cable Corridor Offshore Massachusetts (Epsilon 2019c)	• Vineyard Wind's cultural resources consultant prepared a report summarizing the results of high-resolution geophysical and geotechnical marine surveys of a proposed WDA and OECC for Vineyard Wind's Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (Lease Area OCS-A 0501) performed in 2016, 2017, and 2018. • The marine surveys identified two shipwrecks (historical resources) in the WDA and five additional debris scatters interpreted as potential shipwreck sites along the OECC, which were recommended for avoidance. If Vineyard Wind cannot avoid the wrecks, further investigations were recommended to determine their significance. • The analysis of geophysical and geotechnical data indicated that there are submerged landform features (stream channel, lake, and estuarine landscape features) within the Project area that have the potential to contain pre-Contact Native American archaeological resources. A number of the submerged landform features are located within the Nantucket Sound TCP. Vineyard Wind's cultural resources consultant considered these paleo-landscape features as archaeologically sensitive and recommended Vineyard Wind avoid the paleo-landscape features.
Offshore	Addendum to Volume II-C: Marine Archaeological Report (Epsilon 2019b)	• This addendum assesses potential dredge areas at a depth of 14.7–26.2 feet (4.5–8 meters), and is a supplement to the previous analysis in Volume II-C that assessed potential dredge areas to a depth of 14.7 feet (4.5 meters), so that the total APE depth reviewed in potential dredge areas is up to 26.2 feet (8 meters). • It also defines avoidance areas within the potential deeper dredge areas that are either below the ravinement surface (and thus may represent intact sediments) or are within interpreted submerged landform features. The avoidance areas associated with dredging or deeper cable installation to 26.2 feet (8 meters) are spatially connected to areas previously identified for avoidance.
Viewshed	Visual Impact Analysis for Historic Resources (Epsilon 2020d)	• Vineyard Wind's consultants evaluated visual impacts to historic properties through a Geographic Information System-based computer simulation and field-based study. Evaluated potential adverse effects to historic properties based on the view of the WDA from historic properties and landscapes. • The Historic Properties Visual Impact Assessment identified a variety of historic properties that the proposed Project may affect. These include National Historic Landmarks, properties listed on the National Register of Historic Places, properties on the Massachusetts State Register of Historic Places, and properties on the Inventory of Historic and Archaeological Assets of the Commonwealth.

Project Area/APE	Studies	Summary of Findings
Viewshed	Vineyard Wind Project: Visual Impact Assessment (Epsilon 2020c)	• Vineyard Wind's consultants conducted the visual impacts assessment designed to identify potential visibility of the Project from various historic properties. The report focused the onshore and offshore APE for direct visual effects. The APE included only the areas where the Project may be visible. Six geographical viewshed assessments were conducted including Martha's Vineyard, Nantucket, Nantucket Sound, Cuttyhunk Island, Cape Cod, and Buzzards Bay Western Shoreline. The report provided determinations of effect regarding the Project's direct visual effects on historic properties identified within each assessment area. It was determined that the Project would have an adverse visual effect on the Gay Head Light, the Chappaquiddick Island TCP, the Nantucket National Historic Landmark, and the Vineyard Sound and Moshup's Bridge TCP. • The federally recognized Wampanoag Tribe of Gay Head (Aquinnah) considers the Gay Head Cliffs, including certain unencumbered views from the cliffs, as important cosmological and ceremonial cultural resources.
Viewshed	Vineyard Wind Project Visual Impact Assessment Addendum 1 (Epsilon 2020d)	• This addendum assesses the potential visibility of the Project using the maximum 14 MW WTG modification noted in the updated Project design envelope and compares this with the original 8–10 MW WTG noted in the original envelope. The study includes a revised APE and revised visual simulations.

APE = area of potential effect; B.P. = before present; kV = kilovolt; m^2 = square meters; MW = megawatt; OECC = Offshore Export Cable Corridor; TCP = Traditional Cultural Property; WDA = Wind Development Area

Table 3.8-4: Summary of Historic Properties Cumulative Visual Impact Assessment

Historic Property	Maximum Number of WTGs Theoretically Visible			Distance to Closest WTG (miles)	
	Total	Proposed Project	Other Projects	Proposed Project	Other Projects
Gay Head Light	688	57	528	23.3	13.6
Chappaquiddick Island TCP	636	57	579	12.8	14.6
Nantucket NHL	645	57	588	14.4	16.9
Vineyard Sound and Moshup's Bridge TCP	608	55	553	18.8	12.4

NHL = National Historic Landmark; TCP = Traditional Cultural Property; WTG = wind turbine generator

Table 3.9-1: Summary of Activities and the Associated Impact-Producing Factors for Recreation and Tourism

Baseline Conditions: Coastal New England has been extensively developed for water-based recreation and tourism. The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. The visual qualities of historic coastal towns, which include marine activities within small-scale harbors and the ability to view birds and marine life, are important community characteristics.

Recreational and tourist-oriented activities in the geographic analysis area are oriented towards the southern coast of Cape Cod and around Martha's Vineyard, Nantucket, and the nearby small islands. Water-oriented recreational activities include boating, visiting beaches, hiking, fishing, shellfishing, and bird and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding.

Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks. Many of the activities make use of coastal and ocean amenities that are free for public access. Nonetheless, these features function as key drivers for the coastal recreation and tourism sectors.

The highest density of recreational vessels routes occurs within 1 nautical mile of the coastline. Fishing is the most popular activity for recreational boaters.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Anchoring occurs due to ongoing military, survey, commercial, and recreational activities.	Impacts from anchoring would continue, and may increase due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Modest growth in vessel traffic could increase the temporary, localized impacts of navigational hazards, increased turbidity levels, and potential for direct contact causing mortality of benthic resources.	Based on information from the Proposed Action, an offshore wind facility could generate an estimated average of 25 and a maximum of about 46 vessels present, per project, at any given time during construction, with variations based on the size and construction size of each project. Construction of 12 future offshore wind projects could occur within the RI and MA Lease Areas between 2022 and 2030, with a maximum of 4 projects under construction concurrently in 2024. Occasional anchored vessels would be needed during operations. Anchored vessels would result in temporary, localized impacts, as recreational boaters would need to navigate around anchored vessels. Temporary turbidity associated with anchoring could briefly alter the behavior of species important to recreational fishing and sightseeing.	Anchored vessels related to the Vineyard Wind 1 Project construction or decommissioning would result in temporary navigational hindrances and turbidity that would temporarily affect fish and invertebrates. Some anchored vessels within 12 nautical miles of the coast could be within a temporary safety zone established by the USCG (Section 3.11.2) Peak construction periods could require an average of 25 and a maximum of 46 vessels within the WDA and OECC work areas. Anchoring would have localized, short-term, **mino**r impacts on tourism and recreation.	Localized, temporary turbidity and navigational hindrances from anchoring during construction and decommissioning of the Proposed Action would have short-term, localized, **minor** impacts. Ongoing activities and future non-offshore wind activities would result in modest growth in vessel traffic with associated anchoring. Anchored vessels for construction and decommissioning of future offshore wind development other than the proposed Project would also have localized, temporary impacts on recreational boating within the RI and MA Lease Areas and along the offshore cable routes between 2021 and 2030. As many as five projects including the Proposed Action could be under construction concurrently in 2024, each requiring anchored vessels at offshore construction areas. In context of reasonably foreseeable environmental trends, combined anchoring impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be localized, short-term, and **minor** to **moderate**.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting (Section 3.11.1).	Depending on scheduling for future offshore wind projects, construction vessels could be lit during nighttime transit or construction (i.e., from 2022 through 2030). Construction of 12 offshore wind projects could occur within the RI and MA Lease Areas between 2022 and 2030, with a maximum of 4 projects under construction concurrently in 2024. Vessel lights could be visible from coastal locations depending upon vessel routes. Occasional nighttime vessel movements during operations would also require vessel lighting.	Nighttime lighting for vessels in transit and anchored within offshore work areas would occur when Project construction or maintenance takes place at night. Short-term vessel lighting is not anticipated to discourage recreational or tourist-related activities; lighting would have localized, short-term, intermittent, **negligible** impacts.	Nighttime lighting from construction of the Proposed Action would have localized, intermittent, short-term, **negligible** impacts on recreation and tourism. Nighttime vessel lighting from ongoing activities and future non-offshore wind activities would likely grow modestly. Future offshore wind development other than the proposed Project, if developed using nighttime construction, would result in intermittent increases in nighttime vessel lighting between 2022 and 2030; lighting would be short-term and localized. In context of reasonably foreseeable environmental trends, combined vessel lighting impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be short-term and **negligible**.
Light: Structures	Offshore buoys and towers emit low-intensity light. Onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	Up to 709 WTGs operated as part of the No Action Alternative would have aviation hazard and navigation lights, in accordance with the assumptions in Appendix A Table A-4, as well as USCG and FAA requirements, that would be visible from higher elevations and coastlines within the geographic analysis area depending on vegetation, topography, and atmospheric conditions (assuming the use of 12 or 14 MW WTGs). Views of lights on offshore wind energy structures would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. This contrast could affect visitor decisions in	Vineyard Wind has committed to voluntarily implementing ADLS as a self-imposed measure, which would activate WTG lighting less than 0.1 percent of annual nighttime hours. The lights on all of the Proposed Action's WTGs could potentially be visible from coastal and elevated locations on Martha's Vineyard, Nantucket, and neighboring islands (depending on vegetation, topography, weather, and atmospheric conditions). When visible, WTG lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the use of ADLS, the impacts on	Aviation hazard lighting on all of the Proposed Action's WTGs could possibly be visible from some coastal and elevated locations on Martha's Vineyard, Nantucket, and neighboring islands, but only during ADLS activation, resulting in long-term, continuous, **negligible** impacts on recreation and tourism. Other than offshore wind, few offshore objects would have nighttime lighting. Onshore lighting from ongoing activities would be closer to onshore viewers (who would thus perceive onshore lighting as more intense). Onshore lighting would generally contribute the largest part of the impact of lighting on structures, except in cases where minimal onshore lighting is present. Future offshore wind development would result in aviation hazard lighting from 709 WTGs potentially visible from land within the geographic analysis area for recreation and tourism (assuming the use of 12 or 14 MW WTGs). In context of reasonably foreseeable environmental trends, combined WTG lighting impacts on recreation and tourism from ongoing

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			selecting south-facing coastal and elevated locations to visit, but would be unlikely to affect recreation and tourism activities as a whole. ADLS, if implemented, could reduce the magnitude of these impacts.	recreation and tourism (resulting from impacts on visual resources) would be long-term, continuous, and **negligible**.	and planned actions, including the Proposed Action, would be **minor**, due to potential visitor preferences for locations without visible nighttime lighting. Use of ADLS, if used for offshore wind projects other than the Proposed Action, would reduce the visual impacts on recreation and tourism to **negligible**.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for recreation and tourism, there are six existing power cables.	Cable maintenance or replacement of existing cables in the geographic analysis area would occur infrequently, and would generate short-term disturbances.	Cable emplacement and maintenance between 2022 and 2030 would result in vessel anchoring at offshore worksites, disturbances to the seafloor, and suspended sediment. Assuming similar installation procedures as the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance (Sections 3.3 and 3.4). Offshore wind export cables from the RI and MA Lease Areas could cross 1,310 miles (2,108 kilometers), while inter-array cables could total 1,480 miles (2,382 kilometers). The proportion or length of the export cables that would cross waters within the geographic analysis area is not known. Impacts of onshore cable installation would depend upon the specific location, but could temporarily disrupt beaches and other recreational coastal areas.	Vineyard Wind cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism. The Proposed Action would require export cables that would cross approximately 98 miles (158 kilometers) and inter-array cables that would total about 177 miles (285 kilometers). Impacts on recreation and tourism would be localized, short-term, and **minor**. Onshore cable installation would result in disturbance of a public beach during landfall installation, with short-term, **moderate** impacts on recreation and tourism.	The Proposed Action's cable emplacement and maintenance would have localized, short-term, **minor** impacts on recreation and tourism. Installation at the landfall site would have a short-term, localized, **moderate** impact on recreation and tourism. Ongoing maintenance and installation of offshore cables not related to offshore wind would generate short-term disturbances to recreational vessel routes and marine species. Future offshore wind development other than the proposed Project would require additional cable emplacement. Inter-array cable emplacement within the RI and MA Lease Areas would be within the geographic analysis area; the length and exact locations of export cables within the geographic analysis area would depend upon the detailed design of each offshore wind development, but some would be within the geographic analysis area. Cable emplacement would result in short-term, localized displacement of recreational boating. In context of reasonably foreseeable environmental trends, combined cable emplacement impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be **minor** to **moderate** due to the need for recreational vessels to navigate around work areas, the potential disruption to public beaches and coastal recreation at landfall sites, and the temporary impacts on fish and invertebrates.
Noise: O&M	Limited to Block Island Wind Farm	Not applicable	Noise from up to 775 WTGs within the RI and MA Lease Areas could affect recreation and tourism from the nuisance effects of operational noise for recreational boaters close to WTGs. However, noise produced by WTGs is typically low and would be detectible only within a small area close to each WTG. No evidence suggests that such noise would affect marine mammals, finfish, invertebrates, and EFH (Sections 3.3.1 and 3.4.1). Noise from maintenance would be variable and short-term.	Noise from the 57 to 100 WTGs that would be installed for the Proposed Action could affect recreation and tourism from the nuisance effects of operational noise for recreational boaters. However, noise is anticipated to be of low intensity and detectible only within a small area close to each WTG. (Section 3.3; as measured at the Block Island Wind Farm, the low-frequency noise from WTG operation barely exceeds ambient levels at 164 feet [50 meters] from the WTG base.) Impacts on recreation and tourism would be long-term, continuous, and **negligible**.	The Proposed Action would result in operational noise near each WTG that would be audible only within a small area near the WTG, and is not anticipated to affect fish and marine mammals important to recreational activities. Impacts from Vineyard Wind's operational noise and periodic maintenance on recreation and tourism would be long-term, continuous, and **negligible**. Operation of ongoing and future non-offshore wind activities could result in additional offshore noise from vessel engines. Future offshore wind development would have up to 775 WTGs within the RI and MA Lease Areas, with each WTG creating noise audible within a small area close to the WTG. In context of reasonably foreseeable environmental trends, combined WTG operational noise impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be localized, long-term and constant (from WTGs) or occasional (for maintenance operations) and **negligible.**
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.	An estimated 795 foundations (WTGs and ESPs) would be installed within the RI and MA Lease Areas between 2022 and 2030. Impacts on recreation and tourism would result from pile-driving noise intruding upon the natural sounds of the marine environment, although noise would be most intense within marine construction safety zones established by USCG within 12 nautical miles of the coast, which would be off limits to boaters. Additionally, impacts would result from the effects of pile-driving noise on species important to recreational fishing and marine sightseeing activities (Sections 3.3.1 and 3.4.1). Pile driving is one of the most impactful noises on marine species, and impacts would be greater if multiple project construction activities occur in close spatial and	The Proposed Action would require installation of up to 102 foundations. Impacts on recreation and tourism would result from pile-driving noise intruding upon the natural sounds of the marine environment, although noise would be most intense within marine construction safety zones established by USCG within 12 nautical miles of the coast, which would be off limits to boaters. Additionally, impacts would result from the effects of pile-driving noise on species important to recreational fishing and marine sightseeing activities (Sections 3.3.2 and 3.4.2). Impacts on recreation and tourism would be short-term, variable, and **minor to moderate**.	Pile-driving noise from the Proposed Action construction would have localized, short-term, **minor to moderate** impacts due to the disturbance of the natural sounds of the marine environment and the impact on species important for recreational fishing or sightseeing, respectively. Ongoing and future non-offshore wind activities may result in occasional nearshore pile driving. Future offshore wind development would have similar contributions as the Proposed Action, requiring pile driving for installation of 795 foundations between 2022 and 2030. In context of reasonably foreseeable environmental trends, combined pile-driving noise impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be localized, short-term, and **minor** with respect to the impact on recreational boating, and **minor to moderate** with respect to the impact on marine mammals, finfish, and invertebrates, depending upon the impact on and length of time needed for recovery of marine species.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			temporal proximity. Overall impacts would be short-term, localized, and variable.		
Noise: Cable laying/trenching	Offshore trenching occurs periodically in connection with cable installation or sand and gravel mining.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.	Impacts would result from trenching noise intruding on the natural sounds of the marine environment, with impacts experienced by recreational boaters primarily along OECC cable routes, which extend close to shorelines in areas heavily traveled by recreational boaters. Impacts would also result from effects on species important to recreational fishing and marine sightseeing activities (Sections 3.3.1 and 3.4.1). The length of OECC cable routes within the geographic analysis area cannot be determined without detailed project applications, but a total of about 1,310 miles of OECC cables would extend from the RI and MA Lease Areas to coastlines within or near the geographic analysis area.	Impacts would result from the noise of trenching intruding on the natural sounds of the marine environment, with impacts experienced by recreational boaters primarily along the 98 miles of OECC cable route, especially in nearshore areas heavily traveled by recreational boaters. Impacts would also result from effects on species important to recreational fishing and marine sightseeing activities (Sections 3.3.2 and 3.4.2). Impacts on recreation and tourism would be short-term, variable, and **minor**.	Trenching noise from the Proposed Action construction would have localized, short-term, variable, **minor** impacts on recreation and tourism due to the disturbance of the natural sounds of the marine environment and the temporary impacts anticipated on species important for recreational fishing or sightseeing. Ongoing and future non-offshore wind activities would result in infrequent noise from trenching. Future offshore wind development would result in additional trenching for cable installation within the geographic analysis area from 2022 through 2030. Because the impacts of each trenching project are localized and short-term, in context of reasonably foreseeable environmental trends, combined trenching noise impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be **minor** (Sections 3.3.2 and 3.4.2).
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels (Section 3.11).	Planned new barge routes and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.	Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate about 7 daily vessel trips during the entire construction period and about 18 daily vessel trips during peak construction periods. Up to 12 projects could be installed between 2022 and 2030, with a maximum of 4 projects under construction concurrently in 2024. Each facility would generate about one to three vessel trips per day during its 30-year operational life. Vessel noise, especially during construction, may result in recreational vessels temporarily avoiding an affected area. Impacts would result from avoidance of vessel noise by species important to recreational fishing and marine sightseeing activities (Sections 3.3.1 and 3.4.1). Vessel noise would be concentrated along routes between the ports (outside the recreation and tourism geographic analysis area) and the offshore wind work areas. Most vessel traffic would travel to the WTG and ESP installation areas, with fewer vessels needed along the cable installation routes.	The Proposed Action construction would generate an average of 7 daily vessel trips during the entire construction period and during peak construction periods would generate an average of 18 daily vessel trips. Proposed Action operations would generate 1 to 3 vessel trips from Vineyard Haven and New Bedford to the WDA. Vessel noise during construction may result in recreational vessels temporarily avoiding the highly trafficked water areas, as well as fish and marine mammals temporarily avoiding the areas of vessel noise (Sections 3.7.2 and 3.8.2). Impacts on noise from Proposed Action construction would have localized, short-term, **minor** impacts on recreation and tourism. Operational noise from vessel traffic would have long-term, continuous, **negligible** impacts.	The Proposed Action would result in increased vessel traffic and associated noise, resulting in localized, short-term, constant, **minor** impacts on recreation and tourism during construction, and localized, long-term, intermittent, **negligible** impacts during operations. Ongoing and future non-offshore wind activities would likely lead to increased vessel activity and associated noise. Future offshore wind projects would result in up to 12 offshore wind projects under construction between 2022 and 2030 with a maximum of 5 projects under construction concurrently in 2024; each would generate vessel traffic similar to the Proposed Action, with variations depending on project size and construction schedules. As many as 4 offshore wind projects could be under construction at one time. In context of reasonably foreseeable environmental trends, combined vessel noise impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be localized, short-term, variable, and **minor** to **moderate** during construction, depending upon the temporal overlap of offshore wind project construction; and localized, long-term, intermittent, and **negligible** during operations.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The Marine Commerce Terminal at the Port of New Bedford was upgraded by the port specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.	Ports outside the geographic analysis area for recreation and tourism that are likely to be used for staging and construction, such as New Bedford, Brayton Point, ProvPort, and Davisville/Quonset Point, may provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above and other northeast ports suitable for staging and construction of the No Action Alternative projects are primarily industrial in character. Some provide for recreational vessels as a secondary use.	The Vineyard Wind 1 Project would use facilities at Vineyard Haven Harbor on Martha’s Vineyard for the Operations and Maintenance Facility. Improvements at this facility would be completed to support the offshore wind industry as a whole, and not the Proposed Action specifically. Operation of the Proposed Action would generate 1 to 3 vessel trips per day, which would have localized, long-term, continuous, **negligible** impacts on recreation and tourism.	No expansion of Vineyard Haven Harbor is proposed in connection with the Proposed Action, although the Vineyard Wind 1 Project would use this facility during operations, resulting in a localized, long-term, continuous, **negligible** impact on recreation and tourism. Ongoing and future non-offshore wind activities would include ongoing maintenance for numerous harbors outside the analysis area that are also used for recreation and tourism. Future offshore wind projects would not contribute to this sub-IPF: all ports planned for offshore wind development and operation are outside the analysis area. In context of reasonably foreseeable environmental trends, combined port utilization impacts on recreation and tourism (limited to Vineyard Haven) from ongoing and planned actions, including the Proposed Action, would be localized, long-term, continuous, and **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Port utilization: Maintenance/ dredging	No major ports are within the geographic analysis area. Periodic maintenance is necessary for Vineyard Haven and numerous other harbors within the analysis area.	Ongoing maintenance and dredging of harbors on Martha's Vineyard, Nantucket, and Cape Cod will continue as needed. No specific projects are known.	Ports outside of the recreation and tourism geographic analysis area that are likely to be used for staging and construction, such as New Bedford, Brayton Point, ProvPort, and Davisville/Quonset Point, may provide facilities for recreational vessels, or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above, and other northeast ports suitable for staging and construction of the No Action Alternative projects are primarily industrial in character.	The Vineyard Wind 1 Project would not necessitate maintenance dredging at any port.	The Proposed Action would not require maintenance dredging at any port. Ongoing and future non-offshore wind activities would include ongoing maintenance for numerous harbors within the recreation and tourism geographic analysis area that are important for recreation and tourism. Future offshore wind projects would not contribute to this sub-IPF: no ports that would be used for offshore wind support are within the geographic analysis area. The Proposed Action would not contribute impacts and there would be no combined port maintenance and dredging impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Construction and operations of wind energy facilities would increase the number of structures in the water, therefore increasing the risk of allision (Section 3.11). Up to 977 structures (WTGs and ESPs, assuming use of 8 MW WTGs) could be built within the RI and MA Lease Areas. Generally, vessels more likely to allide with WTGs or ESPs would be smaller vessels such as recreational vessels. Risk of allision with anchored vessels would increase incrementally during construction (i.e., from 2022 through 2030) as more anchored vessels would be within the recreation and tourism geographic analysis area, but the risk would be small due to the flexible, temporary safety zones around work areas within 12 nautical miles of the coast.	Construction and operation of the Proposed Action would add up to 102 offshore wind structures in the water, thereby increasing the risk of allision (Section 3.11). Generally, vessels more likely to allide with WTGs or ESPs would be smaller vessels such as recreational vessels. Risk of allision with anchored vessels would increase incrementally during construction as more anchored vessels would be within the recreation and tourism geographic analysis area, but the risk would be small due to the flexible, temporary safety zones around work areas within 12 nautical miles of the coast. Vineyard Wind would work with USCG to communicate these zones and other work areas to the boating public via Local Notices to Mariners (Section 3.11.2) The impact of the Vineyard Wind 1 Project on recreation and tourism due to the risk of allisions would belong-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to the risk of allisions would be long-term, continuous, and **minor**. Ongoing activities and future, non-offshore wind activities would not result in increased risk of allision. Future offshore wind development would result in a greater risk of allisions within the RI and MA Lease Areas, with a potential total of 977 offshore wind energy structures (assuming the use of 8 MW WTGs). In context of reasonably foreseeable environmental trends, combined impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term, continuous, and **minor** to **moderate,** due to the risk of allisions with offshore wind structures.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.	Development of offshore wind would result in additional WTGs, ESPs, scour protection, and hard cover protection for cables, increasing the risk of recreational fishing gear loss or damage due to entanglement. Offshore wind development within the RI and MA Lease Areas would result in an estimated 339 acres of export cable hard protection, 242 acres of inter-array cable hard protection, in addition to the scour protection around 977 offshore foundations (assuming the use of 8 MW WTGs). Impacts at any one location for recreational fishing would be intermittent, localized, and long-term.	Vineyard Wind would add up to 102 foundations with scour protection, as well as 35 acres of export cable hard protection and 63 acres of inter-array cable hard protection. This would increase the risk of gear loss/damage by entanglement. The impact of Vineyard Wind on recreation and tourism due to the risk of entanglement and gear loss would belong-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to the risk of recreational fishing gear entanglement and loss would belong-term, continuous, and **minor**. Ongoing activities would not increase in risk of gear loss or damage due to entanglement. Future offshore wind would result in the risk of gear entanglement and loss due to the scour protection and inter-array cable hard protection within each offshore wind project in the RI and MA Lease Areas, as well as additional cable hard cover protection for the export cables, which would include cables within the geographic analysis area that cannot be quantified without detailed plans for each offshore wind project. In context of reasonably foreseeable environmental trends, combined impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term, continuous, and **minor** to **moderate** due to the risk of entanglement and gear loss.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. Recreational and commercial fishing can occur near these aggregation	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	The potential for 977 offshore wind energy structures within the geographic analysis area (assuming the use of 8 MW WTGs) could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities, but could potentially result in broad changes in recreational fishing practices if fish attraction and reef effects	The Proposed Action could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels to up to 102 offshore structure foundations (WTGs and ESPs). This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities. This would have long-term, **negligible beneficial** impacts on recreation and tourism.	The impacts on recreation and tourism from this sub-IPF under the Proposed Action would include limited increases in recreational fishing activity due to fish aggregation and reef effects that could occur at some of the Proposed Action's 102 offshore structures. This would have long-term, **negligible beneficial** impacts on recreation and tourism. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action; the 977 potential offshore structures (assuming the use of 8 MW WTGs) could produce changes in recreational fishing practices that would result in more recreational vessels traveling as far from shore as the offshore wind facilities. Impacts would be similar to those described for the Proposed Action, but would occur across the RI

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	locations, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on structures.		are widespread enough to encourage more participants to travel further from shore.		and MA Lease Areas In context of reasonably foreseeable environmental trends, combined fish aggregation impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term and **minor beneficial**.
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy facilities could create foraging opportunities for seals and small odontocetes (toothed whales), and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase recreation and tourism activity associated with offshore sightseeing. New structures would be added intermittently between 2022 and 2030, and could benefit structure-oriented species as long as the structures remain.	Up to 102 foundations (WTGs and ESPs) installed as part of the Proposed Action could create foraging opportunities for seals, small odontocetes, and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. The habitat created by these new structures could thus provide new opportunity for wildlife viewing from vessels fishing. Sightseeing vessels already operating from Nantucket Sound may be attracted to the WDA. The impact of the Proposed Action on recreation and tourism due to the potential for habitat creation would therefore be long-term, continuous, **minor beneficial**.	The impacts on recreation and tourism from this sub-IPF under the Proposed Action would include increased sightseeing vessel activity in the Proposed Action area if marine mammals are attracted to any reef-like habitats created by WTG and ESP foundations. This would have long-term, **minor beneficial** impacts on recreation and tourism. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but the addition of up to 977 offshore wind structures (assuming the use of 8 MW WTGs) between 2022 and 2030 could encourage a larger number of sightseeing vessels to travel to offshore wind facilities. Impacts would be similar to those described for the Proposed Action, but would occur across the RI/MA Lease Areas. In context of reasonably foreseeable environmental trends, combined habitat creation impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term, and **minor beneficial**.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.	Future offshore wind development would add up to 957 WTGs (assuming the use of 8 MW WTGs) and 20 ESPs within the geographic analysis area for recreation and tourism, thereby increasing navigation hazards for recreational boaters. The need to navigate around these structures may present risk to recreational boaters and may discourage some offshore recreation and tourism, resulting in long-term, continuous, regional (throughout the RI and MA Lease Areas) impacts on recreation and tourism.	Up to 102 structures (WTGs and ESPs) installed as part of the Proposed Action would increase navigation hazards for recreational boaters. The risk and perceived hazard of incidents such as allisions and collisions could discourage recreational boaters from traveling to and through the WDA, resulting in selection of other routes. The impact of Vineyard Wind on recreation and tourism due to navigational hazards within the WDA would belong-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to navigational hazards within the WDA, specifically from WTGs and ESPs, would belong-term, continuous, and **minor**. Navigation hazards from ongoing and future non-offshore wind activities would continue to exist, but would not meaningfully increase. Future offshore wind development other than the proposed Project would result in greater navigational hazards from the long-term presence of up to 977 total WTGs and ESPs (assuming the use of 8 MW WTGs). The layout of the Proposed Action's WTGs would differ from the predominant orientation of other offshore wind projects in both spacing (less than 1 x 1 nautical miles) and orientation (rows of WTGs not oriented east-west and north-south). As described in Section 3.11, this disparity in orientation would hamper search and rescue (SAR) activities, with potential impacts on safety for recreational vessels. In context of reasonably foreseeable environmental trends, combined navigational impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term, continuous, and **minor** to **major**.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy structures within up to 12 offshore wind projects in the RI and MA Lease Areas could affect established offshore recreation and tourism activities, including fishing, sailboat races, tour boat routes, and other recreational boating, during construction and operations of the No Action Alternative projects. The structures would require vessels to travel in channels between structures, would hinder passage of large sailboats (depending on mast height and turbine blade clearance), and would occupy areas that might have been used for recreational fishing. The affected area would increase as additional wind energy facilities begin the construction phase.	The constraints on navigation resulting from up to 102 offshore wind structures would require vessels to travel in the channels between structures, increasing the possibility of conflicts or collisions between vessels. WTGs would occupy current locations favored for recreational fishing. The WTG blades would hinder large sailboats (with mast height of 89 feet or greater) from traveling near the WTGs. The impact of Vineyard Wind on recreation and tourism due to space use conflicts within the WDA would be long-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to space use conflicts within the WDA, such as vessels being restricted to channels between WTGs and ESPs, would result in potential conflicts. These impacts would belong-term, continuous, and **minor**. Ongoing activities and planned, non-offshore wind activities would not add offshore structures. Future offshore wind development other than the proposed Project would result in similar navigational constraints, with displacement or channelization of recreational fishing and boating within 12 offshore wind projects in the RI and MA Lease Areas. In context of reasonably foreseeable environmental trends, combined impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term, continuous, and **minor** to **moderate** due to space use conflicts within multiple wind development areas.
Presence of structures: Viewshed	The only existing offshore structures within the viewshed of the Vineyard Wind are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components of the Vineyard Wind 1 Project would be limited to meteorological towers.	Under the No Action Alternative, portions of all 775 WTGs associated with the No Action Alternative (assuming the use of 12 or 14 MW WTGs) would potentially be visible from south-facing shorelines and some elevated areas on Martha's Vineyard, Nantucket, and possibly	Under the maximum impact scenario for the Proposed Action, portions of all 57 of the Proposed Action's 14 MW WTGs could potentially be visible from south-facing shorelines and some elevated areas on Martha's Vineyard, Nantucket, and possibly mainland Cape Cod,	The impact of the Proposed Action on recreation and tourism due to the visual impact of WTGs would belong-term, continuous, and **minor**. Other ongoing and non-offshore wind activity would not contribute to this sub-IPF. Future offshore wind development would result in portions of all 775 WTGs associated with the No Action Alternative (assuming the use of 12 or 14 MW WTGs) potentially visible from coastal locations in the geographic analysis area for recreation and

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		Marine activity would also occur within the marine viewshed.	mainland Cape Cod, depending on vegetation, topography, and atmospheric conditions. The presence of visible WTGs would add a developed/ industrial visual element to ocean views that were previously characterized by open ocean. These impacts on visual resources could influence the decisions of visitors to coastal and elevated locations with south-facing views, especially in locations that do not receive heavy tourist use (i.e., where limited human activity is an expected visual condition), thus affecting recreation and tourism activity, although this effect diminishes with the distance between observers and WTGs. More than 95 percent of WTGs would be more than 15 miles (24 kilometers) from shore, limiting the impact of the No Action Alternative on recreation and tourism in the overall analysis area.	depending on vegetation, topography, and atmospheric conditions. Visible WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean. These impacts on visual resources could influence the decisions of visitors to coastal and elevated locations with south-facing views, thus affecting recreation and tourism activity. This effect would be more likely to occur in locations that do not receive heavy tourist use (i.e., where limited human activity is an expected visual condition), and diminishes with the distance between observers and WTGs, and would be more likely to occur. Due to the distance from the closest WTGs (nearly 15 miles), the impact of the Proposed Action on recreation and tourism due to visibility of WTGs would belong-term, continuous, and **minor**.	tourism, and more than one project may be visible at a time from some locations. Cumulatively, visible WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, especially in locations that do not receive heavy tourist use (i.e., where limited human activity is an expected visual condition) These impacts on visual resources could influence the decisions of visitors to coastal and elevated locations with south-facing views, thus affecting recreation and tourism activity, although this effect diminishes with the distance between observers and WTGs. In context of reasonably foreseeable environmental trends, combined visual impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term, continuous, and **minor** in the overall geographic analysis area, with **moderate** impacts on south-facing shoreline areas of Martha's Vineyard, Nantucket, and Cape Cod with views of WTGs.
Traffic: Vessels	Study area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes (Section 3.11).	New vessel traffic near the study area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the study area economy.	Up to 12 offshore wind projects may be constructed in the RI and MA Lease Areas between 2022 and 2030. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate about 7 daily vessel trips during the entire construction period and about 18 daily vessel trips during peak construction periods. Each facility would generate about one to three vessel trips per day during its 30-year operational life. Increased vessel traffic may result in localized inconvenience, minor delays, and navigational complexity for recreational vessel traffic. Impacts would be greater during construction of multiple wind energy facilities (including 2024, when up to four projects would be simultaneously under construction). Overall, impacts would be short-term, continuous, and localized.	The Proposed Action construction would generate an average of 7 daily vessel trips during the entire construction period and during peak construction periods would generate an average of 18 daily vessel trips. Operation would generate about 1 to 3 trips daily to the WDA from either Vineyard Haven or the Port of New Bedford (outside the recreation and tourism geographic analysis area). Impacts of construction-related vessel traffic on recreation and tourism would be localized, short-term, variable, and **minor**. Impacts of vessel traffic during operations would be localized, long-term, intermittent, and **negligible**.	Increased vessel traffic from the Proposed Action would have a localized, short-term, variable, **minor** impact on recreation and tourism during construction. Impacts of vessel traffic during operations would be localized, long-term, intermittent, and **negligible**. Ongoing and future, non-offshore wind activities would continue to result in substantial vessel traffic within the recreation and tourism geographic analysis area, with potential for modestly increasing volume. Offshore wind development other than the proposed Project would result in up to 12 potential future offshore wind projects within the geographic analysis area, each with vessel traffic similar to the Proposed Action, and the largest impacts would occur when as many as 5 projects are under construction concurrently. In context of reasonably foreseeable environmental trends, combined vessel traffic impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be short-term, continuous, and **minor** to **moderate** during construction, and localized, long-term, intermittent, and **negligible** during operations.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	An increased risk of collisions is not anticipated from future activities.	Increased vessel traffic during offshore wind development (i.e., from 2022 through 2030), and to a lesser extent during offshore wind operations, would marginally increase the risk of collision. Impacts would be greater during simultaneous construction of up to four wind energy facilities in 2024. Impacts of construction-related vessel collision risk on recreation and tourism would belong-term, and variable.	Increased vessel traffic during construction, and to a lesser extent during operations, could result in a proportional increase in the risk of vessel collisions. Impacts of construction-related vessel collision risk on recreation and tourism would belong-term, variable, and **minor**. Impacts of vessel collision risk during operations would be localized, long-term, intermittent, and **negligible**.	The Proposed Action would result in an increased construction-related vessel collision risk, with an impact on recreation and tourism that would be, long-term, variable, and **minor**. Impacts of vessel collision risk during operations would be localized, long-term, intermittent, and **negligible**. Ongoing and future, non-offshore wind activities would continue to result in substantial vessel traffic within the geographic analysis area, with potential for vessel collisions. Future development (other than the proposed Project) of up to 12 offshore wind projects would result in vessel traffic during the 2022 and 2030 construction period (including up to 5 projects under construction simultaneously), resulting in increased risk of collision for recreational vessels sharing the waters near the offshore transit and work areas. In context of reasonably foreseeable environmental trends, combined impacts on recreation and tourism from ongoing and planned actions, including the Proposed Action, would be long-term, variable, and **minor** during construction, and localized, long-term, intermittent, and **negligible** during operations.

ADLS = Aircraft Detection Light System; EFH = essential fish habitat; ESP = electrical service platform; FAA = Federal Aviation Administration; IPF = impact-producing factors; MW = megawatts; OECC = Offshore Export Cable Corridor; RI and MA = Rhode Island and Massachusetts; USCG = U.S. Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.10-1: Summary of Activities and the Associated Impact-Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

Baseline Conditions: The fisheries resources in federal waters off New England provide a significant amount of revenue. New Bedford, Massachusetts, has consistently been the highest value-producing U.S. fishing port (NOAA 2018b). In 2018, commercial fisheries harvested more than 1.2 billion pounds of fish and shellfish in the North and Mid-Atlantic region, for a total landed value of over $1.8 billion; from 2009 to 2018, average annual landings were 1.3 billion pounds with a value of $1.6 billion (ACCSP 2018). From 2009 to 2018, the value of landings has ranged from $1.2 billion to over $1.8 billion, while landings weight has ranged from 1.16 billion pounds to 1.40 billion pounds. In Massachusetts, commercial fisheries harvested over 222 million pounds of fish and shellfish in 2018 for a total landed value of over $630 million.

Regional commercial fisheries are known for the large landings of herring, menhaden, clam, squid, scallop, skate, and lobster, and for being a notable source of profit from scallop, lobster, clam, squid, and other species (NOAA 2019a). Commercial fisheries obtained the greatest concentration of revenue from around the 164-foot (50-meter) contour off Long Island and Georges Bank. Over 4,300 federally permitted fishing vessels were in the Northeast in 2017 landing fish in several major Northeast ports (Table 3.10-2).

For-hire recreational fishing is also an important economic sector regionally with peak activity from June through August (NOAA 2017b). Regionally in 2015, the industry created 2,232 jobs, generated $326 million in sales, and contributed $192 million in value added. The Marine Recreational Information Program data show that mackerels, cod, and striped bass were the most-caught species within the Massachusetts for-hire recreational fishery. Black sea bass, scup, striped bass, summer flounder, and tautog were the most-caught species within the Rhode Island for-hire recreational fishery (NOAA 2017a). For-hire recreational fishing in the Atlantic provides opportunities for recreational fishing of highly migratory species such as tuna, billfish, swordfish, and sharks. Tuna and sharks are targeted in the WDA by for-hire fishing boats. See Section 3.6.1, Demographics, Employment, and Economics, for additional discussion on port communities.

Commercial fisheries and for-hire recreational fishing in the geographic analysis area for this resource are subject to pressure from ongoing activities, including regulated fishing effort, vessel traffic, and climate change. NMFS partners with regional fishery management councils and the Atlantic States Marine Fisheries Commission to predict the abundance of fish stocks, set catch limits, and promulgate and ensure adherence to regulations. Fisheries management affects commercial fisheries and for-hire recreational fishing in the region through management of sustainable fish stocks and measures to reduce impacts on important habitat and protected species. These management plans include measures such as fishing seasons, quotas, and closed areas that constrain how the fisheries are able to operate and adapt to change. Management actions can reduce or increase the size of available landings to commercial and for-hire recreational fisheries. Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60 percent (McCreary and Brooks 2019). This, along with Area 3 trap cap reductions, will likely have a significant impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. Most fisheries will continue to implement adjustments to fishery-specific annual catch limits (both increases and decreases) and measures to prevent exceeding such limits. This will affect fishery operations in different ways that are very difficult to anticipate for the purposes of assessing cumulative impacts of the Proposed Action, future offshore wind activities, ongoing activities, and future non-offshore wind activities.

The Omnibus Deep Sea Coral Amendment's closures in the Gulf of Maine are expected to displace some bottom tending mobile gear effort locally, but not likely in areas affected by the Proposed Action. A future action that would reopen the Cape Hatteras Gear Restricted Area and the Northeastern United States Closed Area to pelagic longline vessels targeting highly migratory species (HMS) may result in seasonal shifts in fishing effort into those areas from other fishing locations, and change vessel transit patterns, including from the Massachusetts, New Jersey, and New York ports. The New England Fishery Management Council's Habitat Clam Dredge Exemption Framework Action allows surfclam vessels to fish in parts of the Great South Channel Habitat Management Area and may move such effort out of lease areas, while proposed lobster trap reductions in Areas 2 and 3 may also slightly decrease effort within the offshore wind areas. Finally, Amendment 8 to the Atlantic Herring FMP implements a ban on using midwater trawl gear inshore of 12 nautical miles from Canada to the Rhode Island/Connecticut border and inshore of 20 nautical miles off Cape Cod; this is expected to either displace herring midwater trawl fishing effort or result in vessels switching to bottom trawl or purse seine gear. If herring midwater trawl vessels switch to using bottom trawl gear, herring fishing effort may continue inshore of the area affected by the Proposed Action. If midwater trawl vessels do not switch to bottom trawl gear, their effort may be displaced offshore into other offshore wind areas (Douglas Christal, Pers. Comm., March 20, 2020).

Additionally, there is substantial variability in the volume and value landed of various species fished within the WDA. Year-to-year variation in available catch, fishing effort, and quotas set for commercial and recreational fisheries to protect stocks and prevent overfishing, introduce significant fluctuations in how much is landed every year from within the WDA, the Massachusetts Lease Area, and other locations. In the New England and Mid-Atlantic regions, as of December 2019, 12 fish stocks are in an overfished condition, and 5 are currently subject to overfishing and are in an overfished condition (NOAA 2019b). See Table 3.3-1 for details on impacts on fish.

In addition to regulated fishing effort, commercial fisheries and for-hire recreational fishing are subject to impacts from climate change. Climate change is also predicted to affect Northeast fishery species (Hare et al. 2016), which will affect commercial and for-hire fisheries differently depending on the targeted species. Changing environmental and ocean conditions (currents, water temperature, etc.), increased storm magnitude or frequency, and shoreline changes can affect fish distribution, populations, and availability to commercial and recreational for-hire fisheries. See Table 3.3-1 for details on impacts on fish.

Vessel traffic would also affect commercial fisheries and for-hire recreational fishing, including traffic congestion, delays at ports, and difficulties with navigation. Currently there are few structures in offshore waters, so there are very few impediments to transiting and fishing. There are also no artificial impediments to movement of currents/waves/wind that might affect the offshore marine (pelagic and benthic) ecosystem. Impacts from other ongoing activities, including structures such as existing cables and pipelines, have been largely mitigated through infrastructure burial.

The following sources provide quantitative details in support of the level of impact associated with the IPFs shown in this Table 3.10-1:

- From Table 3.10-11: Average Annual Percentage of Total Mid-Atlantic and New England Fishery Revenue Exposed to Offshore Wind Energy Development by FMP (2020-2030), Table 3.10-12: Average Annual Revenue from all Lease Areas for Exposed Port Groups, 2013-2018, Figure 3.10-12: All VMS Fisheries in RI and MA Lease Areas—Fishing, Figure 3.10-13: All VMS Fisheries in RI and MA Lease Areas—Transiting, Figure 3.10-14: All VMS Fisheries in the WDA—Fishing and Transiting, Figure 3.10-15: All VMS Fisheries in the WDA—Fishing, Figure 3.10-16: Sea Scallop Fishery in RI and MA Lease Areas—Transiting, Figure 3.10-17: Squid, Mackerel, Butterfish Fishery in RI and MA Lease Areas—Fishing, and Figure 3.10-18: Surfclam and Ocean Quahog Fishery in RI and MA Lease Areas—Transiting
- Table 3.10-9: Average Annual For-Hire Recreational Trips within 1 Mile of Massachusetts Lease Areas, 2007–2012
- Kirkpatrick et al. 2017, Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Impacts from anchoring occur due to ongoing military, survey, commercial, and recreational activities. The short-term, localized impact to this resource is the presence of a navigational hazard (anchored vessel) to fishing vessels.	Impacts from anchoring may occur on a semi-regular basis over the next 30 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Anchoring could pose a temporary (hours to days), localized (within a few hundred meters of anchored vessel) navigational hazard to fishing vessels.	The expanded planned action scenario would result in increased anchoring during construction over the next 10 years, and intermittently during operation of offshore components and survey activities. Anchoring could temporarily (hours to days) disrupt fishing activities within a few hundred yards or meters of the anchored vessel. All impacts would be localized, occurring primarily during construction, but also during operations and decommissioning. The location and level of these temporary, localized impacts would depend on specific locations and activity duration. See the Presence of structures: Navigation hazard sub-IPF.	Anchored vessels could pose a navigational hazard to fishing vessels and temporarily (hours to days) disrupt fishing activities within a few hundred yards or meters of the anchored vessel. The location and level of these temporary, localized impacts would depend on specific locations and activity duration. This IPF is expected to have localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing, occurring primarily during construction, but also intermittently during operations and decommissioning.	Anchoring for the Proposed Action would result in localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing and would likely not be distinguishable from ongoing activities. Ongoing and future non-offshore wind activities would cause short-term, local impacts. Offshore wind activities, other than the proposed Project, would have similar temporary, local impacts on fishing vessels. In context of reasonably foreseeable environmental trends, anchoring from ongoing and planned actions, including the Proposed Action, would result in localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing, including navigational hazards to fishing vessels, especially if projects are overlapping in the same area as fishing or transiting fishing vessels.
New cable emplacement/ maintenance	New cable emplacement and infrequent cable maintenance activities disturb the seafloor, increase suspended sediment, and cause temporary displacement of fishing vessels. These disturbances would be local and limited to the emplacement corridor. In the geographic analysis area for this resource, there are six existing power cables (BOEM 2019b).	Future new cables and cable maintenance, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would occasionally disturb the seafloor and cause temporary displacement in fishing vessels and increases in suspended sediment resulting in local, short-term impacts. The FCC has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the geographic analysis area for this resource, short-term disruption of fishing activities would be expected.	Jet plowing/dredging during construction, installation, and maintenance activities could disrupt fishing activity. The total area of direct seafloor disturbance is estimated at up to 8,153 acres (33.0 km^2). Fishing vessels may need to temporarily relocate from these areas to other fishing locations to continue to earn revenue, which could lead to increased conflict in those locations, increased operating costs for vessels (e.g., additional fuel costs), and reduced revenue (e.g., less productive area; less valuable species). Additionally, increased suspended sediment would have temporary impacts on species important to commercial and for-hire fisheries. Table 3.3-1 discusses impacts on finfish and invertebrates.	The Proposed Action would cause short-term disturbances during construction and possibly during maintenance. The Proposed Action estimated that up to 328 acres (1.3 km^2) of seafloor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term impacts including displacement of fishing vessels from these areas. During the construction and installation activities, it may not be possible to fish in parts of the WDA, which may result in reduced revenue and/or increased conflict over other fishing grounds. For fishing vessels operating within the WDA, the greatest impacts would be during foundation and cable installation. Large areas would not be restricted for long periods; however, temporary limitations to fishing activities could occur. This would have localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing. Additionally, increased suspended sediment could have temporary impacts on species important to commercial and for-hire fisheries. Table 3.3-1 discusses impacts on finfish and invertebrates.	The Proposed Action estimated that up to 328 acres (1.3 km^2) of seafloor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, leading to localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing, including temporary displacement of fishing vessels from these areas during construction and maintenance. Ongoing and future non-offshore wind activities, if any involve this IPF, may cause local, short-term impacts on fishing activities. Future offshore wind activities other than the proposed Project could lead to temporary fishing vessel displacement from these areas. In context of reasonably foreseeable environmental trends, localized, short-term, **minor** impacts (fishing vessel displacement) would occur on commercial fisheries and for-hire fishing as a result of an estimated 8,156 acres (33.0 km^2) of disturbance and temporary avoidance for fishing vessels from ongoing and planned actions, including the Proposed Action.
Noise: Construction, trenching, operations and maintenance	Noise from construction occurs frequently in coastal habitats in populated areas in New England and the Mid-Atlantic, but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. Infrequent offshore trenching could occur in connection with cable installation. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Low levels of elevated noise from operational WTGs likely have low to no impacts on fish and no impacts at a fishery level. Table 3.3-1 discusses impacts on finfish and invertebrates. Noise is also created by operations and maintenance of marine minerals extraction,	Noise from nearshore construction is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource. Noise from dredging and sand and gravel mining could occur. New or expanded marine minerals extraction may increase noise during operations and maintenance over the next 30 years. Impacts from construction, operations, and maintenance would likely be small and local on fish, and not seen at a fishery level. Periodic trenching would be needed for repair or new installation of underground infrastructure. These disturbances would be temporary, local, and extend only a short distance beyond	In the expanded planned action scenario, construction of 2,066 offshore structures would create noise and temporary impacts on commercial fisheries and for-hire recreational fishing. The greatest impact of noise is likely to be caused by pile driving (see below). Such noise would be intermittent and would occur over an assumed 6- to 10-year period. Noise from trenching of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. While noise from trenching could have temporary, local impacts on fish, fishery-level impacts are unlikely. While noise associated with operational WTGs may be audible to some finfish and invertebrates, this would only occur at relatively short distances from the WTG foundations and there is no information to suggest that such noise	Construction of up to 102 offshore structures would create noise and temporary impacts on commercial fisheries and for-hire recreational fishing. The greatest impact of noise is likely to be caused by pile driving (see below). Noise from trenching of inter-array and export cables would occur during construction. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. Noise from construction and trenching could have temporary, local impacts on commercial fish species, and fishery-level impacts would be **negligible.** While noise associated with operational WTGs may be audible to some finfish and invertebrates, this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would negatively affect this resource (English et al. 2017); therefore, fishery-	The majority of impacts from construction noise are likely to be related to pile driving (see below). All other sources of construction noise, including trenching, and operations and maintenance noise would likely not lead to noticeable impacts on commercial fisheries and for-hire recreational fishing.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	which has small, local impacts on fish, but likely no impacts at a fishery level.	the emplacement corridor. Impacts of trenching noise on commercial fish species are typically less prominent than the impacts of physical disturbance and sediment suspension. Therefore, fishery-level impacts are unlikely. Table 3.3-1 discusses impacts on finfish and invertebrates.	would negatively affect this resource (English et al. 2017); therefore, fishery-level impacts are unlikely. Table 3.3-1 discusses impacts on finfish and invertebrates.	level impacts are unlikely. Table 3.3-1 discusses impacts on finfish and invertebrates.	
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around investigation sites. These activities can disturb fish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys and scientific surveys are anticipated to occur infrequently over the next 30 years. Site characterization surveys typically use sub-bottom profiler technologies that generate sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Site characterization surveys for offshore wind facilities would create intermittent noise around sites of investigation over a 2- to 10-year period. This noise is expected to result in behavioral changes to commercial fish species in the immediate vicinity that could affect the catch efficiency of some gears (hook and line); however, the noise is not anticipated to affect reproduction and recruitment of commercial fish stocks into the fishery. Noise impacts from surveys could have temporary, local impacts during the short-term survey period.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes; however, the noise is not anticipated to affect reproduction and recruitment of commercial fish stocks into the fishery. Noise impacts from surveys could have temporary, local impacts during the short-term survey period. Impacts on commercial fisheries and for-hire recreational fishing are anticipated to be temporary and **negligible**.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts on commercial fisheries and for-hire recreational fishing. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent. Future offshore wind other than the proposed Project would likely affect a much greater area than the Proposed Action would, and could lead to temporary impacts on fishing activities in the survey areas. In context of reasonably foreseeable environmental trends, the impacts from ongoing and planned actions, including the Proposed Action, would likely be approximately equal to the sum of all these impacts and would likely qualify as **negligible** to **minor**.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when ports or marinas, piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area, leading to temporary local impacts on commercial fisheries and for-hire recreational fishing. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 4 to 6 hours at a time over a 6- to 10-year period and could have temporary impacts on commercial fish behavior. Sound impacts over a longer period may cause a change in stock locations (i.e., fish would avoid areas with an abundance of noise or may not bite at hooks). Section 3.3.1.1 discusses impacts on fish. The behavioral response would vary by species and could result in changed availability to a fishery. Depending on the duration of pile driving coinciding with fishing activities, fishing vessels may need to temporarily relocate to other fishing locations to avoid or reduce impacts to revenue. This could lead to increased conflict in those locations, increased operating costs for vessels (e.g., additional fuel costs), and lower revenue (e.g., less productive area, less valuable species). Based on estimates from the COP, if all 2,066 foundations in the expanded planned action scenario are summed, the risk of injury is expected to occur over approximately 1 million acres (4,130 km^2), and the risk of mortality is expected to occur over approximately 9,758 acres (39.5 km^2). Noise impacts from pile driving could have temporary, local impacts on fishing activities during the construction period.	Noise from pile driving would occur during installation of foundations for 4 to 6 hours at a time and could cause injury and/or mortality to finfish and invertebrates in a small area around each pile and cause short-term stress and behavioral changes to individuals over a greater area. Sound impacts over a longer period may cause change in stock locations (i.e., fish would avoid areas with an abundance of noise or may not bite at hooks). Section 3.3 discusses the impacts on fish. The behavioral response would vary by species and could result in changed availability to a fishery. The radius for behavioral effects is estimated to likely extend less than 5.7 miles (9.2 kilometers) around each pile, the radius for injury is estimated to extend up to 2,618 feet (798 meters) from each foundation, and the radius for potential mortality is estimated to extend 256 feet (78 meters) from each pile, given the proposed noise attenuation mitigation measures. The area potentially subject to injury is approximately 49,406 acres (200 km^2), and the area potentially subject to mortality is approximately 472 acres (1.9 km^2). Pile driving would only occur during daylight hours with each pile being driven sequentially. Finfish and invertebrate eggs, embryos, and larvae could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure have not been defined as they have been for adult finfish (Weilgart 2018, Hawkins and Popper 2017). Depending on the duration of pile driving coinciding with fishing activities, fishing vessels may need to temporarily relocate to other fishing locations to avoid or reduce impacts to revenue. This could lead to increased conflict in those locations, increased operating costs for vessels (e.g., additional fuel costs), and lower revenue (e.g.,	The Proposed Action is expected to cause short-term impacts, with potential injury occurring across approximately 49,406 acres (200 km^2) and potential mortality occurring across approximately 472 acres (1.9 km^2) of seafloor surface and behavioral changes occurring over a greater area. Depending on the duration of pile driving coinciding with fishing activities, there could be temporary **minor** impacts on commercial fisheries and for-hire recreational fishing. Future offshore wind activities other than the Proposed Action could cause potential injury across approximately 1 million acres (4,130 km^2), mortality across approximately 9,758 acres (39.5 km^2), and behavioral changes over a greater area. The geographic analysis area affected by pile-driving noise would be the same regardless of whether the Proposed Action COP is approved, approved with modifications, or disapproved; impacts could include potential injury across approximately 1 million acres (4,130 km^2), mortality across approximately 9,758 acres (39.5 km^2), and behavioral changes over a greater area. These impacts on commercial fish could affect fishing activities if vessels need to temporarily relocate to other fishing locations to avoid or reduce impacts to revenue. In context of reasonably foreseeable environmental trends, the combined impact of pile driving noise on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action, would depend on the timing and overlap of disturbance areas and would likely qualify as **minor** to **moderate**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				less productive area, less valuable species). Noise impacts from pile driving could have temporary, local, **minor** impacts on commercial fisheries and for-hire recreational fishing during construction.	
Noise: Vessels	Vessel noise is anticipated to continue at levels similar to current levels. While vessel noise may have some impact on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels (Section 3.11.1.2).	Planned new barge route and dredging disposal sites would generate vessel noise when implemented (Section 3.11.1).	Future offshore wind activities would increase vessel noise primarily during construction, but also during operations and decommissioning. While vessel noise could have temporary, local impacts on fish, fishery-level impacts are unlikely. Section 3.3.1.1 discusses impacts on finfish, invertebrates, and EFH.	The Proposed Action would increase vessel noise primarily during construction, but also during operations and decommissioning. While vessel noise could have local, temporary impacts on commercial fish species, fishery-level impacts are unlikely. Vessel noise would have **negligible** impacts on commercial fisheries and for-hire recreational fishing.	Since vessel noise from the Proposed Action is anticipated to cause local, temporary impacts on finfish and invertebrates, fishery-level impacts would be **negligible**. Vessel noise from ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the proposed Project, is also expected to cause local, temporary impacts on commercial fish species and likely no fishery-level impacts. In context of reasonably foreseeable environmental trends, combined vessel noise impacts, equal to the sum of all these impacts from ongoing and planned actions, including the Proposed Action, are anticipated to result in no noticeable change to the condition of finfish and invertebrates in the analysis area; therefore, fishery-level impacts would be **negligible**.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 30 years.	Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Port utilization is expected to increase over the next 30 years, with increased activity during construction. The ability of ports to receive the increase in vessel traffic may require port modifications, such as channel deepening, leading to local impacts on fish populations. Port expansions could also increase vessel traffic and competition for dockside services, which could affect fishing vessels.	At least two projects are contemplating port expansion/modification, in Vineyard Haven and in Montauk. Other ports would likely be upgraded along the East Coast, and some of this may be attributable to supporting the offshore wind industry. Expansion of port facilities could increase vessel traffic, increasing the potential for navigational hazards to fishing vessels. An increase in vessel traffic in ports during construction could result in delays or restrictions in access to ports, which could temporarily affect commercial and for-hire fisheries. South Fork Wind would like to dredge the O&M facility that will be established on Long Island. Fishing vessels may have restrictions and delays accessing port facilities during maintenance dredging. The risk would increase during maintenance, which occurs infrequently. Section 3.3.1.1 discusses port expansion impacts on fish, invertebrates, and EFH.	The Proposed Action is not anticipated to cause any port expansion, but it could cause an increase in vessel traffic in ports and result in delays or restrictions in access to ports due to increased vessel use during construction. This would have localized, short-term, **minor** impacts on commercial and for-hire fisheries. Vineyard Wind's proposed marine coordinator and vessel traffic management plan are expected to mitigate the risks for impacts from increased traffic congestion and competition for dockside services such that impacts on commercial and for-hire fisheries would be **minor**.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect commercial fisheries or for-hire recreational fishing near ports. Ongoing and future non-offshore wind activities are expected to cause impacts on fishing vessels through this sub-IPF by increasing vessel traffic at ports and by competition for dockside services. Future offshore wind activities other than the proposed Project are expected to cause impacts through this sub-IPF on commercial fisheries and for-hire recreational fishing that are the same as above. No impacts of this sub-IPF on commercial fisheries and for-hire recreational fishing can be attributed to the Proposed Action, although ongoing and future activities are expected to result in increased vessel traffic and competition for port services.
Presence of structures: Navigation hazard and allisions	Structures within and near the cumulative lease areas that pose potential navigation hazards include the Block Island Wind Farm WTGs, buoys, and shoreline developments such as docks and ports. An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. Two types of allisions occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately	No known reasonably foreseeable structures are proposed to be located in the geographic analysis area that could affect commercial fisheries. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, and foundations. The addition of up to 2,066 new structures from this sub-IPF would increase navigational complexity, the risk of navigation hazards, as well as the number of collisions and allisions for vessels transiting through or operating within lease areas over an assumed 6- to 10-year construction period and remain constant throughout operations until decommissioning. During the construction and operations periods for future offshore wind projects, these impacts would hinder SAR	The Proposed Action is expected to add up to 102 foundations, which are navigation hazards during construction and throughout operations. The location of the proposed infrastructure within the WDA could affect transit corridors and access to preferred fishing locations. Maneuverability within the WDA would vary depending on many factors (e.g., vessel size, gear or method used, environmental conditions). Larger commercial fishing vessels with mobile gear are the most at risk for an allision, as they are the most limited in maneuverability. Figure 3.10-14 shows the directionality of fishing vessel activity based on VMS data within the proposed WDA. A majority of the 538 unique vessels are transiting or fishing in a	The risk of impacts from this sub-IPF is affected by the amount and layout of structures, increases in recreational fishing vessels due to changes in areas of fish species aggregation, as well as changes in operational planning for vessels resulting in increased space use conflicts (see Presence of structures: Space use conflict sub-IPF below). The Proposed Action would add up to 102 foundations under various layout options, resulting in long-term, **moderate** impacts on all vessels transiting through or around the WDA. Existing structures and future non-offshore wind structures in the cumulative analysis area pose an additional risk to all vessels that may also operate in

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	control their vessel movements, or is distracted.		capability. The capability to conduct SAR would be further hindered if one or more projects in the RI and MA Lease Areas do not align with a uniform 1 x 1 nautical mile WTG spacing with east-west/north-south orientation. The combined effect of increased risk of navigational hazards with the hindrance of SAR capability in a non-uniform scenario would increase the risk of fatalities. Fishing vessels that decide to fish or transit within a lease area run the risk of allisions with structures. Actively fishing with mobile gear results in decreased vessel maneuverability, increasing allision risk in WDAs. The risk would increase as additional offshore wind energy projects are built, which would limit the ocean surface available for transiting and fishing. Fishing in the WDAs would not be as problematic for for-hire recreational fishing vessels that bottom-fish with hook and line gear as the vessels are generally over a fixed location or under a controlled drift. However, fishing for HMS may involve troll gear using many feet of lines and hooks behind the vessel, and in turn following large pelagic fish once they are hooked; these activities pose additional maneuverability challenges. Figures 3.10-12 through 3.10-18 show the directionality of fishing vessel activity based on VMS data. It includes all VMS-equipped vessels, parsed into two speed categories (≥ 5 knots and < 5 knots) representing transiting and fishing activity. These plots show variability between activity type and fishery, and between the proposed Project WDA versus the overall southern New England leases.	northwest-southeast direction through the WDA. The risk of allisions is mitigated through navigational lighting requirements and AIS transponders on foundations that would be used throughout the facility. The potential changes to vessels' transit routes and chosen fishing locations could have a long-term, **moderate** impact on commercial fisheries and for-hire recreational fishing due to the increased time navigating around the area and resulting increased fuel costs.	the WDA. Future offshore wind activities excluding the Proposed Action would add vertical surfaces of up to 2,066 new foundations. In context of reasonably foreseeable environmental trends, navigation hazards due to the presence of structures from ongoing and planned actions, including the Proposed Action, would result in **major** impacts on commercial fisheries and for-hire recreational fishing if offshore wind projects in the RI and MA Lease Areas do not all adopt a uniform 1 x 1 nautical mile WTG spacing with east-west/north-south orientation.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts on fish, but likely no impacts at a fishery level.	No future activities were identified within the analysis area other than ongoing activities.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. Approximately 1,221 acres (4.9 km^2) of hard protection atop cables, 1,723 acres (7.0 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on commercial fisheries and for-hire recreational fishing, which would increase during the construction period and be intermittent over 30 years. The impacts would be localized and the risk of occurrence would persist as long as the structures remain.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. This would increase the risk of gear loss/damage by entanglement and could affect fishing vessels differently depending on the size of the vessel and the fishing gear. The extent of the impacts would depend on the vessel size, the fishing gear, and foundation locations. Larger vessels with mobile gear are the most at risk for entanglement, as they are the most limited in maneuverability and are towing large gear (trawl nets). Concrete mattresses covering cables in hard-bottom areas (estimated to be less than 10% of OECC and inter-array cable route length) could hinder commercial trawlers/dredgers over the long term. The Proposed Action includes voluntary gear loss and revenue compensation funds for fishing interests to mitigate gear and/or revenue losses over the life of the Project (Table 3.10-13). The impact from gear loss and damage is expected to have a	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection, resulting in localized **moderate** impacts on commercial fisheries and **minor** impacts on for-hire recreational fishing. Future offshore wind activities other than the proposed Project would add additional scour/cable protection and vertical surfaces. In context of reasonably foreseeable environmental trends, the installation of up to 2,066 foundations and 2,944 acres (11.9 km^2) of scour/cable protection from ongoing and planned actions, including the Proposed Action, would increase the risk of highly localized, periodic, **moderate** to **major** impacts on commercial fisheries, and **minor** to **moderate** impacts on for-hire recreational fishing through this sub-IPF. The extent of the impacts would depend on vessel size, fishing gear, and foundation locations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				moderate impact on commercial fisheries and a **minor** impact on for-hire recreational fishing, as the effects would be localized to known/charted infrastructure. However, the risk of occurrence would persist as long as the structures remain.	
Presence of structures: Habitat conversion and fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon vertical relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape, but there is some hard and/or complex habitat. Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short-term to permanent. Fish aggregation may be considered adverse, beneficial, or neither. Commercial and for-hire recreational fishing can occur near these structures. For-hire recreational fishing is more popular, as commercial mobile fishing gear risk snagging on the structures.	New cables, installed incrementally in the analysis area over the next 20 to 30 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance IPF above). Any new towers, buoys, or piers would also create uncommon vertical relief in a mostly flat seascape. Structure-oriented species could be attracted to these locations. Structure-oriented species would benefit (Claisse et al. 2014, Smith et al. 2016). This may lead to more and larger structure-oriented fish communities and larger predators opportunistically feeding on the communities, as well as increased private and for-hire recreational fishing opportunities. Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Greene et al. 2010; Guida et al. 2017). These impacts are expected to be local and may be long-term.	See above for quantification. New structures, increasing over an assumed 6- to 10-year period, could attract structure-oriented fish species for as long as the structures remain during operations. Abundance of certain fishes may increase (Claisse et al. 2014, Smith et al. 2016). Such changes could increase for-hire recreational fishing opportunities and concentrate fishing efforts, which may result in increased gear conflicts for commercial fishing vessels that choose to fish within WDAs. Section 3.3.1.1 discusses impacts on finfish and invertebrates.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would be decommissioned at the end of the project while scour/cable protection may remain on the seabed. The infrastructure would modify existing soft-bottom habitat and to a lesser extent hard-bottom habitat. Structure-oriented species would benefit (e.g., lobster, striped bass, black sea bass, scup, and Atlantic cod); however, the local biomass increases are not anticipated to be significant enough to impact total quotas. This may lead to more and larger structure-oriented fish communities and larger predators opportunistically feeding on the communities, as well as increased private and for-hire recreational fishing opportunities around the infrastructure. Such changes could also result in increased space use conflicts between commercial and recreational fishing (see Space use conflict sub-IPF). Section 3.3 discusses impacts on fishery resources. These impacts would be both beneficial and adverse, likely resulting in **minor** impacts on commercial fisheries and **negligible** to **minor** impacts on for-hire recreational fisheries. Impacts are expected to be local to the individual foundations and may be short-term to permanent.	See above for quantification. The Proposed Action is expected to cause **minor** impacts on commercial fisheries and **negligible** to **minor** impacts on for-hire recreational fishing through this sub-IPF. Existing structures and future non-offshore wind structures are expected to cause localized impacts on commercial fisheries and for-hire recreational fishing through this sub-IPF. Offshore wind structures other than those associated with the Proposed Action are also expected to cause localized impacts on commercial fisheries and for-hire recreational fishing through this sub-IPF. In context of reasonably foreseeable environmental trends, ongoing and planned actions, including the Proposed Action, are anticipated to cause **minor** impacts on commercial fisheries and for-hire fishing and **negligible** to **minor** impacts on for-hire recreational fishing that may be short-term to permanent; BOEM does not anticipate that this sub-IPF would result in considerable changes in fish distributions across the geographic analysis area.
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, buoys, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow species migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 30 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, fishery-level impacts are not anticipated.	See above for quantification. New structures would be added intermittently over an assumed 6- to 10-year period and could tend to slow migration of some migratory species. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, there would not be impacts on migrations that would affect commercial or for-hire fisheries.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely permanently remain. This could tend to slow migration. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact is anticipated to be **negligible**.	See above for quantification. The Proposed Action is expected to present a **negligible** risk of slowing migrations of fish and invertebrates, and temperature is expected to be a bigger driver of species movement. Therefore, migratory animals would likely be able to proceed from structures unimpeded and fishery-level impacts are unlikely. Existing structures, future non-offshore wind structures, and Offshore wind structures other than those associated with the proposed Project are also expected to present a **negligible** risk of slowing migrations of fish and invertebrates. In context of reasonably foreseeable environmental trends, the presence of many distinct structures from ongoing and planned actions, including the Proposed Action could increase the time required for migrations; however, the small scale of disturbance (minutes) would likely have **negligible** impacts on commercial fisheries and for-hire recreational fishing.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	No known reasonably foreseeable structures are proposed for location in the geographic analysis area that could affect commercial fisheries and for-hire recreational fishing.	Development of the projects in the expanded planned action scenario would install more buoys, met towers, foundations, and hard protection. See above for quantification. New structures would be added intermittently over an assumed 6- to 10-year period and remain throughout operations for 30 years. The location of proposed offshore wind projects would affect the accessibility and availability of fish for commercial and for-hire recreational fishing. Space use conflicts could cause temporary or permanent reductions in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Commercial fishing vessels have well established and mutually recognized traditional fishing locations. The relocation of fishing activity outside the WDA or OECC may increase conflict among fishermen as other areas are encroached. The competition is expected to be higher for less-mobile species (e.g., lobster, crab, surfclam/ocean quahog, and scallop). The additional structures could lead to fish aggregation of structure-oriented species, increasing the opportunity for the for-hire recreational fishery. This could contribute to space use conflicts with the commercial fisheries within the WDAs. Revenue exposed to offshore wind development in the New England and Mid-Atlantic regions by FMP for 2020-2030 quantifies this sub-IPF (Table 3.10-11).	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. New structures would be added intermittently over the construction period and remain throughout operations for 30 years, affecting the accessibility to fishery resources. Potential displacement of fishing vessels and increased competition on fishing grounds unoccupied by structures would have long-term impacts. Space use conflicts could cause a temporary or permanent reduction in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Commercial fishing vessels have well established and mutually recognized traditional fishing locations. The relocation of fishing activity outside the WDA or OECC may increase conflict among fishermen as other areas are encroached. The competition is expected to be higher for less mobile species (e.g., lobster, crab, surfclam/ocean quahog, and scallop). The additional structures could lead to fish aggregation of structure-oriented species, increasing the opportunity for the for-hire recreational fishery. This could contribute to space use conflicts with the commercial fisheries within the WDAs. The Proposed Action includes voluntary gear loss and revenue compensation funds for fishing interests to mitigate gear and/or revenue losses over the life of the Project (Table 3.10-13). **Moderate** impacts are expected on commercial fisheries and **minor** to **moderate** impacts are expected on for-hire recreational fishing.	The impacts from this sub-IPF are proportional to the amount and location of structure present. The Proposed Action would add up to 102 foundations, resulting in localized, short-term or long-term, **moderate** impacts on commercial fisheries and **minor** to **moderate** impacts on for-hire recreational fishing. Offshore wind structures other than those associated with the Proposed Action would add additional vertical surfaces. Ongoing and planned actions, including the Proposed Action, would result in up to 2,066 foundations that would increase the risk of highly localized, periodic short-term or long-term, **moderate** to **major** impacts on commercial fisheries and **minor** to **moderate** impacts on for-hire recreational fishing through this sub-IPF.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Two subsea cables cross the far western portion of OCS-A 0487. These cables are associated with a larger network of subsea cables that make landfall near Charlestown, Massachusetts. These cables are near the Block Island Wind Farm and cross the Block Island Wind Farm export cable. Shoreline developments are ongoing and include docks, ports, and other commercial, industrial, and residential structures.	No known proposed structures (other than those associated with offshore wind development) are reasonably foreseeable and proposed to be located in the geographic analysis area for this resource.	See above for quantification. Installation of offshore cables for offshore wind facilities would increase intermittently over an assumed 6- to 10-year period and would require temporary rerouting of all vessels away from areas of active construction. These activities would temporarily affect commercial and for-hire fisheries. During operations, periodic maintenance could have similar impacts, although these activities would be less frequent and extensive than installation. Inter-array and export cables would be buried below the seabed approximately 4 to 6 feet (1.2 to 1.8 meters); however, no more than 10% of the cables may not achieve the proper burial depth and would require cable protection in the form of rock placement, concrete mattresses, and/or half-shells. Mobile bottom-tending gear (trawl and dredge gear) could be caught on these cable protection measures and the cost of these impacts	The Proposed Action is expected to add up to 151 acres (0.6 km^2) of scour/cable protection. Fishing vessels would need to temporarily avoid the portions of the OECC route undergoing active construction. During operations, vessels would need to avoid areas of temporary maintenance and repair. The conversion of soft sediment to hard bottom via protective cover could negatively affect the bottom trawl industry by increasing the risk of net hangs and vessel instability. Cable routes would be charted and cable protection locations shared with the fishing industry. Cable protection measures (e.g., concrete mattresses) covering cables in hard-bottom areas (estimated to be less than 10% of OECC and inter-array cable route length) could hinder commercial trawlers/dredgers over the long term if the gear gets caught on them. The risk of damage or loss of deployed gear as a result of operations and maintenance is expected to have an impact on mobile bottom gear commercial fisheries due to striking or hooking on proposed infrastructure. The Proposed Action includes voluntary gear loss and revenue compensation funds for fishing interests to mitigate gear	The risk of impacts from this sub-IPF is proportional to the amount of cable infrastructure present. The Proposed Action would add up to 151 acres (0.6 km^2) of scour/cable protection, which would cause short-term impacts on fishing activities during installation and potentially local, long-term, **minor** to **moderate** impacts on commercial fisheries that use mobile bottom gear. Offshore wind structures other than those associated with the Proposed Action would add additional scour/cable protection. Ongoing and planned actions, including the Proposed Action, would result in up to 2,944 acres (11.9 km^2) of scour/cable protection which would increase the risk of highly localized, periodic short-term impacts on fishing activities during installation and potentially long-term **minor** to **moderate** impacts on commercial and for-hire recreational fisheries that use mobile bottom gear through this sub-IPF.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			would vary depending on the extent of damage to the fishing gear.	and/or revenue losses over the life of the Project (Table 3.10-13). Impacts on commercial fisheries and for-hire recreational fishing are anticipated to be **minor** to **moderate**.	
Traffic: Vessels and vessel collisions	No substantial changes are anticipated to the vessel traffic volumes. The study area would continue to have numerous ports, and the extensive marine traffic related to shipping, fishing, and recreation would continue to be important to the region's economy. The region's substantial marine traffic may result in occasional collisions. Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is more complex, as the vessels need to avoid both the structure and each other. The risk for collisions is ongoing, but infrequent.	New vessel traffic in the geographic analysis area would consistently be generated by proposed barge routes and dredging demolition sites. Marine commerce and related industries would continue to be important to the regional economy.	Development of the projects in the geographic analysis area would increase vessel traffic. An increase in vessel volume could result in increased traffic congestion, delays, difficulties with navigating, and an increased risk for collisions, especially for large commercial fishing vessels towing large mobile gear. However, future offshore wind projects would result in only a small incremental increase in vessel traffic, with a peak during project construction over a 6- to 10-year timeframe.	An increase in vessel volume could result in traffic congestion and an increased risk for collisions. The Proposed Action would result in a small incremental increase in vessel traffic, with a peak during Project construction. During construction and installation, Vineyard Wind anticipates an average of approximately 25 vessels operating during a typical workday in the WDA and along the OECC, including an estimated 18 vessel trips per day to or from ports. Additionally, Vineyard Wind's proposed marine coordinator and vessel traffic management plan are expected to mitigate those risks. Therefore, impacts on commercial fisheries and for-hire recreational fishing are anticipated to be **minor**.	The Proposed Action is expected to cause a small incremental increase in vessel traffic, specifically an average of approximately 25 vessels operating during a typical workday in the WDA and along the OECC. Therefore, fishery-level impacts are anticipated to be **minor**. Ongoing and future non-offshore wind activities are expected to cause temporary impacts through this sub-IPF on commercial fisheries and for-hire recreational fishing. Future offshore wind activities other than the proposed Project are expected to cause temporary impacts through this sub-IPF on commercial fisheries and for-hire recreational fishing during Project construction. In context of reasonably foreseeable environmental trends, ongoing and planned actions, including the Proposed Action, would likely cause an increase in vessel traffic during construction over a 6- to 10-year timeframe, resulting in **minor** to **moderate** impacts on commercial fisheries and for-hire recreational fishing through this sub-IPF.
Climate change	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions of species important for commercial and for-hire recreational fisheries. If the distribution of important fish stocks changes, it could affect where commercial and for-hire recreational fisheries are located, and could potentially increase the cost of fishing if transiting time increases. Continuous CO_2 emissions causing ocean acidification may contribute to reduced growth, or the decline of, invertebrates that have calcareous shells over the course of the next 30 years. Over time, this could potentially directly affect species that are important for commercial and for-hire recreational fisheries or their prey species.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This IPF may contribute to reduced growth or the decline of fish and invertebrates, leading to impacts on commercial fisheries and for-hire recreational fishing. Because this IPF is a global phenomenon, impacts on commercial fisheries and for-hire recreational fishing though this IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish, implemented and enforced by NOAA Fisheries and coastal states, affect how the commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60% (McCreary and Brooks 2019). This would likely have a significant impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. See Baseline Conditions for additional fishery management actions that would	Offshore wind development could influence this IPF and contribute to short-term and long-term impacts on commercial fisheries and for-hire recreational fisheries operations. The impacts would vary depending on the fishery, and the changes in fishing behavior due to offshore wind development. Future offshore wind could influence fisheries scientific surveys and may result in more conservative quota and effort management measures. Impacts on the management process would affect the commercial and for-hire recreational fisheries operations. Fishing regulations may have less	The impacts of the Proposed Action with fisheries regulations would increase impacts on commercial fisheries and for-hire recreational fishing beyond those of the No Action Alternative. However, the extent of impacts from offshore wind development on regulated fishing effort is difficult to predict. The impacts would vary depending on the fishery, and the changes in fishing behavior due to offshore wind development. The Proposed Action could influence fisheries scientific surveys and may result in more conservative quota and effort management measures. Impacts on the management process would impact the commercial and for-hire recreational fisheries operations. Fishing regulations may have less flexibility in area-based	This IPF would contribute to short-term and long-term impacts on commercial fisheries and for-hire fishing. The intensity of impacts on commercial fisheries and for-hire recreational fishing under future fishing regulations are uncertain, but would likely be similar to the *status quo*, as maximum sustainable yield remains the management objective. However, the impacts of the Proposed Action with fisheries regulations would likely have short-term or long-term **moderate** impacts on commercial fisheries and for-hire recreational fishing as management adapts to changing data and management options. Ongoing and future non-offshore wind activities are expected to

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		affect commercial fisheries and for-hire recreational fishing.	flexibility in area-based management due to offshore wind projects, and offshore wind may change the distribution of fishing effort in ways not contemplated in FMPs.	management due to the Proposed Action, and offshore wind may change the distribution of fishing effort in ways not contemplated in FMPs. Therefore, impacts on commercial fisheries and for-hire recreational fishing are anticipated to be **moderate**.	have similar impacts or greater than the *status quo*. Future offshore wind activities other than the Proposed Action are expected to cause an increase in impacts through this IPF on commercial fisheries and for-hire recreational fishing as management adapts to changing data and management options. In context of reasonably foreseeable trends, ongoing and planned actions, including the Proposed Action, would likely cause **moderate** impacts on commercial fisheries and for-hire recreational fishing through this IPF.

AIS = Automatic Identification System; BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; COP = Construction and Operations Plan; EFH = Essential Fish Habitat; FCC = Federal Communication Commission; FMP = fisheries management plan; G&G = Geological and Geophysical; GHG = greenhouse gas; IPF = impact-producing factors; km^2 = square kilometers; met = meteorological; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; RI and MA Lease Area = Rhode Island and Massachusetts Lease Areas; SAR = search and rescue; VMS = vessel monitoring system; WDA = Wind Development Area; WTG = wind turbine generator

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Table 3.10-2: Value and Volume of Commercial Fishery Landings by Port (2019 dollars), 2016-2018

	2016	2017	2018	2016	2017	2018
Port	**Pounds (millions)**			**Value (million $)**		
New Bedford, Massachusetts	106.6	110.8	113.5	346.7	406.0	438.8
Cape May-Wildwood, New Jersey	46.6	101.6	101.2	89.9	84.4	67.5
Point Judith, Rhode Island	53.4	44.3	47.5	59.1	59.8	64.8
Hampton Roads Area, Virginia	12.3	15.5	14.7	64.8	60.6	55.7
Gloucester, Massachusetts	63.4	63.9	59	55.6	54.8	54.2
Provincetown-Chatham, Massachusetts	26.5	22.3	22.5	34.8	35.2	35.4
Reedville, Virginia	321.3	319.9	352.5	33.1	33.9	36.8
Point Pleasant, New Jersey	26.3	37.5	43.3	34.1	36.8	33.0
Long Beach-Barnegat, New Jersey	7.2	7.6	6.3	28.6	25.7	24.7
Atlantic City, New Jersey	24.3	24.7	24.8	20.9	19.4	18.5
Boston, Massachusetts	12.2	15.8	17	18.1	18.0	16.7
Montauk, New York	11.8	10.1	11.3	17.3	15.4	17.6
North Kingstown, Rhode Island	17.6	27	22.8	14.5	18.4	16.3
Accomac, Virginia	7.6	5.9	6.2	21.3	13.3	12.3
Fairhaven, Massachusetts	3.9	3.2	3.2	23.1	10.7	8.6
Newport, Rhode Island	6.6	7.3	5.5	8.5	8.9	8.0
Hampton Bay-Shinnicock, New York	5.2	3.8	3.6	8.5	6.4	5.8
Ocean City, Maryland	4	4.4	4.2	6.1	4.8	4.9
Stonington, Connecticut	2.1	1.8		6.3	6.5	
New London, Connecticut	9	5.6	7.2	5.4	2.8	4.3
Chincoteague, Virginia	2.4	1.9		5.2	4.1	
Belford, New Jersey	2.5	5.1	4.9	3.2	2.8	1.9
Little Compton, Rhode Island			3.1			3.0
Cape Charles-Oyster, Virginia		0.3			1.1	
Greenport, New York		0.2			0.3	

Sources: NOAA 2019a; NOAA 2019c

Table 3.10-3a: Value of Port Landings Harvested from the Vineyard Wind Lease Area (VMS data, 2019 dollars), 2011-2016

Port	2011	2012	2013	2014	2015	2016
Montauk, New York	C	C	$295,840	C	$160,458	$426,771
New Bedford, Massachusetts	$126,017	$1,768,982	$1,227,439	$793,864	$590,584	$1,547,916
Point Judith, Rhode Island	$550,278	$872,311	$1,341,593	$1,318,362	$1,424,764	$3,165,239
Chatham, Massachusetts	$116,844	$162,645	$78,299	$41,058	C	C
New London, Connecticut	$63,854	C	C	NL	C	C

Source: RI DEM 2017

C = confidential landings (fewer than three vessels); NL = no landings; VMS = Vessel Monitoring System
Note: The following ports were also considered; however, the data were either confidential (i.e., fewer than three separate contributors to the data) or there were no landings in those ports from the Vineyard Wind lease area: Barnegat Light, NJ; Belford, NJ; Boston, MA; Cape May, NJ; Gloucester, MA; Hampton Bays, NY; Harwich Port, MA; Little Compton, RI; Mystic, CT; Newport, RI; North Kingstown, RI; Point Pleasant, NJ; Providence, RI; Provincetown Wharf, MA; Shinnecock Reservation, NY; Stonington, CT; Wakefield, RI; Westport, MA; and Woods Hole, MA.

Table 3.10-3b: Value of Port Landings Harvested from the Vineyard Wind Lease Area (VTR data, 2019 dollars), 2008-2017

Vineyard Wind Lease Area	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Montauk, New York								$50,116	$227,598	$84,711
New Bedford, Massachusetts		$46,151	$179,883	$164,171	$108,842		$107,469		$317,624	
Point Judith, Rhode Island	$193,649	$42,152	$58,605	$254,534	$88,828	$372,726	$391,784	$432,069	$1,494,979	$206,102
Other	$100,830	$168,845	$214,111	$108,652	$354,925	$473,058	$167,723	$177,539	$429,707	$84,735

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report
Note: Empty cells indicate that data were not collected or not available.

Table 3.10-4a: Value of Landings by Fisheries Management Plan for the WDA (2019 dollars), 2007-2018

FMP	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	Annual Average
Mackerel, Squid, Butterfish	$11,390	$156,363	$133,246	$36,666	$114,983	$161,675	$98,477	$193,134	$236,455	$978,455	$131,544	$86,104	$2,338,493	$194,874
Monkfish	$24,348	$4,937	$4,927	$16,982	$34,421	$47,055	$17,757	$11,904	$10,631	$22,636	$8,347	$7,111	$211,056	$17,588
Northeast Multispecies–Small Mesh	$32,286	$42,149	$78,763	$22,542	$28,903	$25,763	$31,865	$26,500	$26,832	$35,074	$41,835	$17,359	$409,872	$34,156
Sea Scallop	$12,071	$22,676	$11,266	$5,078	$3,939	$8,185	$1,822	$2,660	$6,992	$28,642	$3,324	$2,224	$108,877	$9,073
Skate	$46,139	$16,181	$19,791	$19,582	$34,594	$10,550	$16,503	$8,390	$4,142	$11,692	$3,427	$3,693	$194,685	$16,224
Summer Flounder, Scup, Black Sea Bass	$27,937	$4,045	$12,543	$13,602	$27,487	$32,310	$62,906	$49,273	$95,594	$96,519	$74,597	$63,547	$560,360	$46,697
Surfclam/Ocean Quahog	$327,689	$283,269	$306,663	$147,807	$49,682	$6,111	$20,155	$8,738	$17,278	$112,401	$11,222	$40,192	$1,331,207	$110,934
None–Unmanaged	$15,441	$26,504	$23,048	$26,110	$20,744	$20,214	$32,230	$35,094	$33,284	$23,965	$24,104	$25,953	$306,691	$25,558
All Other	$81,215	$11,047	$7,756	$35,880	$7,430	$7,097	$49,817	$40,475	$20,250	$7,036	$6,376	$10,264	$284,643	$23,720
Grand Total	**$578,515**	**$567,172**	**$598,004**	**$324,249**	**$322,183**	**$318,960**	**$331,531**	**$376,168**	**$451,459**	**$1,316,420**	**$304,775**	**$256,448**	**$5,745,884**	**$478,824**

Source: G. DePiper, Pers. Comm., 2018

FMP = Fisheries Management Plan; WDA = Wind Development Area
Note: Revenue was converted to 2019 dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics. American lobster and Jonah crab fisheries are included in the “None–Unmanaged” row.

Table 3.10-4b: Value of Landings by Fisheries Management Plan for the WDA as a Percentage of Total Coast-wide FMP, 2007-2018

FMP	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Mackerel, Squid, Butterfish	0.02%	0.35%	0.31%	0.10%	0.26%	0.36%	0.29%	0.52%	0.62%	1.61%	0.24%	0.14%
Monkfish	0.09%	0.02%	0.03%	0.11%	0.16%	0.22%	0.10%	0.07%	0.06%	0.11%	0.05%	0.05%
Northeast Multispecies–Small Mesh	0.27%	0.42%	0.72%	0.18%	0.25%	0.24%	0.35%	0.24%	0.26%	0.33%	0.51%	0.20%
Sea Scallop	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%
Skate	0.44%	0.20%	0.27%	0.23%	0.44%	0.14%	0.13%	0.08%	0.06%	0.18%	0.06%	0.05%
Summer Flounder, Scup, Black Sea Bass	0.07%	0.01%	0.04%	0.04%	0.07%	0.09%	0.16%	0.13%	0.24%	0.24%	0.20%	0.18%
Surfclam/Ocean Quahog	0.39%	0.38%	0.44%	0.23%	0.08%	0.01%	0.04%	0.02%	0.03%	0.19%	0.02%	0.07%

Source: G. DePiper, Pers. Comm., 2018

FMP = Fisheries Management Plan; WDA = Wind Development Area; VTR = Vessel Trip Report
Note: Table 3.10-4a shows the value of landings for the WDA by FMP; Table 3.10-4b shows the percentage of each FMP’s revenue from landings within the WDA compared to each FMP’s total revenue from landings in the entire region covered by the FMP. The data represent the revenue-intensity raster developed using fishery dependent landings’ data. To produce the data set, VTR information was merged with data collected by at-sea fisheries observers, and a cumulative distribution function was estimated to present the distance between VTR points and observed haul locations. This provided a spatial footprint of fishing activities by FMPs.

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Table 3.10-5a: Value of Landings by Species for the WDA (VTR, 2019 dollars), 2008-2017

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Black sea bass					$1,001	$1,747		$1,307	$795	$5,406	**$10,257**
Bluefish	$314		$667	$2,920	$547	$162	$637	$855	$276	$1,000	**$7,378**
Butterfish	$1,754	$1,420	$1,739	$2,004		$8,166	$2,912	$2,170	$3,711	$5,795	**$29,673**
Crab, Jonah	$645		$2,996	$8,205	$31,405	$92,197					**$135,448**
Crab, rock				$5,124							**$5,124**
Dogfish, smooth, fins										$2,122	**$2,122**
Dogfish, spiny, fins										$287	**$287**
Eel, conger										$9	**$9**
Flounders	$10,917			$9,112		$75,535	$33,636	$62,155	$6,571	$32,286	**$230,212**
Hakes	$68,210	$15,631	$95,466	$37,024		$147,956	$39,432	$40,828	$46,560	$61,734	**$552,841**
Lobster, American	$35,456	$30,539	$26,600	$89,701	$49,682	$29,094	$5,345		$25,915	$2,897	**$295,229**
Mackerel, Atlantic									$13		**$13**
Monkfish	$10,100	$2,587	$36,213	$61,199	$147,521	$48,449	$43,175	$16,387	$32,073	$31,474	**$429,179**
Scallops/shells	$545					$118,081	$4,542		$1,666		**$124,834**
Scup			$11,954	$34,878		$17,454		$53,685	$4,502	$80,630	**$203,103**
Skate, rack	$8,547	$12,904	$17,926	$20,266	$58,747	$44,949	$39,410	$27,723	$32,805	$11,627	**$274,905**
Squids	$31,252	$7,535	$9,613	$4,925		$79,560	$38,805	$45,661	$526,582	$7,795	**$751,728**
All others	$8,800	$19,904	$120,677	$8,219	$24,153	$3,754	$67,989	$60,905	$3,567	$1,402	**$319,370**
Total	**$176,542**	**$90,521**	**$323,851**	**$283,578**	**$313,056**	**$667,105**	**$275,883**	**$311,678**	**$685,036**	**$244,464**	**$3,371,714**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available.

Table 3.10-5b: Volume of Landings by Species for the WDA (VTR, landed pounds), 2008-2017

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Black sea bass					218	335		357	149	1,319	**2,378**
Bluefish	664		1,149	3,899	786	195	891	863	318	1,020	**9,785**
Butterfish	1,944	2,855	1,944	2,043		15,830	3,100	3,242	9,564	9,426	**49,948**
Crab, Jonah	994		5,155	10,341	36,458	105,190					**158,138**
Crab, rock				8,301							**8,301**
Dogfish, smooth, fins										3,507	**3,507**
Dogfish, spiny, fins										1,099	**1,099**
Eel, conger										10	**10**
Flounders	4,099			3,317		33,274	8,645	23,471	1,286	7,770	**81,861**
Hakes	93,784	41,015	90,708	53,819		189,158	54,456	66,232	98,906	107,786	**795,863**
Lobster, American	7,899	7,301	5,857	21,023	12,739	6,320	1,012		4,544	530	**67,225**
Mackerel, Atlantic									35		**35**
Monkfish	4,501	1,314	22,487	28,504	70,787	35,890	30,622	10,151	20,735	22,122	**247,112**
Scallops/shells	62					10,241	353		144		**10,800**
Scup			22,276	69,464		27,348		58,626	5,053	120,684	**303,451**
Skate, rack	60,160	35,210	30,287	34,339	88,488	51,991	46,248	43,033	66,971	32,623	**489,349**
Squids	28,186	5,940	7,075	3,277		67,388	34,440	37,488	405,651	3,878	**593,323**
All others	8,830	15,629	18,254	8,003	51,526	10,331	65,270	5,463	2,984	967	**187,257**
Total	**211,123**	**109,264**	**205,192**	**246,330**	**261,002**	**553,491**	**245,038**	**248,926**	**616,338**	**312,740**	**3,009,443**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available. Values are reported in landed pounds.

Table 3.10-6a: Value of Landings by Gear Type for the WDA (VTR, 2019 dollars), 2008-2017

Gear Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Gillnet-sink				$78,873		$85,447		$39,135		$37,394	**$240,849**
Pot		$31,507	$32,495	$102,699	$85,362	$123,203			$27,124		**$402,390**
Trawl-bottom	$132,630	$46,213	$129,383	$99,829		$341,190	$178,591	$211,315	$595,795	$203,909	**$1,938,854**
All others	$43,912	$12,800	$161,972	$2,176	$227,696	$117,268	$97,290	$61,228	$62,120	$3,160	**$789,623**
Total	**$176,542**	**$90,520**	**$323,850**	**$283,576**	**$313,058**	**$667,109**	**$275,881**	**$311,677**	**$685,039**	**$244,463**	**$3,371,715**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available.

Table 3.10-6b: Volume of Landings by Gear Type for the WDA (VTR, landed pounds), 2008-2017

Gear Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Gillnet-sink				68,048		86,257		48,931		44,444	**247,680**
Pot		8,852	18,358	39,792	54,476	114,160			6,244		**241,882**
Trawl-bottom	194,035	86,126	124,107	137,741		343,217	157,024	195,226	523,556	267,443	**2,028,474**
All others	17,088	14,286	62,727	749	206,526	9,857	88,014	4,769	86,539	853	**491,408**
Total	**211,123**	**109,264**	**205,192**	**246,330**	**261,002**	**553,491**	**245,038**	**248,926**	**616,339**	**312,740**	**3,009,443**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available. Values are reported in landed pounds.

Table 3.10-7a: Value of Landings by Port for the WDA (VTR, 2019 dollars), 2008-2017

Port	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Montauk										$40,629	**$40,629**
New Bedford		$46,151	$179,883	$66,084	$13,553		$20,164		$100,867		**$426,702**
Point Judith	$116,149		$58,605	$83,392		$286,689	$160,234	$242,957	$452,756	$119,803	**$1,520,587**
Point Pleasant										$26,108	**$26,108**
Westport				$60,428							**$60,428**
All others	$60,393	$44,369	$85,361	$73,674	$299,505	$380,418	$95,483	$68,720	$131,416	$57,922	**$1,297,260**
Total	**$176,542**	**$90,520**	**$323,849**	**$283,578**	**$313,058**	**$667,108**	**$275,881**	**$311,677**	**$685,039**	**$244,462**	**$3,371,713**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available.

Table 3.10-7b: Volume of Landings by Port for the WDA (VTR, landed pounds), 2008-2017

Port	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Montauk										56,022	**56,022**
New Bedford		27,226	58,609	35,007	10,286		17,638		97,357		**246,123**
Point Judith	137,296		68,664	121,160		208,264	140,186	186,758	378,589	187,326	**1,428,241**
Point Pleasant										10,975	**10,975**
Westport				30,113							**30,113**
All others	73,827	82,038	77,919	60,050	250,716	345,227	87,214	62,168	140,393	58,417	**1,237,969**
Total	**211,123**	**109,264**	**205,192**	**246,330**	**261,002**	**553,491**	**245,038**	**248,926**	**616,339**	**312,740**	**3,009,443**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available. Values are reported in landed pounds.

Table 3.10-8a: Value of Landings by State for the WDA (VTR, 2019 dollars), 2008-2017

State	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Connecticut									$44,948		**$44,948**
Massachusetts		$49,364	$241,696	$181,889	$210,955	$130,524	$101,223	$53,757	$182,414	$41,400	**$1,193,221**
New Jersey										$26,108	**$26,108**
New York										$43,784	**$43,784**
Rhode Island	$132,736	$40,751	$58,605	$83,392	$94,914	$383,233	$167,113	$242,957	$457,322	$122,733	**$1,783,758**
All others	$43,806	$405	$23,548	$18,295	$7,187	$153,352	$7,545	$14,963	$354	$10,438	**$279,892**
Total	**$176,542**	**$90,520**	**$323,849**	**$283,576**	**$313,057**	**$667,109**	**$275,881**	**$311,677**	**$685,038**	**$244,462**	**$3,371,711**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available.

Table 3.10-8b: Volume of Landings by State for the WDA (VTR, landed pounds), 2008-2017

State	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Connecticut									50,935		**50,935**
Massachusetts		33,979	119,758	108,050	161,338	121,793	94,743	55,763	179,187	47,982	**922,593**
New Jersey										10,975	**10,975**
New York										57,619	**57,619**
Rhode Island	176,776	75,216	68,664	121,160	97,583	310,638	145,876	186,758	386,160	192,486	**1,761,315**
All others	34,347	69	16,770	17,120	2,081	121,060	4,419	6,405	57	3,678	**206,006**
Total	**211,123**	**109,264**	**205,192**	**246,330**	**261,002**	**553,491**	**245,038**	**248,926**	**616,339**	**312,740**	**3,009,443**

Source: Benjamin Galuardi, Pers. Comm., April 3, 2019

VTR = Vessel Trip Report; WDA = Wind Development Area
Note: Empty cells indicate that data were not collected or not available. Values are reported in landed pounds.

Table 3.10-9: Average Annual For-Hire Recreational Trips Within 1 Mile of Massachusetts Lease Areas, 2007–2012

Port Group	Exposed For-Hire Boat Trips
Barnstable, Massachusetts	2
Falmouth, Massachusetts	1
Nantucket, Massachusetts	1
Oak Bluffs, Massachusetts	1
Onset, Massachusetts	1
Tisbury, Massachusetts	~0
Montauk, New York	16
Narragansett, Rhode Island	8
South Kingstown, Rhode Island	2
Westerly, Rhode Island	1

Source: Kirkpatrick et al. 2017

Table 3.10-10: Summary Statistics of Total Cost by Trip Duration and Vessel Length for Commercial Fishing (2012 dollars), 2008-2012

Length Categories	Large (greater than 80 feet)	Medium (40 to 80 feet)	Small (smaller than 40 feet)
All Trips			
Number	2,852	14,272	3,417
Mean	$15,819	$2,750	$279
Standard deviation	$9,571	$5,391	$429
Maximum	$75,180	$76,725	$6,305
Single Day Trips			
Number	114	9,455	3,246
Mean	$2,332	$358	$235
Standard deviation	$1,695	$371	$310
Maximum	$8,200	$7,781	$6,305
Multiday Trips			
Number	2,738	4,817	171
Mean	$16,380	$7,446	$1,114
Standard deviation	$9,350	$7,249	$1,065
Maximum	$75,180	$76,725	$5,422

Source: Das 2013

Note: Trip cost data were collected as a part of the Northeast Fishery Observer Program's data collection effort to inform fisheries decision-makers in the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council, and National Marine Fisheries Service.

Table 3.10-11: Average Annual Percentage of Total Mid-Atlantic and New England Fishery Revenue Exposed to Offshore Wind Energy Development by FMP, 2020-2030

FMP	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2030 [a]
Atlantic Herring	0.00%	0.00%	0.05%	0.32%	0.40%	0.53%	0.71%	0.75%	0.75%	0.75%	0.75%	$194,175
Bluefish	0.00%	0.00%	0.14%	0.49%	0.66%	0.81%	1.18%	1.20%	1.20%	1.20%	1.28%	$18,322
Golden Tilefish	0.00%	0.00%	0.03%	0.06%	0.39%	0.68%	1.06%	1.06%	1.06%	1.06%	1.06%	$49,716
HMS	0.00%	0.00%	0.01%	0.06%	0.07%	0.07%	0.10%	0.10%	0.10%	0.10%	0.13%	$2,262
Mackerel/Squid/Butterfish	0.00%	0.00%	0.48%	0.96%	1.30%	1.70%	2.38%	2.47%	2.47%	2.47%	2.56%	$1,160,421
Monkfish	0.00%	0.00%	0.33%	2.62%	2.97%	3.32%	4.57%	4.62%	4.62%	4.62%	4.70%	$904,187
Multispecies Large Mesh	0.00%	0.00%	0.04%	0.28%	0.31%	0.33%	0.45%	0.45%	0.45%	0.45%	0.45%	$300,026
Multispecies Small Mesh	0.00%	0.00%	0.39%	1.53%	2.36%	3.37%	4.21%	4.22%	4.22%	4.22%	4.22%	$442,456
Sea Scallop	0.00%	0.00%	0.05%	0.28%	0.29%	0.47%	0.59%	0.75%	0.75%	0.75%	0.77%	$3,538,272
Skate	0.00%	0.00%	0.47%	4.27%	4.75%	5.11%	7.03%	7.04%	7.04%	7.04%	7.08%	$582,748
Spiny Dogfish	0.00%	0.00%	0.29%	1.35%	1.67%	1.75%	2.10%	2.11%	2.11%	2.11%	2.13%	$57,465
Summer Flounder/ Scup/Black Sea Bass	0.00%	0.00%	0.36%	1.14%	1.46%	1.91%	2.50%	2.56%	2.56%	2.56%	2.70%	$991,601
Surfclam/Ocean Quahog	0.00%	0.00%	0.46%	1.38%	1.49%	1.61%	5.17%	5.20%	5.20%	5.20%	5.30%	$3,329,762
None–Unmanaged (includes lobster and Jonah crab)	0.00%	0.00%	0.11%	0.42%	0.54%	0.83%	1.07%	1.08%	1.08%	1.08%	1.21%	$1,476,467
Red crab	0.00%	0.00%	0.03%	0.09%	0.12%	0.19%	0.25%	0.25%	0.25%	0.25%	0.33%	$10,381

Source: G. DePiper, Pers. Comm., 2018

FMP = Fisheries Management Plan; HMS = Highly Migratory Species; VTR = Vessel Trip Report
[a] This column represents the total average revenue exposed in 2030 in order to give a value reference to for the percentage of revenue exposed in 2030.
Notes: Revenue was converted to 2019 dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery dependent landings' data. To produce the data set, VTR information was merged with data collected by at-sea fisheries observers, and a cumulative distribution function was estimated to present the distance between VTR points and observed haul locations. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. American lobster and Jonah crab fisheries are included in the "None–Unmanaged" row.

Table 3.10-12: Average Annual Revenue from all Lease Areas for Exposed Port Groups (nominal dollars), 2013-2018

State Landed	Port Landed	Average Annual Revenue from all Lease Areas	Average Percent of Port Revenue
Massachusetts	New Bedford	$2,866,630	1%
Rhode Island	Point Judith	$2,401,731	5%
New Jersey	Atlantic City	$867,267	4%
New Jersey	Cape May	$795,656	1%
Rhode Island	Little Compton	$392,608	22%
New Jersey	Point Pleasant	$358,783	2%
New York	Montauk	$307,661	2%
Rhode Island	Newport	$307,129	4%
New Jersey	Barnegat	$224,674	1%
Massachusetts	Westport	$175,404	16%
Massachusetts	Fairhaven	$173,077	2%
Maryland	Ocean City	$158,460	3%
New Jersey	Sea Isle City	$144,291	8%
Virginia	Newport News	$138,144	1%
Virginia	City of Seaford	$126,244	1%
Connecticut	New London	$98,615	2%
Virginia	Hampton	$92,523	1%
Massachusetts	Chatham	$88,490	1%
Connecticut	Stonington	$71,916	1%
Rhode Island	Tiverton	$70,402	5%
Rhode Island	Davisville	$61,687	1%
Rhode Island	North Kingstown	$53,545	1%
Delaware	Indian River	$45,930	13%
North Carolina	Beaufort	$43,292	1%
Massachusetts	Menemsha	$41,284	10%

Source: B. Galuardi, Pers. Comm., 2020

Table 3.10-13: Vineyard Wind's Voluntary Financial Compensation Agreements

Measure	Description	Proposed Project Phase
Rhode Island Compensation Fund [a,b]	A $4.2 million direct compensation fund would be held in escrow to compensate for any claims of direct impacts on Rhode Island vessels or Rhode Island fisheries interests [c] in the Project area.	Construction, Operations and Maintenance, and Decommissioning
Massachusetts Compensation Fund [a,b]	A $19.2 million direct, downstream, and cumulative (upstream) compensation fund would be held in escrow to compensate for any claims of direct or indirect impacts on Massachusetts vessels or Massachusetts fisheries interests [c] in the Project area.	Construction, Operations and Maintenance, and Decommissioning
Rhode Island Fisherman's Future Viability Trust [b]	Vineyard Wind entered into an agreement with the Rhode Island Coastal Resources Council regarding the establishment and funding of the Rhode Island Fishermen's Future Viability Trust (the "Trust"). The purpose of the $12.5 million Trust is to further the policies of the Ocean Special Area Management Plan with respect to the continued viability and success of Rhode Island's fishing industry and to support and promote the compatibility of offshore wind and commercial fishing interests within Rhode Island's Geographic Location Description. The Trust will provide funds to address concerns about safety and effective fishing in and around the Project area and wind energy facilities generally. Examples of how the funds may be used include improvements in fishing vessels, fishing methods, and gear, supporting widespread deployment of navigational equipment, financial support of individual fisherman, purchase of updated safety equipment (e.g., radar, global positioning systems, survival suits, life rafts), and payment for increased insurance costs related to fishing around wind energy facilities.	Construction, Operations and Maintenance, and Decommissioning
Massachusetts Fisheries Innovation Fund [b]	On May 21, 2020, the Massachusetts Executive Office of Energy and Environmental Affairs and Vineyard Wind entered into a Memorandum of Agreement for a $1.75 million Fisheries Innovation Fund. The purpose of the Fisheries Innovation Fund is to support programs and projects that ensure the continuation of safe and profitable fishing as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. The Fund will provide support to programs and projects through grants to conduct studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries as well as provide grants for technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy facility area. These programs and projects may include, but are not limited to, studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries, improvements in fishing vessels and gear, development of new technology to improve navigation in and around the wind energy facility area, the development of alternative gear and fishing methods, optimization of vessel systems, technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy facility area, and general fishing vessel safety improvements.	Construction, Operations and Maintenance, and Decommissioning

Sources: COP Volume. III, Appendix III-P; Epsilon 2020b; Vineyard Wind 2020

[a] The $25.4 million is calculated as follows: Rhode Island economic exposure was valued at $6,190,281 over 30 years using a 2.5 percent annual escalator to the initial 1-year exposure value. When the Rhode Island Fisheries Advisory Board asked to front-load the initial payment, the amount in nominal dollars was reduced to $4.2 million (but the value in real terms is still $6.1 million). For Massachusetts, the economic exposure plus upstream and downstream multipliers is $19,185,016. The Rhode Island $6,190,281 plus the Massachusetts $19,185,016 equals $25,375,297. The $25.4 million compensation funds are calculated from Fishing Vessel Trip Reports, Dealer Reports, and Vessel Monitoring System data (http://www.crmc.ri.gov/windenergy/vineyardwind/VW_EconExposureCommFisheries.pdf and the Memorandum of Agreement between Vineyard Wind and the Massachusetts Executive Office of Energy and Environmental Affairs, for detailed methodology).

[b] This voluntary measure was included in the May 2019 COP Addendum to Volume III and in the May 21, 2020, Memorandum of Agreement between Vineyard Wind and the Massachusetts Executive Office of Energy and Environmental Affairs and executed by the Massachusetts Office of Coastal Zone Management. The COP approval for the proposed Project would require compliance with consistency concurrence under the Coastal Zone Management Act (COP Addendum, Epsilon 2019a).

[c] Fishing interests are broadly defined to include vessel owners and operators, vessel crews, shoreside processors, vessel supplier and support services, and other entities that can demonstrate losses directly related to the Vineyard Wind 1 Project.

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Table 3.11-1: Summary of Activities and the Associated Impact-Producing Factors for Navigation and Vessel Traffic

Baseline Conditions: Total vessel transits in the Vineyard Wind 1 Project area have remained relatively stable since 2010. Within the WDA and the surrounding area, vessel traffic is primarily seasonal with approximately 75 percent of all annual WDA area traffic occurring between Memorial Day and Labor Day. This is primarily due to high seasonal activity by recreational vessels and commercial fishing vessels. Cargo vessel traffic is less seasonal. Traffic patterns in the vessel traffic routes within the proposed WDA are relatively stable. Tankers, tug/tow, cargo, and passenger vessels generally stay within fairways and designated traffic lanes and do not usually traverse the proposed WDA. However, 2015 to 2017 AIS maps show that a large volume of sailing, fishing, and other unspecified vessels traverse this area (Northeast Regional Ocean Council 2018).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Larger commercial vessels (specifically tankers) sometimes anchor outside major ports to transfer their cargo to smaller vessels for transport into port, an operation known as lightering. These anchors have deeper ground penetration and are under higher stresses. Smaller vessels (commercial fishing or recreational vessels) would anchor for fishing and other recreational activities. These activities cause temporary to short-term impacts on navigation in the immediate anchorage area. All vessels may anchor if they lose power to prevent them from drifting and creating navigational hazards for other vessels or for drifting into structures.	Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep draft visits to major ports are expected to increase as well, increasing the potential for an individual vessel to lose power and need to anchor, creating navigational hazards for other vessels or for drifting into structures. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.	Developers are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk for deep draft vessels would come from anchoring in an emergency scenario. Vessel masters would be expected to consult nautical charts, where cable locations would be marked, before dropping anchor. If a larger vessel accidently drops anchor on top of an export cable (buried or mattress protected) to prevent drifting in the event of vessel power failure, potential impacts would include damage to the export cable, risks associated with an anchor contacting an electrified cable, and impacts on the vessel operators liability and insurance. For smaller vessels (i.e., recreational or commercial fishing vessels), cables would only pose a risk if they were not buried to the target burial depth (generally 6 to 8 feet), which smaller vessel anchors would not penetrate. When cables are surface-laid or protected with concrete mattresses (generally because geologic conditions prohibit burial), vessel operators would be expected to consult nautical charts before dropping anchor. Smaller vessels anchoring within any development areas would also need to consider the foundation and any associated scour protection when dropping anchor near any WTGs. Anchors may have trouble holding onto these surfaces, or could become snagged. For the former, the smaller vessels may need to make several attempts to get their anchor to hold. For the latter, the smaller vessels may have difficulty eventually dislodging their anchors, leading to potential loss of that anchor.	Larger vessels that may be concerned with the export cable are not expected to pass over the cable area, transiting instead farther to the west and the south. For smaller commercial or recreational vessels, the risks would be the same as for all offshore wind installations, except only over the 151 acres (0.6 km^2) of hard cover and scour protection over foundations and cables. This would have localized, long-term continuous, **negligible** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this IPF under the Proposed Action would include temporary to short-term, localized impacts due to deep draft vessels anchoring in an emergency scenario, resulting in damage to the export cable, risks associated with an anchor contacting an electrified cable, and impacts on the vessel operators liability and insurance. Smaller vessels anchoring in the WDA may have issues with anchoring failing to hold near foundations and any associated scour protection, or, alternately, where the anchors may become snagged, and potentially lost. These impacts would be localized, temporary to short-term, and **negligible**. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts, especially along the routes of potential cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale due to the potential for up to 775 foundations and 1.482 acres (6.0 km^2) of scour/cable protection. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic from ongoing and planned actions, including the Proposed Action, would occur across the RI and MA Lease Areas and would thus be long-term, continuous, and **negligible**.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Impacts from these activities would be short-term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Ports would need to perform maintenance and perform upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size. Impacts would be short-term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Construction of offshore wind energy projects requires port facilities for staging and installation vessels, including crew transfer, dredging, cable lay, pile driving, survey vessels, and potentially feeder lift barges and heavy lift barges. These vessels would all add traffic to port facilities and would require berthing. For staging activities, developers would use large, open spaces integrated into port facilities and adjacent to sufficient berthing to unload, lay down, stage, and load the WTG, ESP, and foundation components onto feeder or heavy lift barges. Improvements to the MCT in New Bedford are unlikely to allow the MCT to simultaneously host multiple projects. This would require use of (and potential expansion, dredging, or other impacts at) other ports in Rhode Island, Connecticut, New York, Massachusetts, or beyond.	Vessel traffic generated by construction of the Proposed Action would constitute less than 10 percent of typical daily vessel transits into and out of the Port of New Bedford. Broad-beamed transfer barges or installation vessels could leave little room for other vessels to maneuver in the entry channel for the Port of New Bedford. The presence of these vessels could cause delays and changes in port usage by some fishing or recreational vessel operators. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action could include congestion at the Port of New Bedford from added vessel traffic and from staging operations. Navigation and vessel traffic impacts due to port utilization associated with the Proposed Action would be localized, long-term, continuous, and **moderate**. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but a greater spatial and temporal extent. Ports throughout the Northeast may need upgrades to support staging operations of future offshore wind activities other than the Proposed Action. Simultaneous construction may also stress port access and resources. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, are expected to be short-term and regional. BOEM expects that the Proposed Action, when combined with past, present, and future projects, would have **moderate** impacts from this sub-IPF due to the short-term nature and regional potential impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. There are two types of allisions that occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements, or is distracted.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 30 years. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Wind energy projects would add potential structures for vessels to allide with in the water, including up to 955 WTGs and 20 ESPs (i.e., a total of 975 foundations) and the lift vessels used during construction (which would essentially be stationary objects while constructing each WTG). Impacts would increase as each facility is built and completed starting in 2022 and continuing through 2030, would remain constant during simultaneous operations, and would decrease as projects are decommissioned and structures are removed.	The Proposed Action would include 102 potential new structures (100 WTGs and 2 ESPs) with which vessels could allide. Additional impacts would likely be felt during the later stages of construction where there would also be heavy lift and feeder lift barges, as well as pile driving vessels, further increasing the navigational complexity and risk of allision. The layout of the Proposed Action (0.75-nautical-mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include an increased allision risk and probability for smaller vessels using the area. Allisions with a WTG or an ESP could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. However, the layout of the Proposed Action (0.75-nautical-mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic. Existing structures and future non-offshore wind structures also have localized risks of allisions with similar impacts. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Additionally, there is the potential consequence of large vessels alliding with WTGs or ESPs for offshore wind installations near ports or traffic lanes (specifically near the inbound lane of the Buzzards Bay TSS). In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and would thus be long-term, continuous, regional, and **major**.
Presence of structures: Fish aggregation	Items in the water, such as ghost fishing gear, buoys, and energy platform foundations can create an artificial reef effect, aggregating fish. Recreational and commercial fishing can occur near the artificial reefs. Recreational fishing is more popular than commercial near artificial reefs as commercial mobile fishing gear can risk snagging on the artificial reef structure.	Fishing near artificial reefs is not expected to change meaningfully over the next 30 years.	Wind energy projects would add potential structures that could act as artificial reefs, including up 955 WTGs and 20 ESPs (i.e., a total of 975 foundations). As a result, wind energy projects would likely attract substantial numbers of recreational fishing vessels. These structures would be less likely to attract commercial fishing vessels, due to differences in fishing techniques. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities. However, it may include recreational vessels traveling farther offshore than is currently typical, and these would be additive to the vessel traffic that already transits within the lease areas. The USCG has no intention of closing offshore wind energy facilities to vessel traffic.	The Proposed Action would include 102 potential new structures (100 WTGs and 2 ESPs) that could act as artificial reefs. Due to the Project's relative proximity to Martha's Vineyard, Nantucket, and Nantucket Sound, it is predicted that the WTGs would attract recreational fishermen on both private and chartered vessels. This would introduce additional vessels to the area, some of which may not be skilled mariners whose vessels may not be seaworthy for that far offshore, and may have difficulty navigating safely. This would have localized, long-term, continuous, **minor** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include increased recreational fishing vessel traffic in the WDA. This could lead to increased congestion and navigational complexity within the wind energy facility, which could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, long-term, continuous, **minor** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale and adjusted to consider likelihood of visitation by recreational vessels due to relative proximity to shore. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and would be long-term, continuous, regional, and **minor**.
Presence of structures: Habitat conversion	Equipment in the ocean can create a substrate for mollusks to attach to, and fish eggs to settle near. This can create a reef-like habitat and benefit structure-oriented species on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy facilities could create foraging opportunities for seals and small odontocetes, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase navigational complexity as each new facility is built, completed, and matures. New structures would be added intermittently over an assumed 6- to 10-year period and could benefit structure-oriented species as long as the structures remain.	The Proposed Action could create foraging opportunities for seals, small odontocetes, and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase navigational complexity as each new facility is built, completed, and matures. This would have long-term, **negligible** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include increased recreational fishing vessel traffic in the WDA. This could lead to increased congestion and navigational complexity within the wind energy facility, which could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, long-term, continuous, **negligible** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and would thus be regional, long-term, continuous, and **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Migration disturbances	Noise-producing activities, such as pile driving and vessel traffic, may interfere and adversely affect marine mammals during foraging, orientation, migration, response to predators, social interactions, or other activities. Marine mammals may also be sensitive to changes in magnetic field levels. The presence of structures and operation noise could cause mammals to avoid areas.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Wind energy projects could encourage cetaceans to migrate outside normal patterns to avoid WTGs and ESPs. These revised routes might lead the cetaceans to locations where they are more likely to interact with vessels, leading to a larger probability of vessel strike. The anticipated 1-nautical-mile spacing between structures would be sufficient to allow vessels unimpeded access within wind energy facilities and between wind energy projects. Additional or more compressed vessel traffic within the WDA may increase the risk of marine mammal or turtle vessel strikes. New structures would be added intermittently over an assumed 6- to 10-year period and could increase this risk as long as the structures remain.	The anticipated 1-nautical-mile spacing between structures would be sufficient to allow unimpeded access within wind energy facilities. Additional or more compressed vessel traffic within the WDA may increase the risk of marine mammal or turtle vessel strikes. New structures would be added intermittently over an assumed 6- to 10-year period and could increase this risk as long as the structures remain. This would have long-term, **minor** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would be due to the presence of structures, encouraging cetaceans to migrate outside normal patterns to avoid WTGs and ESPs in the WDA. This could lead to increased risk of marine mammal or turtle vessel strikes within the wind energy facility, which could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, long-term, continuous, **minor** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service. Additionally, as the Proposed Action layout is a differing layout than the one in the expanded planned action scenario (an east to west 1 x 1 nautical mile aligned grid), there would be increased navigational complexity in moving through the differing adjacent layouts. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would be regional, long-term, continuous, and **moderate**.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is made more complex, as the vessels need to avoid both the structure and each other.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 30 years. Even with increased port visits by deep draft vessels, this is still a relatively small adjustment when considering the whole of New England vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.	In addition to avoiding each other, vessels would need to avoid all WTGs and ESPs contemplated in the expanded planned action scenario (up to 955 WTGs, and 20 ESPs). Vessel bridge viewfields would become more cluttered, requiring vessel operators to increase their vigilance and/or rely more heavily on technological aids to support safe navigation. Depending on the individual layout of each project, wind energy projects would increase navigational complexity, including potential compression of vessel traffic both outside and within wind development areas, and potential difficulty seeing other vessels due to a cluttered view field. Grid layouts that do not align with adjacent projects would further increase navigation complexity. Impacts would increase as each facility is built and completed starting in 2022 and continuing through 2030.	The Proposed Action includes a grid layout with up to 100 WTG and 2 ESP locations. The gridded layout increases predictability, allowing vessels to more easily plan their movements. The yellow foundation color and the marking of turbines on nautical charts mean that operators would be more easily able to discern stationary WTGs/ESPs from other vessels, whether stationary or moving. However, there is the likelihood that the lanes set by the WTGs/ESPs would force vessels into tighter passing scenarios than they would have experienced operating normally in open waters, requiring operators to maintain a higher level of alertness when transiting within or near the WDA, which could lead to increased crew fatigue. The layout of the Proposed Action (0.75-nautical-mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include more restrictive vessel movement in the WDA, as it previously was open ocean. This would lead to increased congestion and navigational complexity within the wind energy facility, which could result in crew fatigue, damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. However, the layout of the Proposed Action (0.75-nautical-mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service. Additionally, as the Proposed Action layout is a differing layout than the one in the expanded planned action scenario (an east to west 1 x 1 nautical mile aligned grid), there would be increased navigational complexity in moving through the differing adjacent layouts. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would be regional, long-term, continuous, and **major**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Space use conflicts	Currently, the offshore area is occupied by marine trade, stationary and mobile fishing, and survey activities. Some deep draft and tug/towing vessels transit between the Narragansett/Buzzards Bay TSS precautionary area and points north/east by way of the Nantucket-Ambrose Fairway and can cross through the southern portion of the RI and MA Lease Areas, particularly through OCS-A 0500 and 0501.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy projects would add potential structures, including up to 955 WTGs and 20 ESPs. Fishing vessels may have difficulty conducting their exercises and typical activities through these areas. Fixed gear fisheries may have difficulty placing their pots in locations that avoid active fishing or mobile gear vessels. Grid layouts that do not align with adjacent projects would further increase navigation complexity. The existing deep draft and tug/towing vessels that can cross through the lease areas would need to adjust their course farther west and south to avoid structures, potentially adding congestion or choke points to the Nantucket-Ambrose Fairway due south of the precautionary area. Impacts would increase as each facility is built and completed starting in 2022 and continuing through 2030.	The Proposed Action's WTGs and ESPs could affect established sailboat races, tour boat routes, for-hire recreational boating and fishing, and commercial fishing locations and techniques. Space use conflicts could result in reduced commercial fishing effort and survey vessels unable to complete their mission with existing methodologies, meaning that the species population estimates could have increased uncertainty. NOAA has indicated that survey vessels may have difficulty maneuvering within the project area. The layout of the Proposed Action (0.75-nautical-mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include space use conflicts and more restricted vessel movement in the WDA, as it previously was open ocean. This would lead to increased congestion and navigational complexity within the wind energy facility, which could result in crew fatigue, damage to vessels and fishing gear, injury to crews, engagement of USCG SAR, and vessel fuel spills. However, the layout of the Proposed Action (0.75-nautical-mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service. Additionally, as the Proposed Action layout is a differing layout than the one in the expanded planned action scenario (an east to west 1 x 1 nautical mile aligned grid), there would be increased navigational complexity in moving through the differing adjacent layouts. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic under this sub-IPF would be regional, long-term, continuous, and **major**.
Presence of structures: Transmission cable infrastructure	See IPF for Anchoring.	See IPF for Anchoring.	See IPF for Anchoring.	See IPF for Anchoring.	See IPF for Anchoring.
New cable emplacement/ maintenance	Within the geographic analysis area for navigation and vessel traffic, existing cables may require access for maintenance activities. Infrequent cable maintenance activities may cause temporary increases in vessel traffic and navigational complexity. Six existing power cables are currently in the geographic analysis area for navigation and vessel traffic. Refer to Appendix A for details.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables, perhaps including those connecting Martha's Vineyard and/or Nantucket to the mainland, would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 30 years. Care would need to be taken by vessels that are crossing the cable routes during these activities.	Cable maintenance would increase vessel traffic, and would specifically add slower-moving vessel traffic above cable routes. Vessels not associated with wind energy projects would need to exercise caution when crossing the cable routes during maintenance and installation activities.	Non-Project vessels operating in the waters between the ports used by Vineyard Wind and the WDA would be able to avoid Vineyard Wind vessels, components, and access restrictions through small, routine adjustments to navigation. For the OECC, non-Project vessels required to travel a more restricted (narrow) lane near the OECC could potentially experience greater delays waiting for cable-laying vessels to pass. Installation or maintenance would have localized, short-term, intermittent, **minor** impacts on navigation and vessel traffic in general.	The impacts on navigation and vessel traffic from this IPF under the Proposed Action would include more restricted vessel movement in the WDA and OECC during construction and cable maintenance activities. This would lead to increased congestion and navigational complexity within the wind energy facility, which could result in crew fatigue, damage to vessels and fishing gear, injury to crews, engagement of USCG SAR, and vessel fuel spills. The space use conflicts for fishing could result in reduced commercial catch within the WDA. This would have localized, short-term, intermittent, **minor** impacts on navigation and vessel traffic in general. Ongoing activities, future non-offshore wind activities, and future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic from this IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas. The extent of coverage from combined impacts on navigation and vessel traffic from this IPF would increase as additional offshore wind projects are placed in service. The combined impacts on navigation and vessel traffic from this IPF would be dependent upon the cable-array layout differences and the difficulty of moving through more complex layouts, as well as differing adjacent layouts. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic under this IPF from installation would be localized, short-term, intermittent, and **minor**. The collective impacts of cable maintenance during operation would be localized, long-term, intermittent, and **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Traffic: Aircraft	USCG SAR helicopters are the main aircraft that may be flying at low enough heights to risk interaction with WTGs. USCG SAR aircraft need to fly low enough that they can spot objects in the water.	SAR operations could be expected to increase with any increase in vessel traffic. However, as vessel traffic volume is not expected to increase appreciably, neither should SAR operations. FEIS Section 3.11 provides a discussion of navigation impacts on fishing vessel traffic.	USCG SAR aircraft need to fly low enough that they can spot objects in the water during days of potentially low visibility, typically lower than the height of the WTGs likely to be installed as part of the reasonably foreseeable environmental trends and planned actions. As a result, SAR aircraft (specifically helicopters) would need to fly between proposed WTGs to reach the desired altitude. The Final MARIPARS stated that WTGs with 1-nautical-mile spacing and north-south/east-west orientation would provide the USCG with adequate SAR access (north-to-south travel) (USCG 2020). However, SAR pilots would require training on flying through arrays, and may be less comfortable with such maneuvers in poor conditions than over open waters. This, combined with the increased likelihood of vessel allision and collision, could lead to more incidents requiring SAR activity, combined with fewer successful rescues. This concern notwithstanding, the presence of WTGs and ESPs could provide refuge for incident victims, and marking of individual WTGs could facilitate location and rescue by USCG.	Similar impacts to those described for future offshore wind activities (limitations on SAR altitudes and routes). The layout of the Proposed Action would differ from the assumed 1 x 1 nautical mile, east-west/north-south layout of other adjacent offshore wind projects. This would have localized, long-term, continuous, **minor** impacts on aircraft navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include more restricted vessel movement to boaters and low-flying aircraft in the WDA and an increased likelihood of vessel allusion, which may result in more incidents and fewer successful rescues. This would have localized, long-term, continuous, **minor** impacts on aircraft navigation and vessel traffic. Ongoing activities, future non-offshore wind activities, and future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would occur across the RI and MA Lease Areas. The extent of coverage from combined impacts on navigation and vessel traffic from this IPF would increase as additional offshore wind projects are placed in service. The combined impacts on navigation and vessel traffic from this IPF would be dependent upon the layout differences and the difficulty of moving through more complex layouts, as well as differing adjacent layouts. In context of reasonably foreseeable environmental trends, combined impacts on navigation and vessel traffic through this sub-IPF from ongoing and planned actions, including the Proposed Action, would be localized, long-term, continuous, **moderate** impacts.
Traffic: Vessels	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.
Traffic: Vessels, collisions	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.

AIS = Automatic Identification System; BOEM = Bureau of Ocean Energy Management; ESP = electrical service platform; FCC = Federal Communications Commission; IPF = impact-producing factors; km^2 = square kilometers; MARIPARS = Massachusetts and Rhode Island Port Access Route Study; MCT = Marine Commerce Terminal; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; SAR = search and rescue; TSS = traffic separation scheme; USCG = U.S. Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

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Table 3.11-2: 2016 and 2017 AIS Vessel Traffic Data

Vessel Type [a]	Vessel Dimensions (maximum-minimum)					Vessel Traffic	
	Length	Beam	Draft	DWT [b]	Speed (knots)	2016	2017
Research vessels	108–236 feet (33–72 meters)	23–46 feet (7–14 meters)	7–20 feet (2–6 meters)	97–2,328 tons (88–2,112 MT)	<1–19	1	1
Passenger cruise ships/ferries	na	na	na	na	na	1	9
Commercial fishing	36–197 feet (11–60 meters)	13–49 feet (4–15 meters)	13–16 feet (4–5 meters)	453 tons (411 MT)	<1–18	198	314
Dredging/underwater/ diving operations	112–341 feet (34–104 meters)	39–66 feet (12–20 meters)	9–22 feet (3–7 meters)	4,400 tons (3,992 MT)	<1–22	2	1
Military or military training	141–269 feet (43–82 meters)	39–43 feet (12–13 meters)	11 feet (3 meters)	1,820–2,250 tons (1,651–2,041 MT)	3–9	4	8
Recreational (pleasure, sailing, charter fishing, etc.)	36–184 feet (11–56 meters)	13–33 feet (4–10 meters)	7–38 feet (2–12 meters)	499 tons (452 MT)	<1–58	142	176
Cargo	551–656 feet (168–200 meters)	56–108 feet (17–33 meters)	23–36 feet (7–11 meters)	22,563 tons (20,469 MT)	2–8	5	13
Tug-and-barge	118–492 feet (36–150 meters)	36–76 feet (11–23 meters)	17–23 feet (5–7 meters)	637 tons (578 MT)	10–21	2	14
Other/unspecified	na	na	na	na	na	76	147
Total						431	683

Source: COP Table 4.0-2 and Table 4.3-6, Volume III, Appendix III-I; Epsilon 2020b

AIS = Automatic Identification System; DWT = deadweight ton; na = data not available; MT = metric ton
[a] Includes only vessels equipped with AIS (required for commercial vessels >65 feet in length)
[b] Displacement based on example vessels

Table 3.11-3: Vessels per Vessel Category within WDA per Month in 2016 and 2017

Month	Vessel Type	2016		2017	
		Number of Vessels (MMSI counts)	Percent of all Vessels (per month)	Number of Vessels (MMSI counts)	Percent of all Vessels (per month)
January	Unspecified	2	28.6	1	7.7
	Fishing	3	42.9	11	84.6
	SAR	1	14.3	0	0.0
	Cargo	1	14.3	0	0.0
	Other	0	0.0	1	7.7
February	Unspecified	1	12.5	1	5.6
	Fishing	7	87.5	15	83.3
	Other	0	0.0	1	5.6
March	Unspecified	3	15.8	2	6.5
	Fishing	14	73.7	26	83.9
	Tanker/Tug	1	5.3	0	0.0
	Other	1	5.3	5	3.2
April	Unspecified	7	50.0	1	1.7
	Fishing	7	50.0	56	94.9
	Pleasure Craft	0	0.0	1	1.7
	Other	0	0.0	1	1.7
May	Unspecified	7	25.9	1	1.5
	Fishing	15	55.6	60	89.6
	Sailing	3	11.1	2	3.0
	Pleasure Craft	0	0.0	2	3.0
	Passenger	0	0.0	1	1.5
	Other	2	3.7	1	1.5
June	Unspecified	11	17.5	6	6.7
	Fishing	37	58.7	67	74.4
	Sailing	5	7.9	6	6.7
	Pleasure Craft	6	9.5	8	8.9
	Passenger	0	0.0	1	1.1
	Other	4	6.4	2	1.1
July	Unspecified	2	2.8	35	28.0
	Fishing	45	63.4	53	42.4
	Sailing	2	2.8	3	2.4
	Pleasure Craft	22	31.0	28	22.4
	High Speed Craft	0	0.0	1	0.8
	Passenger	0	0.0	1	0.8
	Other	0	0.0	4	2.4
August	Unspecified	3	2.8	35	33.7
	Fishing	64	60.9	44	42.3
	Diving/Operations	1	0.9	0	0.0
	Sailing	2	1.9	0	0.0
	Pleasure Craft	33	31.1	21	20.2
	High Speed Craft	0	0.0	1	1.0
	Passenger	0	0.0	1	1.0
	Cargo	2	1.9	1	1.0
	Other	1	0.9	1	1.0

Month	Vessel Type	2016 Number of Vessels (MMSI counts)	2016 Percent of all Vessels (per month)	2017 Number of Vessels (MMSI counts)	2017 Percent of all Vessels (per month)
September	Unspecified	2	2.3	19	33.9
	Fishing	68	78.2	26	46.4
	Sailing	1	1.2	1	1.8
	Pleasure Craft	11	12.6	3	5.4
	"Reserved"/Dredging/ Activities	1	1.2	1	1.8
	Tug	0	0.0	1	1.8
	Passenger	0	0.0	1	1.8
	Cargo	1	1.2	0	0.0
	Other	3	3.5	4	6.9
October	Unspecified	1	3.2	2	7.4
	Fishing	22	71.0	18	66.7
	Dredging/Underwater Activities	1	3.2	0	0.0
	Military Operations	0	0.0	1	3.7
	Sailing	1	3.2	0	0.0
	Pleasure Craft	3	9.7	4	14.8
	"Reserved"/Dredging/ Activities	1	3.2	1	3.7
	Cargo	2	6.5	1	3.7
November	Unspecified	1	5.0	1	9.1
	Fishing	16	80.0	9	81.8
	Dredging/ Underwater Activities	1	5.0	0	0.0
	Military Operations	1	5.0	0	0.0
	"Reserved"/Dredging/ Activities	1	5.0	0	0.0
	Cargo	0	0.0	1	9.1
December	Fishing	11	100.0	6	75.0
	Cargo	0	0.0	1	12.5
	Other	0	0.0	1	12.5

Source: COP Volume III, Appendix III-I; Epsilon 2020b

MMSI = Maritime Mobile Service Identity; SAR = search and rescue; WDA = Wind Development Area

Table 3.11-4: Project-Related Vessel Traffic during Proposed Action Construction

	Maximum Single-Day	Average, Peak Construction Period	Average, Entire Construction Period
Daily trips	46 [a]	18	7
Vessels in WDA or OECC	46	46	25

Source: COP Volume III, Section 7.8; Epsilon 2020a

OECC = Offshore Export Cable Corridor; WDA = Wind Development Area

[a] During maximum single day, Proposed Action construction could generate up to a total of 46 trips from the New Bedford Marine Commerce Terminal (MCT) or secondary ports in the United States or Canada, as defined in Table 2.1-3.

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Table 3.12-1: Summary of Activities and the Associated Impact-Producing Factors for Other Uses

Military and National Security Uses, Baseline Conditions: The geographic analysis area includes military and national security entities' use of airspace, surface, and submarine areas. Generally, an area roughly bounded by Montauk, New York; Providence, Rhode Island; and Provincetown, Massachusetts, and within a 10-mile (16.1-kilometer) buffer from wind lease areas in the RI and MA Lease Areas. The United States Navy (Navy), the USCG, and other military and national security entities have numerous facilities in the region (Figure 3.12-1). Major onshore regional facilities include Naval Station Newport, the Naval Submarine Base New London, the Northeast Range Complex/Narragansett Bay Operation Area, Joint Base Cape Cod, and numerous USCG stations. Onshore and offshore military and national security use areas may have designated surface and subsurface boundaries and special use airspace. Warning Area W-105A is a special use airspace area primarily used by the USAF located offshore Massachusetts and Rhode Island, and overlapping the RI and MA Lease Areas.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Allisions	Existing stationary facilities that present allision risks include the five offshore wind turbines associated with Block Island Wind Farm, dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No additional non-offshore wind stationary structures were identified within the geographic analysis area. Stationary structures such as private or commercial docks may be added close to the shoreline.	Allision risks would be increased around the 718 WTGs and 18 ESPs during project operations and near lift vessels used during construction. Military and national security vessels more likely to allide with stationary structures would be smaller vessels moving within and near wind installations for SAR operations or other non-typical activities. Deep-draft military and national security vessels near traffic separation schemes or port entrances could potentially lose power and allide with a nearby WTG. Risks would increase incrementally between 2022 and 2030 as additional offshore wind facilities are built within the RI and MA Lease Areas. All structures would be lighted according to USCG and BOEM requirements. Allision risks would be mitigated by WTG spacing at 1 x 1 nautical mile apart. Risk would incrementally decrease as projects are decommissioned and structures are removed.	The addition of up to 57 WTGs and two ESPs to the WDA would increase the risk of allisions for military vessels for 30 years during project operations particularly in bad weather or low visibility. During construction, stationary lift vessels within the WDA would also increase allision risk. Military traffic within the WDA is relatively low, and military vessels are not anticipated to navigate outside navigation channels unless necessary for SAR operations and non-typical activities. The Department of Defense concluded that the Proposed Action would have minor but acceptable impacts on their operations; however, this determination does not include USCG's activities such as SAR. Allision risks would be mitigated by WTG spacing at 1 x 1 nautical mile apart such that vessels anywhere in the RI and MA Lease Areas pass one WTG on either side every 1 nautical mile when traveling north-south or east-west, and every 0.6 to 0.8 nautical mile when traveling northwest-southeast or northeast-southwest, as recommended in the USCG Final MARIPARS. The Final MARIPARS did not recommend implementation of a wider transit lane. Vineyard Wind would coordinate with military and national security interests to minimize impacts during construction, operations, and decommissioning. Allision risk would be eliminated after decommissioning when structures are removed. Overall, presence of stationary structures would cause localized, long-term, **minor** to **moderate** impacts from allision risk.	Section 3.11 discusses navigation and vessel traffic. The impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased allision risk of within the WDA by adding up to 59 stationary structures (57 WTGs and 2 ESPs) for 30 years during operations, and by use of stationary lift vessels within the WDA during construction. Allision risks would be mitigated by spacing the WTGs at 1 x 1 nautical mile apart, by implementing navigational hazard marking per BOEM and USCG guidance and requirements, and by Vineyard Wind coordinating with military and national security interests throughout the life of the Proposed Action. Overall, presence of stationary structures from the Proposed Action would cause localized, long-term, **minor** to **moderate** impacts from allision risk. Stationary structures associated with ongoing activities and future non-offshore wind activities that increase allision risks are widely dispersed in the open ocean within the geographic analysis area, and limited to the five offshore wind turbines associated with the Block Island Wind Farm, deployed meteorological buoys associated with the offshore wind site assessment activities, and shoreline developments such as docks. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 775 WTGs and 20 ESPs proposed to be constructed within the RI and MA Lease Areas before 2030. In the context of reasonably foreseeable environmental trends, combined impacts on military and national security uses from this sub-IPF associated with the Proposed Action and ongoing and planned actions would be localized, long-term, and **minor** to **moderate**.
Presence of structures: Fish aggregation	Existing stationary facilities that act as FADs include offshore wind turbines associated with Block Island Wind Farm.	No future non-offshore wind additional stationary structures that would act as FADs were identified within the geographic analysis area.	WTGs and ESPs in the leased areas could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing, which could increase demand for USCG SAR operations near the WTGs. Increased risk of conflict or collision risks for military and national security vessels would be *de minimis*, because military vessels are not anticipated to transit outside navigation channels unless necessary for SAR operations or other non-typical activities. Risk would gradually increase between 2022 and 2030 as stationary structures are installed across the	Construction of the Proposed Action would add 57 WTGs and one to two ESPs that could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing within the WDA, potentially causing conflict or collision risks for military and national security vessels and increased demand for SAR operations. Military traffic within the WDA is relatively low, and military vessels are not anticipated to navigate outside navigation channels unless necessary for SAR operations. Risk would increase during operations when stationary structures are installed and recreational fishing vessels can access the development area. Overall,	Section 3.11 discusses navigation and vessel traffic. Impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased risks of conflicts between military and national security and recreational fishing vessels, and increased demand for SAR operations due to increased recreational fishing within the WDA. The Proposed Action's addition of 59 stationary structures could attract additional recreational fishing boats to the WDA, but conflicts with military vessels would be limited because military vessels are not anticipated to navigate outside navigation channels unless necessary for SAR operations. Overall, the reef effects of the Proposed Action's structures would have localized, long-term, **minor** impacts on military and national security vessels. Stationary structures associated with ongoing and future non-offshore wind activities that could generate reef effects are limited to the five WTGs associated with the Block Island Wind Farm, and shoreline developments such as docks. Impacts from future offshore wind activities would be similar to those of the Proposed

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			RI and MA Lease Areas, and recreational fishing vessels begin to access the development area.	the reef effect of structures within the WDA would have localized, long-term, **minor** impacts due to allision and collision risk.	Action, but more extensive with up to 795 structures proposed for construction within the RI and MA Lease Areas before 2030. In the context of reasonably foreseeable environmental trends, combined impacts on military and national security uses from this sub-IPF associated with the Proposed Action and ongoing and planned actions would be localized, long-term, and **minor**.
Presence of structures: Navigation hazard	Existing stationary facilities within the geographic analysis area that present navigational hazards include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.	Addition of up to 718 WTGs with maximum blade tip height of up to 853 feet (260 meters) AMSL and 18 ESPs to RI and MA Lease Areas between 2022 and 2030 would incrementally change navigational patterns and increase navigational complexity for vessels and aircraft operating in the region around offshore wind projects. Use of stationary lift vessels in the lease areas, cranes at port locations, and vessels transporting WTGs components in transit between the two locations during construction would further increase navigational complexity in localized areas. Increased navigational complexity could increase the risk of collisions and allisions for military and national security vessels or aircraft. The USCG Final MARIPARS evaluated vessel traffic through the lease areas and recommended all surface structures be aligned in a 1 x 1 nautical mile grid, such that vessels anywhere in the RI and MA Lease Areas would pass one WTG on either side every 1 nautical mile when traveling north-south or east-west, and every 0.6 to 0.8 nautical mile when traveling northwest-southeast or northeast-southwest (USCG 2020). The Final MARIPARS did not recommend implementation of a wider transit lane. It is assumed that offshore wind operators would implement a strict operational protocol with the USCG that requires the WTGs to stop rotating within a specified time to mitigate impacts to SAR aircraft operating in the leased areas. Additionally, USCG would need to adjust their SAR planning and search patterns to allow aircraft to fly within the geographic analysis area leading, to a less optimized search pattern and a lower probability of success. Structures would be visible on military and national security vessel and aircraft radar. Mitigation measures include marking navigational hazards and coordinating with relevant agencies during the COP development process. The FAA would invite the Department of Defense and the Department of Homeland Security (which includes the USCG) to review and comment on each Form 7460-1 filing submitted.	Addition of 57 WTGs with maximum blade tip height of up to 837 feet (255 meters) AMSL and up to two ESPs within the WDA, and use of stationary lift vessels within the WDA, cranes in ports, and vessels transporting WTGs components in transit between the two locations during construction would increase local navigational complexity and change navigational patterns for vessels and aircraft operating in the area around the WDA. This would increase the risk of collisions and allisions for military and national security vessels or aircraft. Structures would be marked as a navigational hazard per FAA, BOEM, and USCG requirements and guidance. The WTGs would be visible on radar systems of low-flying military and national security aircraft. As part of the proposed Project, Vineyard Wind would implement a strict operational protocol with the USCG that requires the WTGs to stop rotating within a specified time to mitigate impacts to SAR aircraft operating in the WDA. Additionally, USCG would need to adjust their SAR planning and search patterns to allow aircraft to fly within the WDA, leading to a less optimized search pattern and a lower probability of success. Nonetheless, the Proposed Action's structures and layout (i.e., lacking 1 x 1 nautical mile spacing and not aligned in east-west rows and north-south columns) could make it more difficult for SAR aircraft to perform operations in the lease area, leading to less effective search patterns or earlier abandonment of searches. This could lead to increased loss of life due to maritime incidents. Vineyard Wind's Marine Coordinator would liaise with the Department of Defense and Department of Homeland Security to reduce potential conflicts. These actions would improve safety but would not remove the navigational hazard associated with installing WTGs in the open ocean. The navigational hazard would be gradually eliminated during decommissioning as structures are removed. Overall, presence of stationary structures within the WDA would cause localized, long-term, **moderate** impacts to SAR operations from increased navigational complexity and associated risks, but **minor** impacts to other military and national security uses.	Section 3.11 discusses navigation and vessel traffic. Impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased navigational complexity, changed navigational patterns for aircraft and vessels operating in the area around the WDA, increased collision/allision risk within the WDA, and increased difficulty in completing SAR missions within the WDA (potentially leading to increased fatalities from maritime incidents). Overall, the presence of stationary structures from the Proposed Action within the WDA would cause localized, long-term, **moderate** impacts on USCG SAR operations from increased navigational complexity and associated risks, but **minor** impacts on other military and national security uses. Additions of stationary structures associated with ongoing and future non-offshore wind activities would continue primarily onshore and would include communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 775 WTGs and 20 ESPs proposed for construction within the RI and MA Lease Areas before 2030. In the context of reasonably foreseeable environmental trends, combined impacts on military and national security uses from this sub-IPF associated with the Proposed Action and ongoing planned actions would be regional, long-term, and **major** on USCG **SAR** operations due to the larger area affected by other offshore wind projects compared to the WDA. All onshore or offshore structures that exceed 200 feet (61 meters) in height and are located in U.S. territorial waters would require submitting Form 7460-1 to the FAA, and military and national security interests would be invited to comment through the FAA review process. BOEM conducted extensive coordination with the Department of Defense throughout the RI and MA Lease Areas identification process and associated environmental review to identify and mitigate potential concerns, and will continued to coordinate with the military and national security agencies throughout development of future offshore wind projects in the RI and MA Lease Areas. Other offshore wind operators would be required act to coordinate with military and national security interests during the development of the project COPs and during construction, operations, and decommissioning, to identify and mitigate impacts of offshore wind development. Collectively, these actions would improve safety but would not remove the navigational hazard associated with installing WTGs in the open ocean. In the context of reasonably foreseeable environmental trends and planned actions, impacts are anticipated to be **minor**, but impacts to USCG SAR would be **major** because impacts would occur over the entire MA and RI leased areas, and not just limited to the WDA.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			Navigational hazards would gradually be eliminated when structures are removed during decommissioning.		
Presence of structures: Space use conflicts	Existing stationary facilities within the geographic analysis area that present a navigational hazard include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.	Construction and operation of the project structures—primarily 718 WTGs—would change long-term navigational patterns in and around RI and MA Lease Areas during each project's 30-year operational period, potentially concentrating vessels around the outsides of the leased areas, increasing the risk of collisions among military, national security, and civilian vessels. Warning area W-105A overlies the majority of the OCS-A 0500 and all of OCS-A 0520, OCS-A 0521, and OCS-A 0522. These projects could affect military and national operations conducted in the warning area. BOEM would work with the USAF to identify strategies to de-conflict these concerns through conditions of COP approval. Space use conflicts would decrease during decommissioning as structures are removed.	Access to portions of the WDA would be restricted during construction, and presence of WTGs would change long-term navigational patterns in and around the WDA during the 30-year operational period. Space use conflicts could occur as military and national security vessels, commercial vessels, and recreational vessels route around project facilities. Military traffic within the WDA is relatively low (four vessels recorded within the WDA between 2016 and 2017). BOEM coordinated with Department of Defense throughout the leasing area identification process, environmental review process for the RI and MA Lease Areas, and the COP development and approval process to minimize conflicts with military and national security concerns (Fred Engel, Pers. Comm., September 13, 2018; Military Aviation and Installation Assurance Siting Clearinghouse 2020). Addition of 57 WTGs within the WDA could affect operations within a portion of W-105A. The USAF indicated they were willing to concur with the Proposed Action if structures can withstand daily sonic overpressures from supersonic operations, and potentially falling debris from chaff and flare, and if the USAF would not be held liable for damage to property or injury to personnel, BOEM will continue to work with the USAF to identify strategies to de-conflict these concerns through conditions of COP approval. Vineyard Wind's Marine Coordinator would liaise with the military and national security interests to reduce potential conflicts. Risks would be eliminated gradually during decommissioning as stationary structures are removed. Overall, presence of stationary structures within the WDA would cause localized, long-term, **minor** impacts from increased space use conflicts.	Impacts on military and national security uses from this sub-IPF under the Proposed Action would include potential space use conflicts between the Proposed Action structures within the WDA–primarily 57 WTGs—and military and national security exercises. Project construction would temporarily restrict access to portions of navigable areas within the WDA, and change long-term navigational patterns in and around the WDA during the 30-year operational period. However, military traffic in the WDA is relatively low. The Proposed Action could affect military operations within warning area W-105A; however, BOEM will continue to work with the USAF to identify strategies to de-conflict these concerns through conditions of COP approval. In addition, Vineyard Wind would hire a Marine Coordinator for the life of the Proposed Action to liaise with the military and national security interests to reduce potential conflicts. BOEM coordinated with Department of Defense throughout the leasing area identification process, environmental review process for the RI and MA Lease Areas, and the COP development and approval process to minimize conflicts with military and national security concerns (Fred Engel, Pers. Comm., September 13, 2018; Military Aviation and Installation Assurance Siting Clearinghouse 2020). Overall, presence of stationary structures from the Proposed Action within the WDA would cause localized, long-term, **minor** impacts from increased space use conflicts. Stationary structures associated with ongoing activities and future non-offshore wind activities would continue to be added, primarily onshore, including communications towers, onshore WTGs, and other developments. Onshore developments could cause additional space use conflicts with onshore military activities including in W-105A. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but increased with up to 775 WTGs and 20 ESPs proposed for construction within the RI and MA Lease Areas before 2030. In addition, as multiple projects are built, changing navigation patterns could concentrate vessels within designated navigation corridors and around the outsides of the RI and MA Lease Areas potentially causing space use conflicts in these areas and increasing the risk of collisions among military and national security vessels, commercial vessels, and recreational vessels. BOEM would continue coordination with military and national security agencies during development of each individual project's COP to identify and de-conflict potential concerns. In the context of reasonably foreseeable environmental trends, combined impacts on military and national security uses from this sub-IPF associated with the Proposed Action and ongoing and planned actions would be localized, long-term, and **minor**.
Presence of structures: Transmission cable infrastructure	Eight existing submarine cables are in the geographic analysis area, including submarine power cables between the mainland and Nantucket and Martha's Vineyard, and two cables that cross the far western side of OCS-A 0487.	Submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future.	Construction timeframes for the South Fork Wind Farm cable, the Bay State offshore cable, and future offshore wind farm cables would likely be staggered between 2022 and 2030. Military and national security vessels may need to navigate around construction sites. While projects are operational, transmission cables would be passive structures on the seafloor, and would potentially affect military and national security operations during infrequent cable maintenance events. The Navy has raised concerns about impacts on naval operations from deployment of distributed acoustic sensing (DAS) technology through fiber optic	Military and national security vessels may need to navigate around the Proposed Action's temporary construction sites. Cable maintenance activities during the 30-year operational period would be infrequent. As a condition of the COP, Vineyard Wind would coordinate with the Department of Defense and the Department of the Navy on any proposal to utilize DAS to address impacts on naval operations. Vineyard Wind's Marine Coordinator would liaise with the military and national security interests to reduce potential conflicts. Impacts on military and national security uses would be localized, temporary, and **negligible**.	Impacts on military and national security uses from this sub-IPF under the Proposed Action would include military and national security vessels having to route around cable construction vessels along the cable routes and within the WDA, and during infrequent cable maintenance events. Impacts from construction and operation from the Proposed Action would be localized, temporary, and **negligible** due to the temporary nature of construction along the cable routes, the anticipated rarity of cable maintenance events, and ongoing coordination with military and national security interests. Ongoing activities and future non-offshore wind activities are limited to infrequent maintenance events along existing submarine cables within the geographic analysis area. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but located at the Bay State and South Fork Wind Farm cable routes and at currently unknown cable routes associated with other lease areas offshore of Massachusetts and Rhode Island. Construction of cable routes associated with other wind developments would likely be staggered temporally, further minimizing risk to military operations. BOEM assumes all offshore wind project operators would coordinate with the Department of Defense and the

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			cables in the submarine cable system. Similar to the proposed Project, it is assumed that other future offshore wind project operators would coordinate with the Department of Defense and the Navy on any proposal to use DAS.		Navy on any proposed uses of DAS to address impacts on Navy operations, as required by conditions in the COP. In the context of reasonably foreseeable environmental trends, combined impacts on military and national security from the presence of cables associated with the Proposed Action and ongoing and planned actions would be localized, temporary, and **negligible**.
Traffic: Vessels	Current vessel traffic in the region is described in Section 3.11. Vessel activities associated with offshore wind in the expanded planned action scenario is currently limited to site assessment surveys.	Continued vessel traffic in the region, as described in Section 3.11.	See Section 3.11.2. Vessel traffic could cause military and national security to change routes, and could cause congestion and delays in port and within transit routes, particularly during construction (between 2022 and 2030) and decommissioning, when vessel traffic would be highest, particularly if construction periods overlap. Operational traffic would occur at lower, consistent levels over the 30-year operational timeframes for each project. Operational traffic volumes would be small compared to existing civilian vessel traffic in the region.	See Section 3.11.2. Vessel traffic associated with construction and decommissioning of the Proposed Action could cause military and national security vessels to change routes, and could cause congestion and delays in port and within transit routes. Vineyard Wind would coordinate with the Navy and USCG during all phases of the proposed Project to minimize conflicts within the WDA, along transit routes, and within ports. Operational vessel traffic would be similar to existing civilian vessel activity in and near the WDA. Impacts on military and national security from Proposed Action-related vessel traffic would be localized, temporary, and **minor** during construction and decommissioning and **negligible** during operations.	See Section 3.11.2. The Proposed Action's vessel traffic could cause military and national security vessels to change routes or experience congestion and delays in port and within transit routes. Risks under this sub-IPF would be highest during project construction and decommissioning when vessel traffic associated with the Proposed Action would be highest, and risks would be lowest during operations when Proposed Action vessel traffic would be similar to civilian vessel traffic in the area. Impacts from the Proposed Action on military and national security vessels would be localized, temporary, and **minor** during construction and decommissioning, and **negligible** during operations, considering ongoing coordination with military and national security interests. Current levels of vessel traffic are discussed in Section 3.11.1. Vessel traffic from each future offshore wind project would be similar to the Proposed Action, although as many as five projects could be under construction simultaneously in 2024. Operational traffic volumes from each offshore wind project would be small compared to existing civilian vessel traffic in the region. In the context of reasonably foreseeable environmental trends, combined impacts—most likely to occur during construction and decommissioning timeframes—associated with the Proposed Action and ongoing and planned actions would be localized, temporary, and **minor**.
Traffic: Vessels, collisions	Current vessel traffic in the region is described in Section 3.11. Vessel activities associated with offshore wind in the MA and RI lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region is described in Section 3.11.	See the discussion of "Traffic: Vessels" above for a detailed description of vessel traffic from future offshore wind activities. During construction and operation, risks of collisions between military and national security vessels and offshore wind vessels would increase, particularly at port facilities and within transit routes.	See the discussion of "Traffic: Vessels" above for a detailed description of vessel traffic associated with the Proposed Action. Vessel traffic associated the Proposed Action could increase collision risk among project vessels and military and national security vessels during construction and decommissioning. Impacts would be localized, temporary, and **negligible**.	See the discussion of "Traffic: Vessels" above for conclusions regarding vessel traffic. The impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased collision risks. These impacts would occur mostly during construction and decommissioning, and would be localized, temporary, and **negligible**. Similar to the discussion above for the Traffic: Vessels sub-IPF, impacts are most likely to occur during construction and decommissioning associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, and would be localized, temporary, and **negligible**.

Aviation and Air Traffic, Baseline Conditions: The geographic analysis area includes airspace and airports used by regional air traffic. Generally, an area roughly bounded by Montauk, New York; Providence, Rhode Island; and Provincetown, Massachusetts, and within a 10-mile (16.1-kilometer) buffer from wind lease areas in the RI and MA Lease Areas. Numerous public and private-use airports are in the region. Major airports serving the region include Boston Logan International Airport, approximately 90 miles (145 kilometers) north of the WDA, and T.F. Green Airport in Providence, Rhode Island, approximately 65 miles (105 kilometers) northwest of the WDA. The closest public airports to the WDA are Nantucket Memorial Airport on Nantucket, and Katama Airpark and Martha's Vineyard Airport, both located on Martha's Vineyard. Private airports or airstrips proximate to the proposed Project area are located on Tuckernuck Island and Martha's Vineyard (Trade Wind Airport). Other public and private airports and heliports are located on the mainland. Military air traffic use the area, and government and other private aircraft may occasionally fly over the WDA for data collection and SAR operations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Navigation hazard	Existing aboveground stationary facilities within the geographic analysis area that present navigational hazards include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore development activities are anticipated to continue with additional proposed communications towers.	Addition of 718 WTGs with maximum blade tip heights of up to 853 feet (260 meters) AMSL, stationary and vessel-mounted construction cranes in ports during construction, and WTGs are anticipated to have a temporary height of up to 328 feet (100 meters) during assembly at construction staging areas would incrementally increase navigational complexity and necessitate changes in aircraft navigation patterns in the region around the leased areas offshore of Massachusetts and Rhode Island, increasing collision risks for low-flying aircraft. The	Addition of 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL within the WDA would increase navigational complexity and change aircraft navigational patterns around the WDA, increasing collision risks for low-flying aircraft during the Proposed Action's 30-year operational life. The WTGs would have navigational markings and lighting pursuant to FAA and BOEM requirements and guidance, and would be visible on the radar systems of low-flying aircraft. The WTGs could necessitate changes in some designated instrument flight routes for Nantucket Memorial Airport and other airports in	Impacts on aviation and air traffic from this sub-IPF under the Proposed Action would include increased navigational complexity and necessitate changes in aircraft navigation patterns around the WDA. Reasonably foreseeable consequences include increased collision risks for low-flying aircraft due to addition of up to 57 WTGs within the WDA, plus use of cranes in ports during the construction period. The WTGs would be visible on radar systems of low-flying aircraft, and would have obstruction marking and lighting in accordance with FAA and BOEM requirements and guidelines. Vineyard Wind would coordinate with air traffic interests to address airspace conflicts and changes to designated instrument flight routes at airports in the region, as identified during FAA review. Vineyard Wind's Marine Coordinator would also manage potential airspace conflicts. Impacts on aviation and air traffic are therefore anticipated to be localized, long-term, and **negligible**. Stationary structures associated with ongoing and future non-offshore wind activities would continue to be added, primarily onshore, and would include

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			WTGs would be visible on low-flying aircraft radar, and would have obstruction marking or lighting pursuant to FAA and BOEM requirements and guidance to reduce collision risk. BOEM assumes that all project operators would coordinate with aviation interests during permitting to minimize navigational hazards. This coordination would include notification to the FAA of construction activities, and the FAA would issue Notices to Airmen for each movement of a vessel carrying components that extend above a specified height along with Temporary Flight Restrictions associated with WTGs under construction in the WDA or in transit between ports and the WDA. Changes to airport flight routes may be required, and would be identified through FAA review or independent studies conducted by the project proponents. Navigational hazards and collision risks at ports and in transit routes would be reduced as construction is completed, and all navigation hazards and collision risks would be gradually eliminated during decommissioning as structures are removed.	the region. These changes would be confirmed during FAA review for the 14 MW WTGs located in U.S. territorial waters. More than 90% of existing air traffic over the WDA occurred at altitudes that would not be affected by the presence of WTGs. Pilots who choose to fly at lower altitudes over open ocean near the WDA would have to alter routes to avoid potential collisions with WTGs. Vineyard Wind's Marine Coordinator would also manage potential airspace conflicts. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed. Overall impacts on aviation and air traffic would be localized, long-term, and **minor**.	communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 775 WTGs with maximum blade tip height of up to 853 feet (260 meters) AMSL proposed for construction within RI and MA Lease Areas by 2030. Onshore or offshore construction projects with structures exceeding 200 feet (61 meters) in height (such as wind turbines and communication towers) and located in U.S. territorial waters are required to conduct FAA reviews or will conduct independent studies through which necessary changes to navigational patterns are identified, resulting in regional, long-term, and **minor** impacts on aviation and air traffic uses.
Presence of structures: Space use conflicts	Existing aboveground stationary facilities within the geographic analysis area that could cause space use conflicts for aircraft include the five WTGs associated with Block Island Wind Farm, onshore wind turbines, communication towers, and other onshore and offshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers.	See the discussion of Presence of structures: Navigation hazard sub-IPF above. Addition of WTGs and construction cranes would necessitate altering aviation navigation patterns near offshore wind facilities. These changes could compress lower-altitude aviation activity into more limited airspace around RI and MA Lease Areas, leading to airspace conflicts or congestion. Open airspace around RI and MA Lease Areas would still be available over the open ocean. Changes to airport flight routes would be identified and implemented through FAA review or independent studies conducted by project proponents. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed.	See the discussion of Presence of structures: Navigation hazard sub-IPF above. Construction of the Proposed Action would add 57 WTGs with maximum blade tip height of up to 837 feet (255 meters) AMSL to the WDA and would necessitate changes in aircraft navigation patterns at nearby airports, as described above in "Presence of structures: Navigation hazards." These changes could compress lower-altitude aviation activity into more limited airspace around the WDA, leading to airspace conflicts or congestion. Open airspace around RI and MA Lease Areas would still be available over the open ocean. Changes to airport flight routes may be required, and would be identified confirmed through FAA review for the 14 MW turbines located in U.S. territorial waters. Any space use conflicts would be gradually eliminated during decommissioning as structures are removed. Overall impacts on aviation and air traffic from space use conflicts would be localized, long-term, and **negligible**.	See the discussion of Presence of structures: Navigation hazard sub-IPF above. Impacts on aviation and air traffic from this sub-IPF under the Proposed Action could cause airspace conflicts or congestion with low-flying air traffic. Construction of the Proposed Action would require changes to aircraft navigation patterns at nearby airports. Open airspace around the RI and MA Lease Areas would still be available over the open ocean. Changes to airport flight routes would be identified and implemented through FAA review, and impacts on aviation and air traffic would be localized, long-term, and **negligible**. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed. Stationary structures associated with ongoing and future non-offshore wind activities would continue to be added primarily onshore and may include communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 775 WTGs with maximum blade tip height of up to 853 feet (260 meters) AMSL proposed to be constructed within RI and MA Lease Areas before 2030. The FAA review process would be used to identify and resolve space use conflicts for all structures exceeding 200 feet in height and located in U.S. territorial waters; potential space use conflicts related to other structures would be identified through independent studies conducted by project proponents. Airspace over open ocean would remain, resulting in regional, long-term, and **minor** impacts on aviation and air traffic.

Cables and Pipelines, Baseline Conditions: The geographic analysis area is within 1 mile (1.6 kilometers) of the OECC and WDA, and other undersea facilities and wind lease areas in RI and MA Lease Areas that could affect future siting or operation of cables and pipelines. The coastal region of Massachusetts and Rhode Island is served by the onshore electrical grid and a network of pipelines. Islands in the region, including Block Island, Martha's Vineyard, and Nantucket, are served by submarine power cables. Several transatlantic cables make landfall near Charlestown, Massachusetts. No offshore pipelines are in the region immediately surrounding the proposed Project.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Allisions and navigation hazards	Structures within and near the geographic analysis area that pose potential allision hazards include the five Block Island Wind Farm WTGs, meteorological buoys associated with offshore wind lease areas, and shoreline developments such as docks, ports, and other commercial, industrial, and residential structures.	Reasonably foreseeable non-offshore wind structures that could affect submarine cables have not been identified in the geographic analysis area.	WTGs, ESPs, and use of stationary lift vessels during construction could pose allision risks to vessels conducting maintenance activities on the two submarine cables that cross OCS-A 0487 (Sunrise Wind). Such risk would be rare due to infrequent submarine cable maintenance. Risk would increase during construction as structures are built out, be consistent during operations, and decrease to zero during decommissioning as structures are removed. Allision risks would be mitigated by implementing navigational hazard marking per FAA, BOEM, and USCG requirements and guidance, and by the 1 x 1 nautical mile spacing throughout the leased areas.	No existing submarine cables are within the WDA. The Proposed Action's 57 WTGs and two ESPs are not likely to pose an allision risk to vessels conducting maintenance activities at existing submarine cables near the WDA. Such vessels could route around or through the WDA, and impacts would be rare due to infrequent submarine cable maintenance. Risk would increase during construction as structures are built out, be consistent during operations, and decrease to zero through decommissioning as structures are removed. Impacts would be localized, temporary, and **negligible**.	Impacts on cables from this sub-IPF under the Proposed Action would include increased allision risk for vessels conducting maintenance activities at existing submarine cables as they transit through or near the WDA. Such impacts would be rare due to infrequent submarine cable maintenance, mitigated by implementing navigational hazard marking per FAA, BOEM, and USCG requirements and guidance, and mitigated by the 1 x 1 nautical mile spacing throughout the leased areas. Impacts from the Proposed Action would be localized, temporary, and **negligible**. Existing structures that pose allision risks are limited within the open ocean geographic analysis area. Increased allision risks to vessels conducting cable maintenance would be caused mainly by addition of WTGs and ESPs associated with future offshore wind activities in RI and MA Lease Areas. Cable maintenance vessels transiting through the leased areas and vessels conducting maintenance on the two submarine cables that cross OCS-A 0487 would be at risk of allisions, but risk would be mitigated by navigational hazard marking and implementation of the 1 x 1 nautical mile spacing throughout the leased areas. In the context of reasonably foreseeable environmental trends, combined impacts on vessels conducting cable maintenance in the geographic analysis area associated with the Proposed Action and ongoing and planned actions would be localized, temporary during rare cable maintenance events, and **negligible**.
Presence of structures: Space use conflicts	Eight existing submarine cables and no pipelines were identified in the geographic analysis area, including two submarine cables cross the far western portion of OCS-A 0487. These cables are associated with a larger network of submarine cables that make landfall near Charlestown, Massachusetts.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.	Presence of WTGs, inter-array cables, and inter-link cables could preclude additional submarine cable development through the wind development areas and require cables to route around the leased areas. Cable crossings could be accomplished using standard protection techniques. Impacts on submarine cables would be eliminated during decommissioning of offshore wind developments if export cables associated with those projects are removed.	No existing submarine cables are within the WDA. Construction of the Proposed Action could preclude future submarine cable development through the WDA, forcing future submarine cables, including future offshore wind export cables, to be routed around the WDA. Space use conflicts could be eliminated during decommissioning if structures are removed. Cables can be protected by standard techniques during construction, operations, and decommissioning; therefore, impacts would be localized, long-term, and **negligible**.	Under this sub-IPF, construction of the Proposed Action would preclude future submarine cables within the WDA, due to presence of WTGs and inter-array cabling. Submarine cables, including future offshore wind export cables, would need to be routed around the Proposed Action. Cables can be protected by standard techniques during construction, operations, and decommissioning; therefore, impacts from the Proposed Action would be localized, long-term, and **negligible**. Ongoing maintenance of existing submarine cables in the western portion of OCS-A 0487 would continue into the future, and future offshore wind activities would restrict future cable placement within developed areas of RI and MA Lease Areas. Reasonably foreseeable impacts would be the same as those for the Proposed Action, but more extensive. Because cables can be protected by standard techniques during construction, operations, and decommissioning, impacts would be localized, long-term, and **negligible**. Implementation of Anbaric's Southern New England OceanGrid Project could consolidate cables associated with offshore wind projects around RI and MA Lease Areas, reducing the potential for space- use conflicts between offshore wind export cables and existing submarine cables; however, this project is not considered reasonably foreseeable.
Presence of structures: Transmission cable infrastructure	Eight existing submarine cables and no pipelines were identified in the geographic analysis area, including two submarine cables cross the far western portion of OCS-A 0487. These cables are associated with a larger network of submarine cables that make landfall near Charlestown, Massachusetts.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.	Cables associated with future offshore wind developments would have to consider the location of existing cables during routing, including the South Fork Wind Farm cable and the Bay State offshore cable. Export cables associated with offshore wind developments would be able to cross existing cables using standard protection techniques. Impacts during project operations would be infrequent and limited to times when work at the cable crossings would be required.	The Proposed Action would use standard techniques during construction, operations, and maintenance to prevent damage to the National Grid Hyannis Port Jetties Beach submarine power cable, if the New Hampshire Avenue landfall site is selected. Impacts during Project operations would be infrequent and limited to times when work at the cable crossings would be required. Impacts would decrease to zero after decommissioning if cables are removed. Cables can be protected by standard techniques during construction, operations, and decommissioning; therefore, impacts would be localized, long-term, and **negligible**.	The Proposed Action under this sub-IPF is unlikely to affect existing submarine cables, because standard techniques can be used to protect both cables during construction, maintenance, and decommissioning where crossings occur. Ongoing activities and future non-offshore wind activities are limited to infrequent maintenance events along existing submarine cables within the geographic analysis area. Construction, operations, and decommissioning of the Proposed Action's export cables are not likely to affect existing submarine cables, because standard techniques can be used to protect both cables where crossings occur. As a result, the Proposed Action would have localized, long-term, **negligible** impacts on transmission cable infrastructure. Existing submarine cables and infrequent maintenance at those cables would continue into the future. Future offshore wind activities would add at least one export cable for each Project area. Impacts would be the same as those for the Proposed Action, but over a larger geographic area, affecting additional existing submarine cables. Because cables can be protected by standard techniques during construction, operations, and decommissioning, impacts on transmission cables from the Proposed Action when combined with future offshore wind projects, impacts would be localized, long-term, and **negligible**.

Radar Systems, Baseline Conditions: The geographic analysis area includes airspace used by regional air traffic. Generally, the geographic analysis area is an area roughly bounded by Montauk, New York; Providence, Rhode Island; and Provincetown, Massachusetts, and within a 10-mile (16.1-kilometer) buffer from wind lease areas in RI and MA Lease Areas. Commercial air traffic control radar systems, national defense radar systems, and weather radar systems operate in the proposed Project region. Military radar systems within the geographic analysis area include the Precision Acquisition Vehicle Entry/Phased Array Warning System installation at Joint Base Cape Cod. Other radar sites within the geographic analysis area include Boston Airport Surveillance Radar (ASR), Cape Cod Air Force Station Early Warning Radar, Falmouth ASR-8, Nantucket ASR-9, North Truro Air Route Surveillance Radar (ARSR)-4, Providence ASR-9, Riverhead ARSR-4, and Brookhaven WASR-88D (COP Volume III, Section 7.9.1.6; Epsilon 2020b). The closest NEXRAD (WSR-88D) facilities are near Boston, more than 90 miles (145 kilometers) from the WDA. The nearest NEXRAD system is approximately 60 miles (97 kilometers) north of the proposed Project. The FAA operates a Terminal Doppler Weather Radar installation at the Boston Logan International Airport approximately 90 miles (145 kilometers) north of the WDA. Rutgers University maintains a series of high-frequency radars that study ocean currents as part of the Mid Atlantic High Frequency Radar Network, including installations on Nantucket, Martha's Vineyard, and Block Island (Roarty 2020).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Navigation hazards	Wind developments in the direct line-of-sight with, or extremely close to, radar systems can cause clutter and interference. Existing wind developments in the area include scattered onshore wind turbines, and five WTGs in the Block Island Wind Farm.	Reasonably foreseeable non-offshore wind structures proposed for construction in the lease areas that could affect radar systems have not been identified.	WTGs installed in RI and MA Lease Areas between 2022 and 2030 would be located a sufficient distance from NOAA NEXRAD weather radar systems such that radar interference and mitigation would not be anticipated. Rutgers University indicates that the operational WTGs could affect signals from the Mid Atlantic High Frequency Radar Network (Roarty 2020). Development of offshore wind projects in the RI and MA Lease Areas could incrementally decrease the effectiveness of individual military radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs within the RI and MA Lease Areas could create a large geographic area of degraded radar coverage that could impact multiple radars. The Military Aviation and Installation Assurance Siting Clearinghouse review of the Proposed Action conducted in 2020 stated that such impacts could adversely affect NORAD's radar operations and defense of national critical infrastructure located in the same geographic areas (Military Aviation and Installation Assurance Siting Clearinghouse 2020). It is reasonable to assume that offshore wind projects near the Proposed Project may cause similar impacts. The FAA would evaluate potential impacts on aeronautical, military, and weather radar systems, as well as mitigation measures when project operators file Form 7460-1 for each WTG that exceeds 200 feet AMSL in height and is located in U.S. territorial waters. For WTGs not located in U.S. territorial waters, it is assumed that project proponents would conduct independent analyses in compliance with BOEM's recommendations for COP development. In addition, BOEM would continue to coordinate with the Military Aviation and Installation Assurance Siting Clearinghouse to review each proposed offshore wind project on a project-by-project basis, and attempt to de-conflict project concerns related to military and national	Construction of the Proposed Action would add up to 57 WTGs with maximum blade tip height of up to 837 feet (255 meters) AMSL to the WDA. A U.S. Department of Energy screening tool did not identify any potential conflicts between the Proposed Action and ground-based NEXRAD radars. The Proposed Action is outside of the instrumented range for the FAA's Terminal Doppler Weather Radar located at Boston Logan International Airport (COP Volume III, Section 7.9.2.1.2; Epsilon 2020b). Impacts to Falmouth ASR-9 and Nantucket ASR-9 are anticipated to be mitigated to an acceptable level by Radar Adverse Impact Management (RAM) and overlapping radar coverage. BOEM would include approval conditions in the COP regarding notification to NORAD of RAM scheduling, funding of RAM execution, and curtailment of Project operations for national security or defense purposes as needed. The FAA would evaluate potential impacts on aeronautical, military, and weather radar systems, as well as mitigation measures for those when Vineyard Wind refiles Form 7460-1 for individual WTGs located in U.S. territorial waters (see the "Aviation and Air Traffic" discussion above). Vineyard Wind's Marine Coordinator would liaise with military, national security, civilian, and private interests for the life of the Proposed Action to reduce potential radar conflicts. Impacts on radar systems from the Proposed Action would be localized, long-term, and **minor**.	Impacts on radar systems from this sub-IPF under the Proposed Action may include impacts on long-range radar systems that could be mitigated by overlapping coverage and radar optimization. No impacts on NOAA NEXRAD weather radar systems or the FAA's Terminal Doppler Radar System are anticipated from development of WTGs in the WDA, due to distance. Impacts to military and civilian radar facilities are not anticipated due to, ongoing coordination conducted by the Marine Coordinator, FAA, or project operator review of impacts on radar systems, and BOEM implementation of COP conditions to address potential impacts to the Falmouth ASR-8 and Nantucket ASR-9. Impacts on radar systems from the Proposed Action would be localized, long-term, and **minor**. Previous FAA review will have identified impacts on radar systems from existing structures exceeding 200 feet in height and located in U.S. territorial waters. The FAA would also review future non-offshore wind and offshore wind structures exceeding 200 feet in height and located in U.S. territorial waters, pursuant to filing of Form 7460-1, and specifically for each of the 775 WTGs proposed for construction within the RI and MA Lease Areas located in U.S. territorial waters. For WTGs located outside U.S. territorial waters, it is assumed that project proponents would conduct independent analyses in compliance with BOEM's radar-specific recommendations for COP development. In addition, BOEM would continue to coordinate with the Military Aviation and Installation Assurance Siting Clearinghouse to review each proposed offshore wind project on a project-by-project basis, and would attempt to de-conflict any concerns related to individual projects or multiple projects with COP approval conditions. These processes would identify potential impacts and any mitigation measures specific to radar systems for each WTG and impacts in the context of reasonably foreseeable environmental trends and planned actions on radar systems would be regional, long-term, and **moderate**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			security radar systems identified at that time with COP approval conditions—including concerns related to installation of multiple projects. Together, these analysis processes would identify potential impacts and any mitigation measures specific to radar systems for each WTG analyzed.		

Scientific Research and Surveys, Baseline Conditions: The geographic analysis area is the same as that provided for Finfish, Invertebrates, and Essential Fish Habitat (Section 3.3.1, Figure A.7-4) and includes the footprint of the Proposed Action and all reasonably foreseeable projects (as outlined in Appendix A) between Maine and mid-North Carolina. The geographic analysis area is reduced from what was considered in the DEIS—which also included areas southward to Florida—to better reflect the locations of scientific research and surveys similar to what is expected to occur within the WDA and OECC route.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Navigation hazards	Stationary structures are limited in the open ocean environment of the geographic analysis area, and include met buoys associated with site assessment activities, the five Block Island Wind Farm WTGs, and the two CVOW WTGs. Other lease areas within the geographic analysis area are not yet developed, and are in various stages of permitting.	Reasonably foreseeable non-offshore wind activities would not implement stationary structures within the open ocean environment that would pose navigational hazards and raise the risk of allisions for survey vessels and collisions for survey aircraft.	Construction of future offshore wind facilities would add up to 775 WTGs to the RI and MA Lease Areas and 1,059 WTGs outside the New England area, with a maximum blade tip heights of up to 853 feet (260 meters) AMSL to the geographic analysis area between 2022 and 2030. Collectively, these developments will prevent continued NMFS scientific research surveys under current vessel capacities and monitoring protocols in the geographic analysis area and may reduce opportunities for other NMFS scientific research studies in the area. Survey operations will be curtailed or eliminated under current vessel capacities and monitoring protocols. The need for survey vessels to navigate around large offshore wind projects to access survey stations would cause a loss of efficiency for surveys conducted outside the wind energy areas by reducing sampling time available with limited sea day allocations for survey vessels. Coordinators of large vessel survey operations or operations deploying mobile survey gear have currently determined activities within offshore wind facilities are not within their safety and operational limits. In addition, changes in required flight altitudes due to proposed turbine height will affect aerial survey design and protocols. BOEM acknowledges that NOAA's Office of Marine and Aviation Operations endorses the restriction of large vessel operations to greater than 1 nautical mile from wind installations due to safety and operational challenges.	Construction of the Proposed Action would add up to 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL height to the WDA during the construction period. Presence of structures would pose navigational hazards and prevent sampling within the Vineyard Wind lease area. For Fish and Shellfish Research Programs, the Vineyard Wind lease area alone overlaps strata associated with three different coast-wide Northeast Fisheries Science Center fishery resource monitoring surveys. For the spring and fall multi-species bottom trawl surveys, 6% of the area in one stratum would be within the Vineyard Wind lease area. For the ocean quahog (*Arctica islandica*) survey, 3% of the area in one stratum would be within the lease area. For the Protected Species Research Programs, aerial survey track lines at the altitude used in current cetacean and sea turtle abundance surveys (600 feet AMSL) could not occur in the WDA due to safety concerns. Overall, the Proposed Action is anticipated to have **major** impacts on scientific surveys, potentially leading to impacts on fishery participants and communities (Sections 3.6.2 and 3.10.2), and potential **major** impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.	Overall, the Proposed Action is anticipated to have **major** impacts on scientific surveys, potentially leading to impacts on fishery participants and communities (Sections 3.6.2 and 3.10.2), and potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species. In the context of reasonably foreseeable environmental trends and planned actions, the NMFS Northeast Fisheries Science Center will require significant resources to quantify and account for the complexity and scope of effects on NMFS core scientific surveys and the management advice that relies on these surveys, and to implement necessary survey adaptations. Potential challenges include identification of appropriate sampling protocols and technology, development and establishment of parameters for new statistical survey models, and calibration of new approaches to existing ones in order to continue to sample within areas occupied by turbine foundations and submarine cables. The expanded planned action scenario for the NMFS scientific surveys presented in this document has not been fully assessed, but preliminary analyses of the effects on survey areal coverage demonstrate substantial impacts on NMFS' ability to continue using current methods to fulfill its mission of precisely and accurately assessing fish and shellfish stocks for the purpose of fisheries management, and assessing protected species for the purpose of protected species management. Changes to protected species survey methodologies could introduce biases or inaccuracies that could impact marine mammal abundance estimates and dedicated NARW studies. These changes could result in management implications for NARW and other protected species, as well as for fisheries and shipping industries that impact these species. Similarly, changes to existing survey methodologies or disruption to the long-term survey time series of fish and shellfish will have implications for stock assessments by increasing uncertainty in biomass estimates and other parameters used in projecting fishery quotas. Uncertainty in estimating fishery quotas could lead to unintentional underharvest or overharvest of individual fish stocks, which could have both beneficial and adverse impacts on fish stocks, respectively. Based on existing regional Fishery Management Councils' acceptable biological catch control rule processes and risk policies (e.g., 50 CFR §§ 648.20 and 21), increased assessment uncertainty would likely result in lower commercial quotas that may reduce the likelihood of overharvesting and mitigate associated biological impacts on fish stocks. However, such lower quotas would result in lower associated fishing revenue that would vary by species, which could result in impacts on fishing communities. Development of new survey technologies, changes in survey methodologies, and required calibrations may help to mitigate losses in accuracy and precision of current practices due to the impacts of wind development on survey strata. Until a plan is established to holistically mitigate impacts to NMFS core surveys, information generated from project-specific monitoring plans may be required to supplement or complement existing survey data. Such monitoring plans must be developed in a comprehensive and integrated manner consistent with NOAA and NMFS' long-standing surveys. In order to address this need, these fisheries monitoring plans should be developed collaboratively

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
					with NOAA and NMFS and incorporate NMFS survey standards and requirements to ensure collected data are usable. To address the proposed Project's impacts on NMFS trust responsibilities under MSA, ESA, and MMPA, NMFS, in partnership with BOEM, is considering a mitigation program to establish resources for the NMFS Northeast Fisheries Science Center to design and implement effective survey adaptations. The intent of this mitigation program would be to minimize or avoid adverse consequences from the proposed Project. If successful, this mitigation program could potentially be applied to future offshore wind projects. Specifically, NMFS recommends implementation of a mitigation program that includes the specific elements listed below to address the proposed Project's adverse impacts on the multi-species bottom trawl surveys, Atlantic scallop surveys, ocean quahog and Atlantic surf clam surveys, ecosystem monitoring surveys, marine mammal and sea turtle ship-based and aerial surveys, and NARW aerial surveys. While this mitigation is focused on the proposed Project, impacts from future offshore wind projects on NOAA scientific surveys would be mitigated through future coordination between BOEM and NOAA, as well as measures included in future NEPA analyses. Overall, BOEM anticipates that the Proposed Action, when combined with other past, present, and reasonably foreseeable activities, would have **major** impacts on NMFS' scientific research and surveys and the resulting stock assessments, which could lead to potential beneficial and adverse impacts on fish stocks when management decisions are based on biased or imprecise estimates of stock status (Sections 3.6.2 and 3.10.2 for additional discussion about economics and commercial fisheries). Construction and decommissioning of the Proposed Action could lead to increased opportunities to study impacts of construction and operation of the offshore components, perform other oceanographic research, and develop or adapt new approaches to research including but not limited to use of unmanned aerial vehicles or vessels, and remote sensing and digital technologies. Operations and maintenance activities may present an opportunity to collaborate with researchers on data collection, thus potentially reducing survey costs. NOAA's Unmanned Systems Strategy (NOAA 2020a), which aligns with the Commercial Engagement Through Technology Act of 2018 (Public Law 115-394) is intended to "directly improve the understanding, coordination, awareness and application of [unmanned systems].In addition, sampling, monitoring, and/or research contributions from the offshore wind industry and other non-NOAA stakeholders could play a key role in development of innovative approaches that would enable to scientific research and surveys to continue in offshore wind development areas. These approaches and opportunities help inform certain types of scientific research and surveys in the long-term, but Alternative A would still have **major** effects on existing NMFS scientific research and surveys conducted in and around the WDA because long-standing surveys would not be able to continue as currently designed, and extensive costs and efforts will be required to adjust survey approaches, potentially leading to impacts on fishery participants and communities (Sections 3.6.2 and 3.10.2); as well as potential **major** impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species. The loss of precision and accuracy would be a significant hurdle, as new data collection methods are tested and become usable and robust over time. Implementing mitigation measures, including the development of survey adaptation plans, standardization and calibration of sampling methods, and annual data collections following new designs and methods, would help reduce uncertainty in survey data and associated assessment results and increase the utility of additional data collected as part of any required project-specific monitoring plan. In context of reasonably foreseeable environmental trends, ongoing and planned actions, including Alternative A, the overall impacts on scientific research and surveys would qualify as **major** because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas, with potential long-term and irreversible impacts on fisheries, the commercial fisheries community, protected species research, and programs for the conservation and management/recovery of fishery resources and protected species.

AMSL = above mean sea level; USAF = U.S. Air Force; BOEM = Bureau of Ocean Energy Management; CVOW = Coastal Virginia Offshore Wind; ESA = Endangered Species Act; ESP = electrical service platform; FAA = Federal Aviation Administration; FAD = fish aggregating device; IPF = impact-producing factor; met = meteorological; MMPA = Marine Mammal Protection Act; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NARW = North Atlantic right whale; NEPA = National Environmental Policy Act; NEXRAD = Next Generation Weather Radar; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OECC = Offshore Export Cable Corridor(s); OCS = outer continental shelf; RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; SAR = search and rescue; USCG = United States Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

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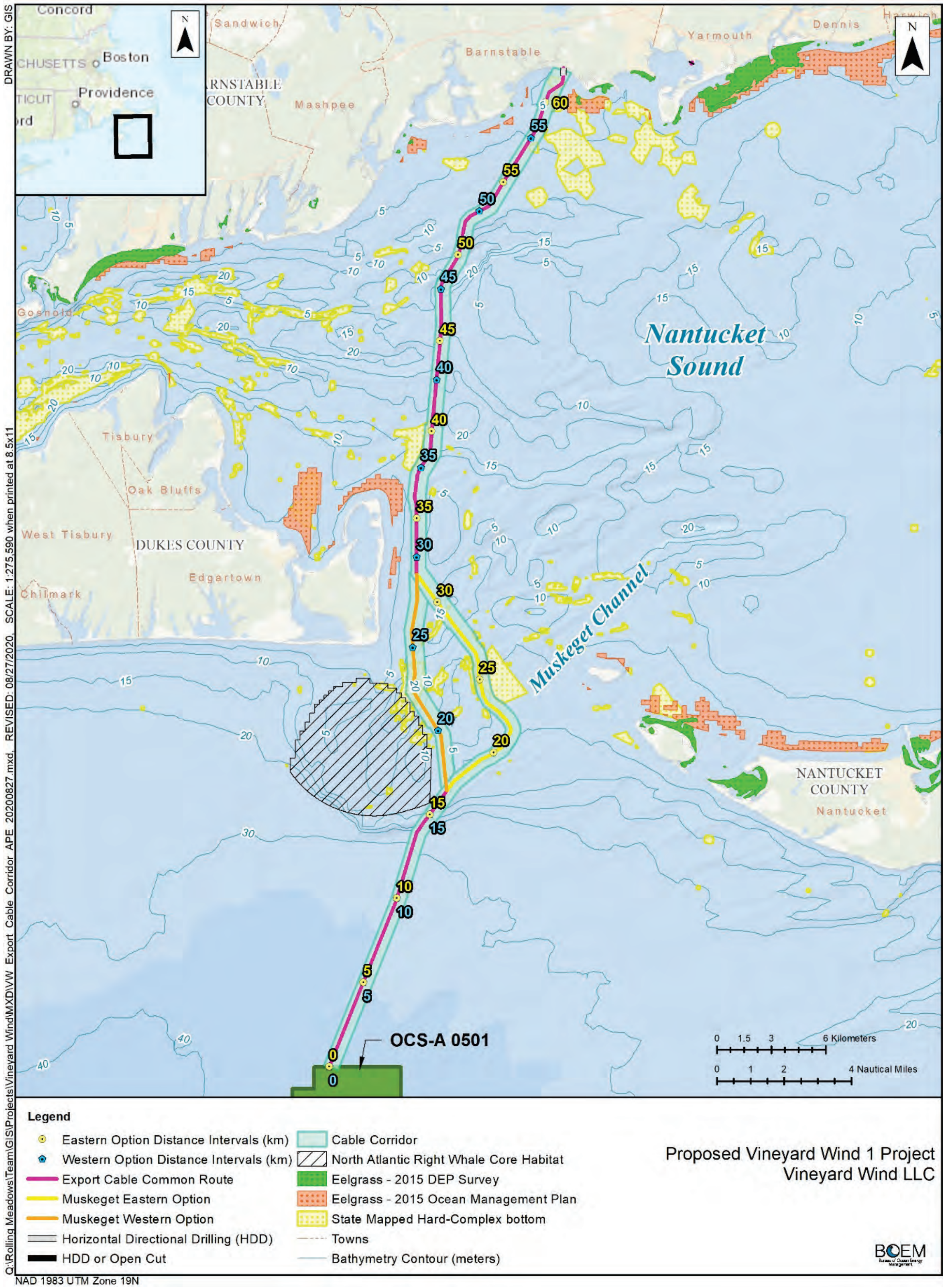
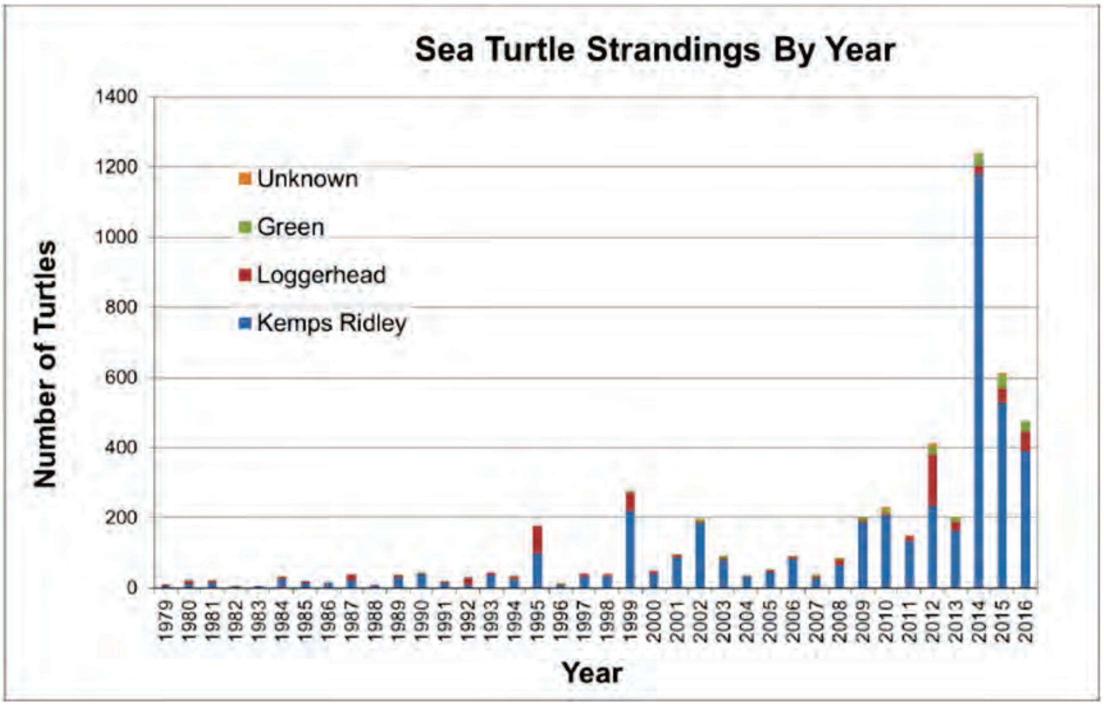
B.2. FIGURES



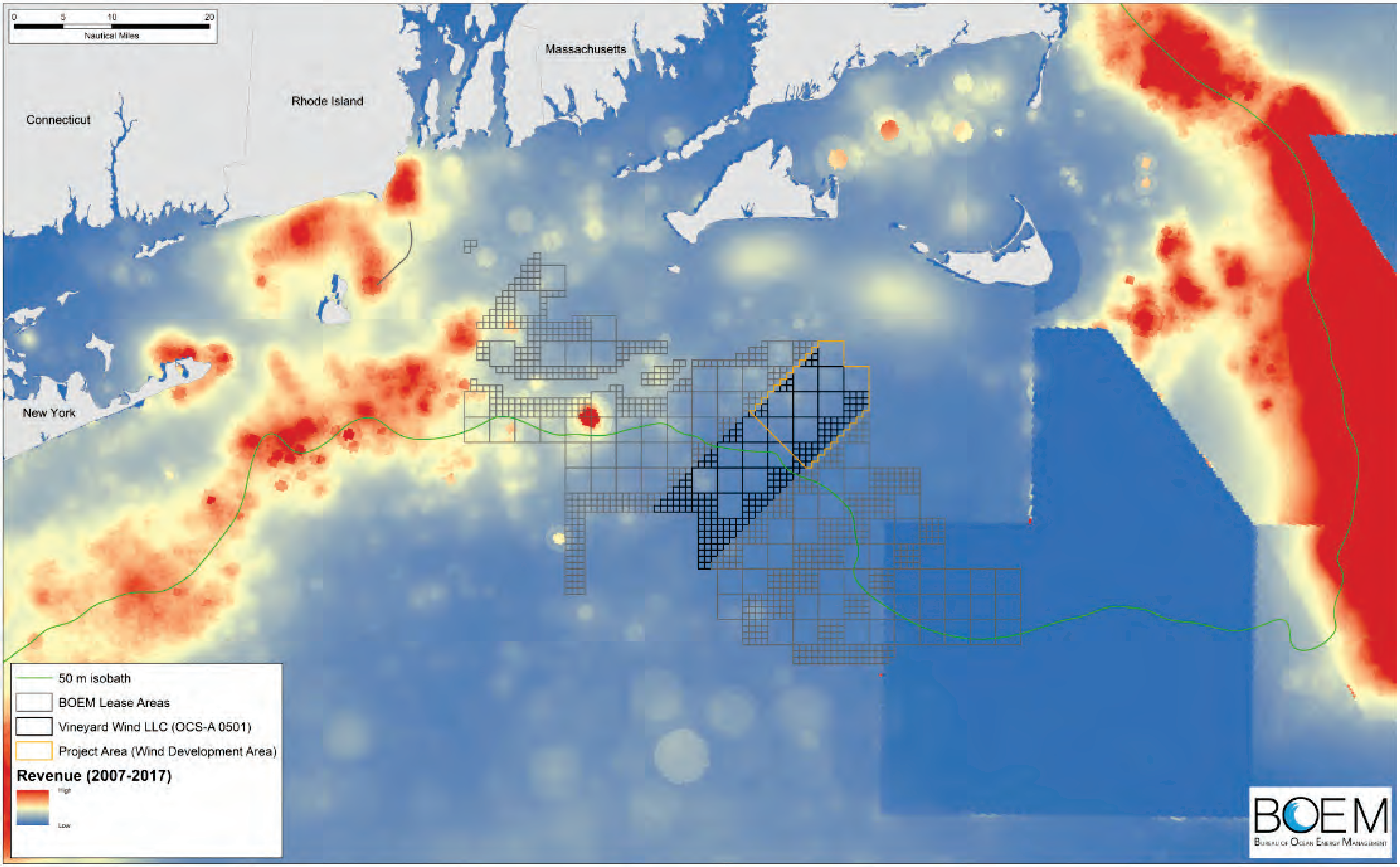
Figures E.3-1a to E.3-1e in Appendix E provide higher resolution maps based on 2018 survey data.

Figure 3.1-1: Previously Mapped Coastal Habitat Areas near the Proposed OECC



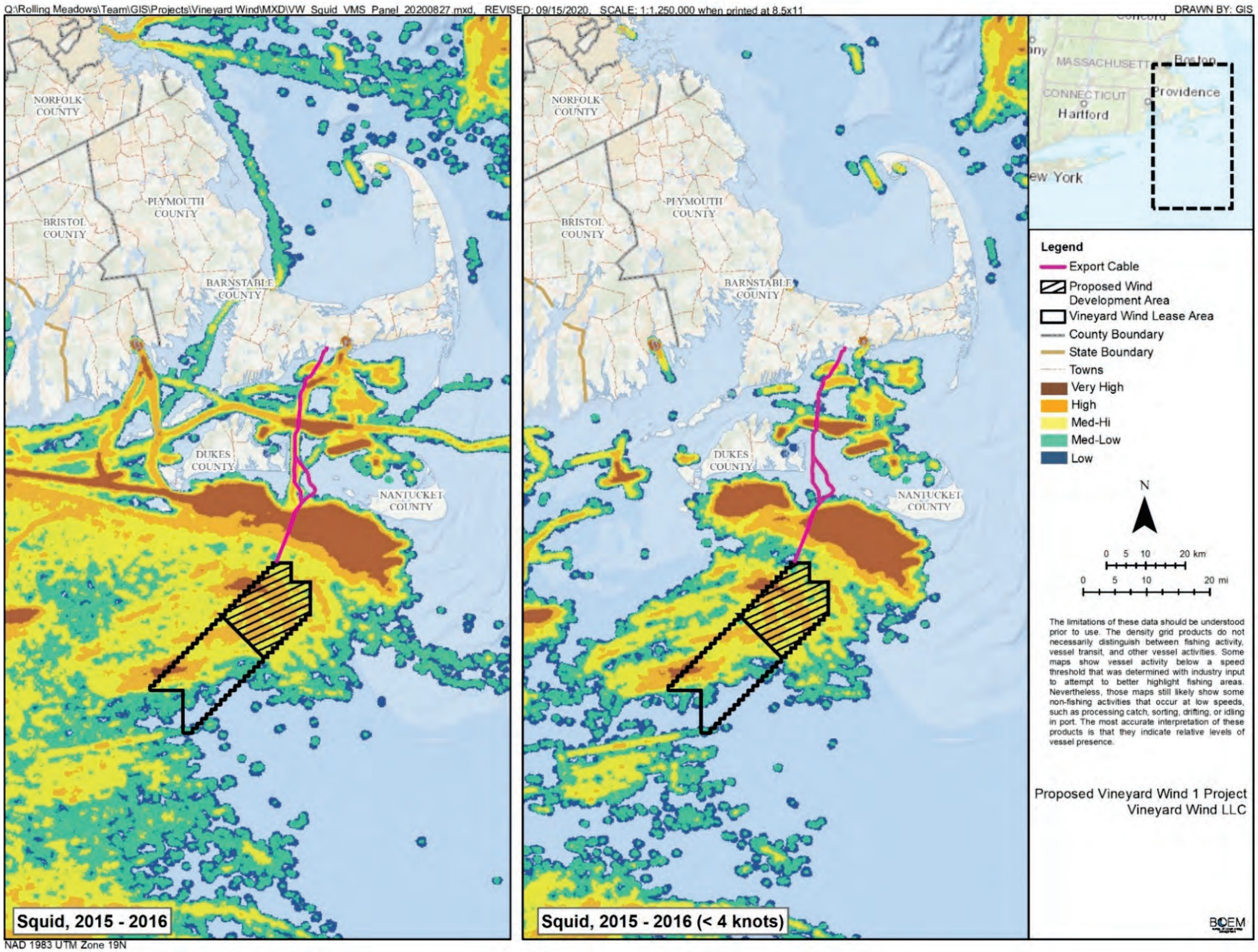
Source: WBWS 2018

Figure 3.5-1: Sea Turtle Strandings by Year on Cape Cod from 1979 through 2016



Note: Based on federally reported Vessel Trip Reports (VTRs) and conversion by Northeast Fisheries Science Center (G. DePiper, Pers. Comm., April 2019). The top 5% of revenue was clipped to lessen high-value scallop revenue skew of regional revenue. Without clipping, the top 5 percent areas important to lesser value fisheries would not appear. Removing the top 5% does not remove any areas that are not already represented in the red (high) end of the color ramp.

Figure 3.10-1: Fishing Intensity Based on Average Annual Revenue for Federally Managed Fisheries (2007-2017)



Source: Northeast Ocean Council Data 2018

Figure 3.10-2: Squid Fishing Vessel Density Based on VMS Data (2015-2016)

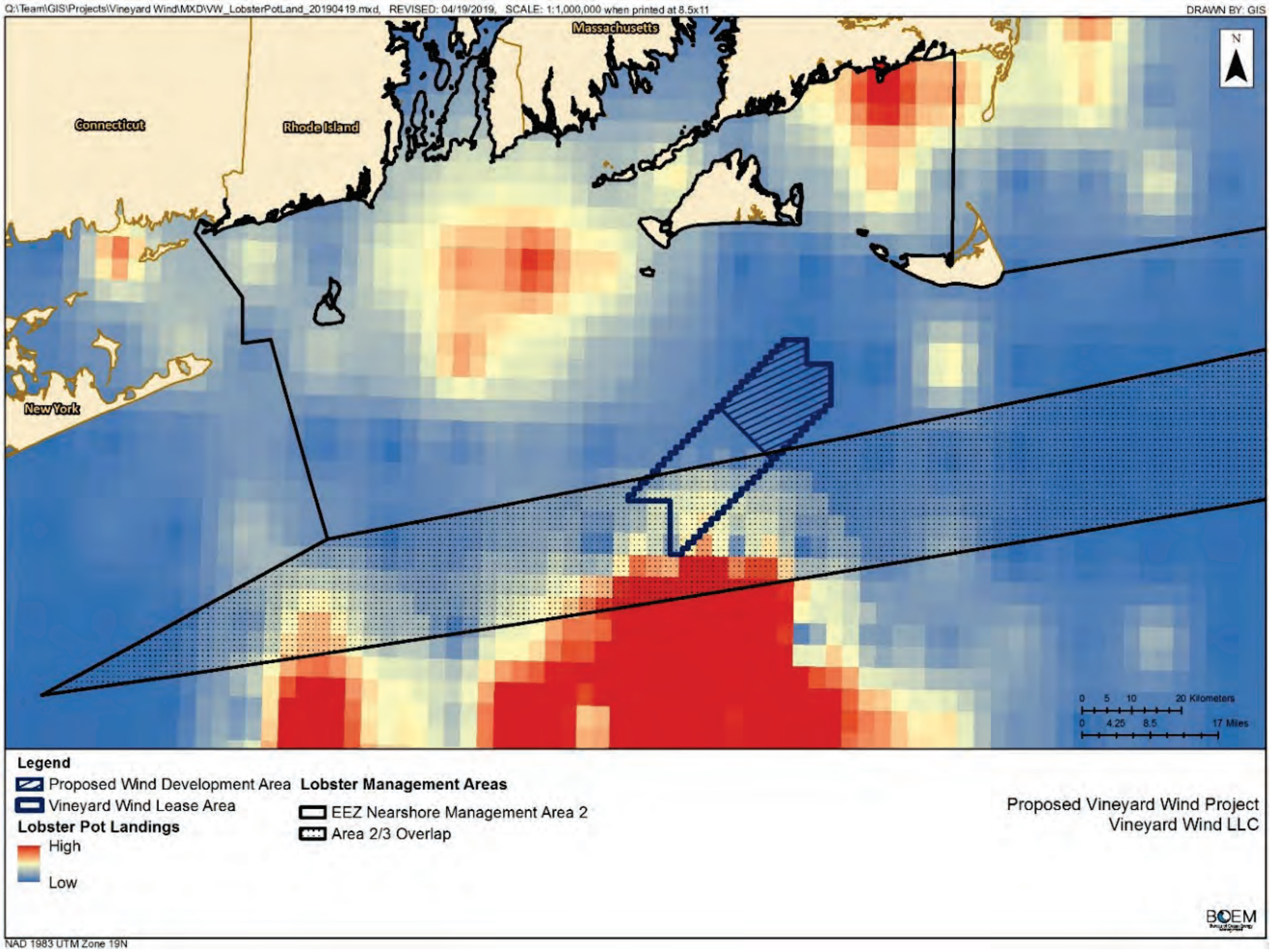
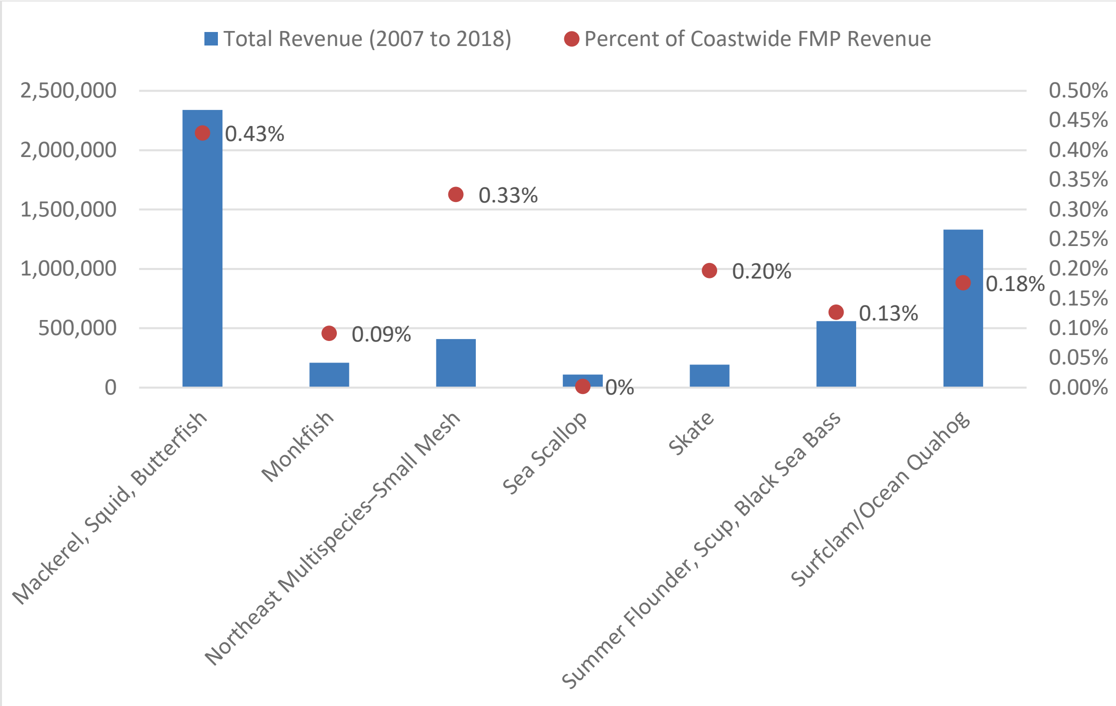
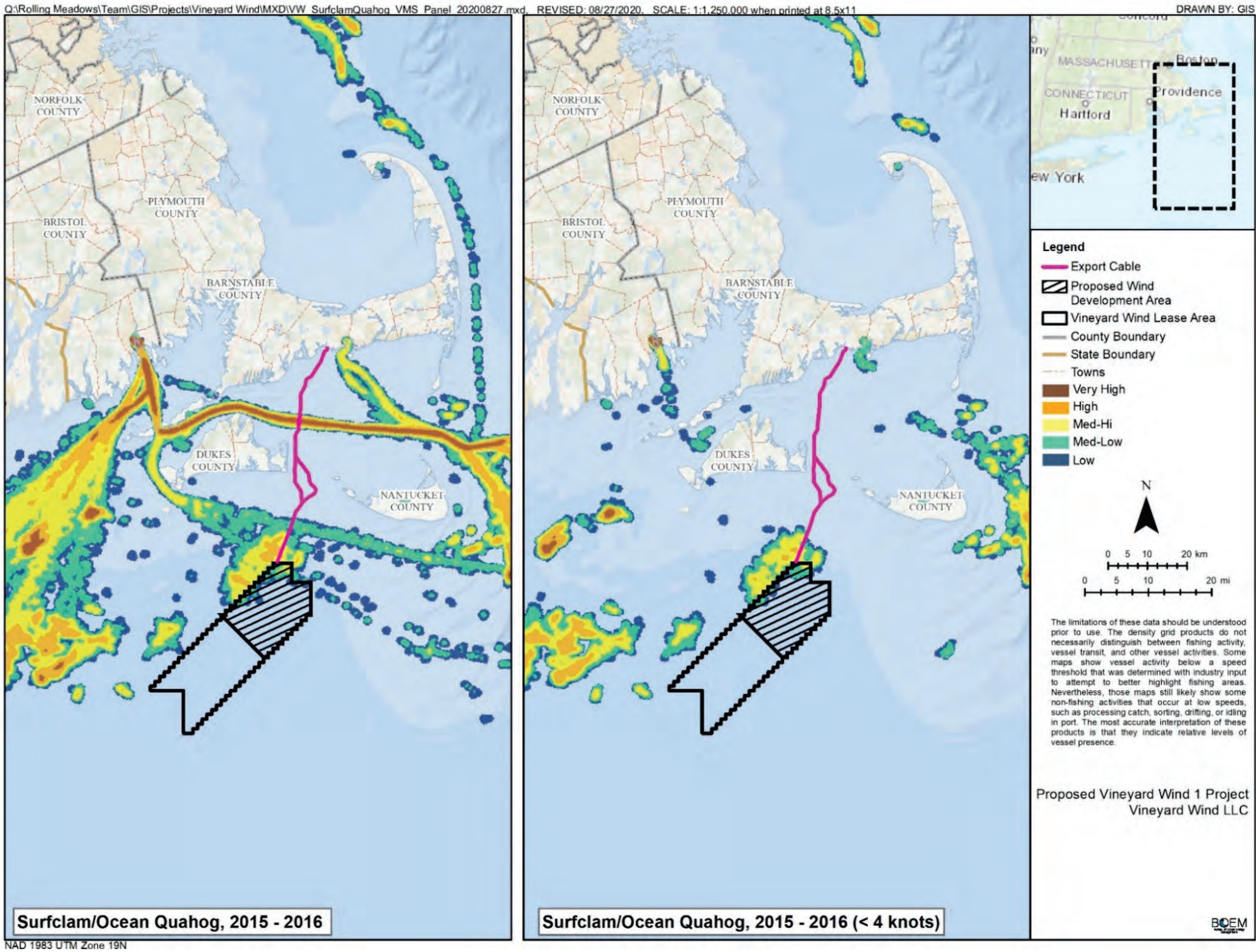


Figure 3.10-3: Lobster Pot Landings 2001-2010



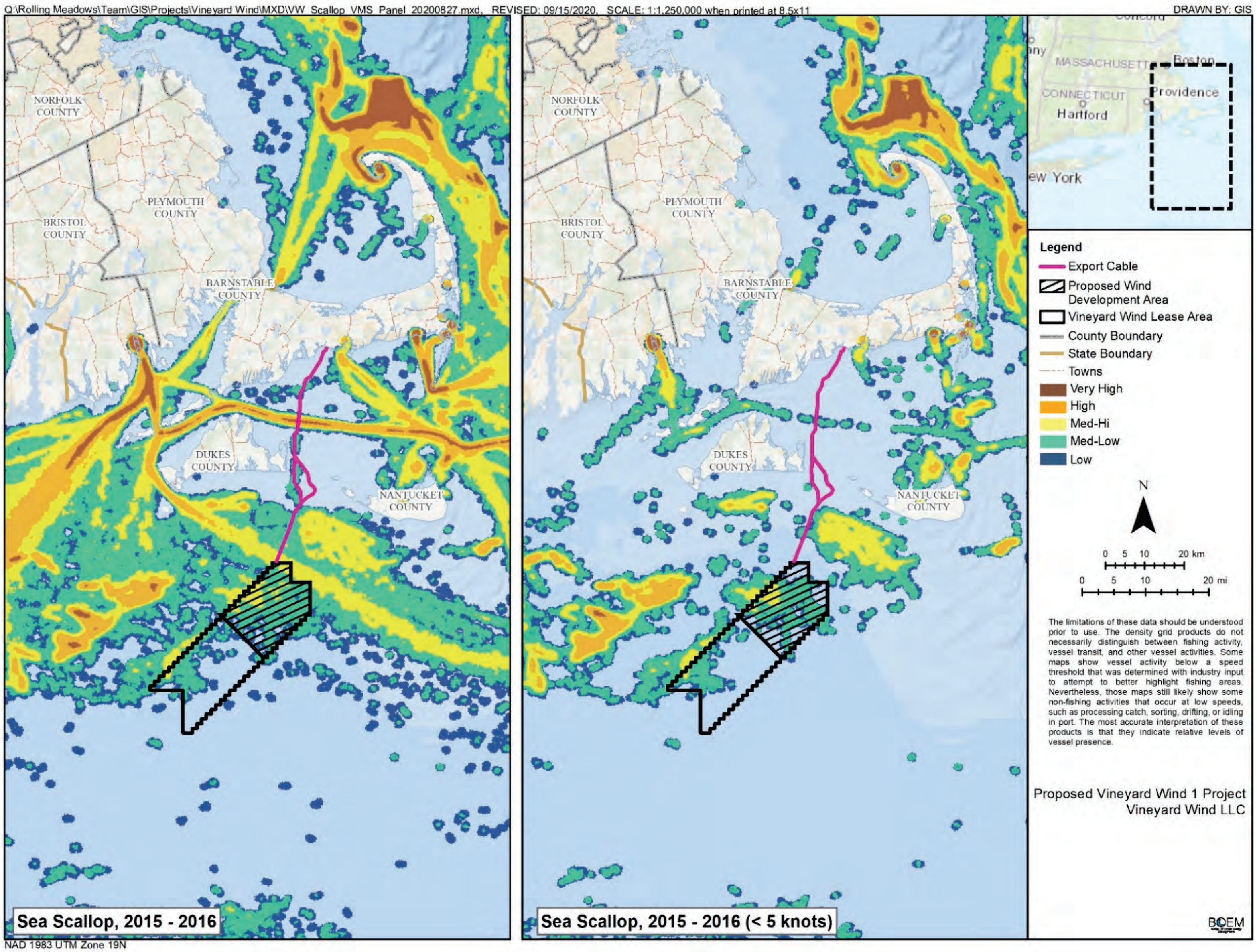
Notes: Revenue was converted to 2019 dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics.

Figure 3.10-4: Top Seven Fisheries Management Plans with Harvests from the WDA (2007-2018)



Source: Northeast Ocean Council Data 2018

Figure 3.10-5: Surfclam/Ocean Quahog Fishing Vessel Density Based on VMS Data (2015-2016)



Source: Northeast Ocean Council Data 2018

Figure 3.10-6: Sea Scallop Fishing Vessel Density Based on VMS Data (2015-2016)

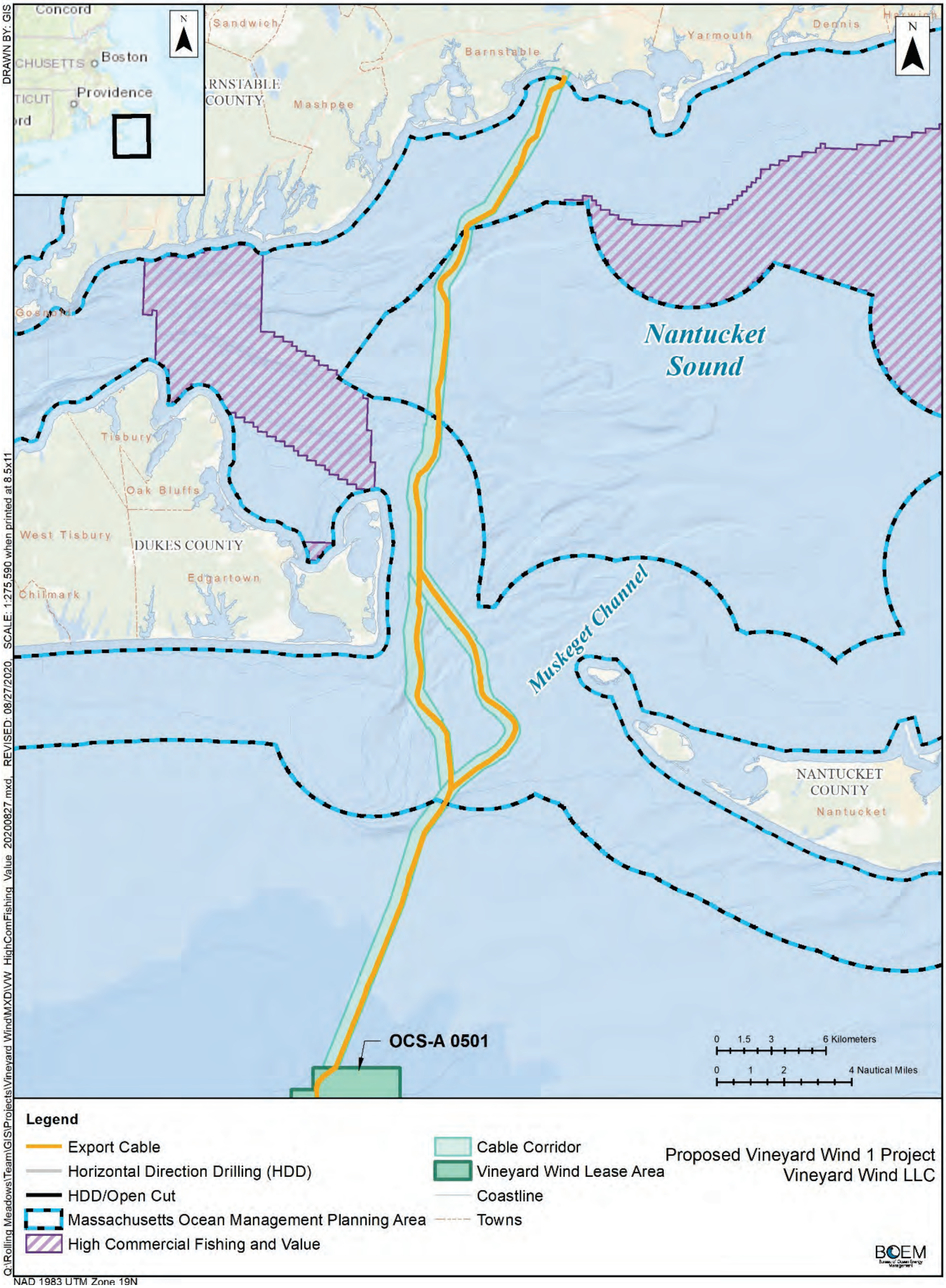
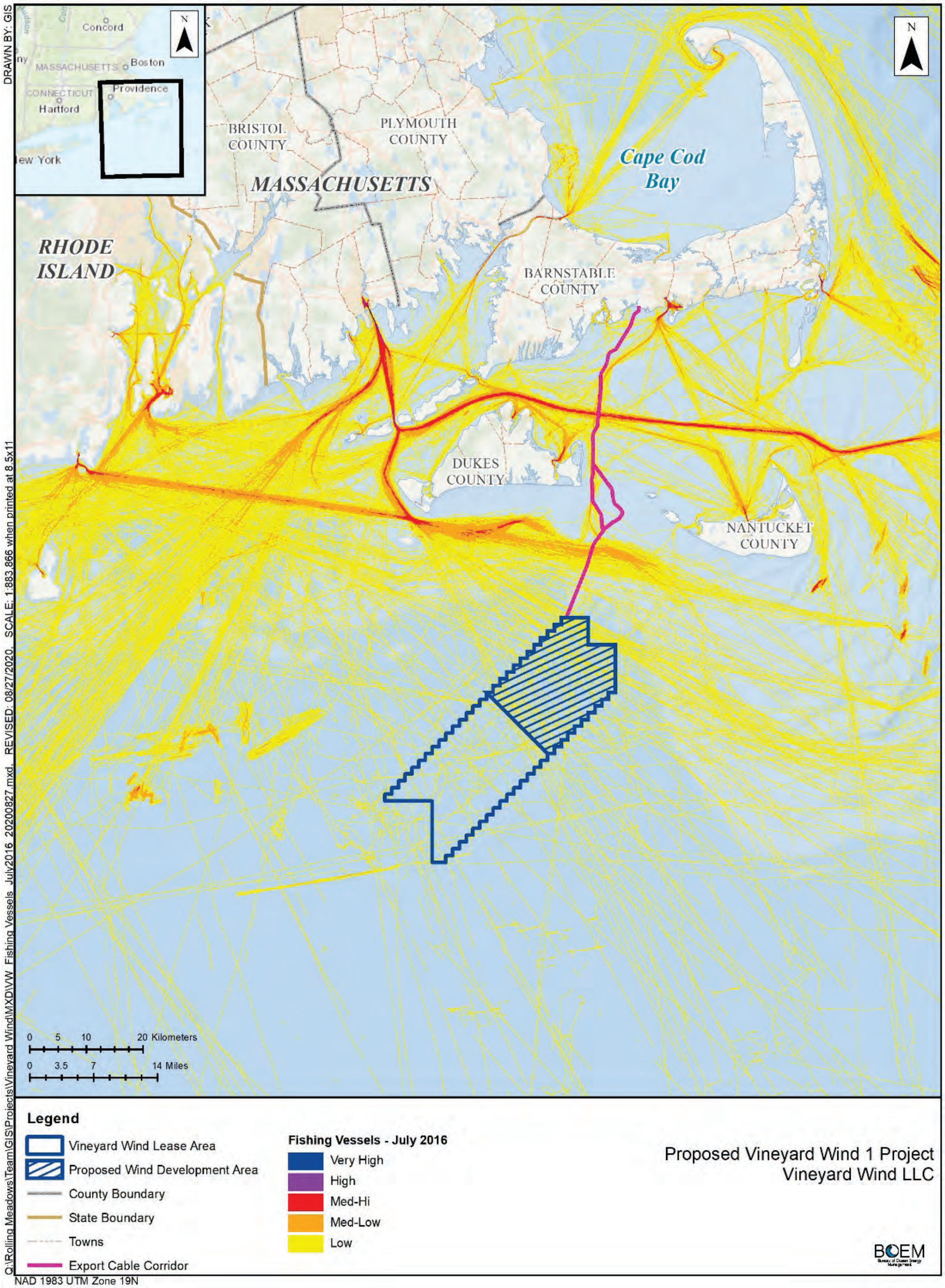
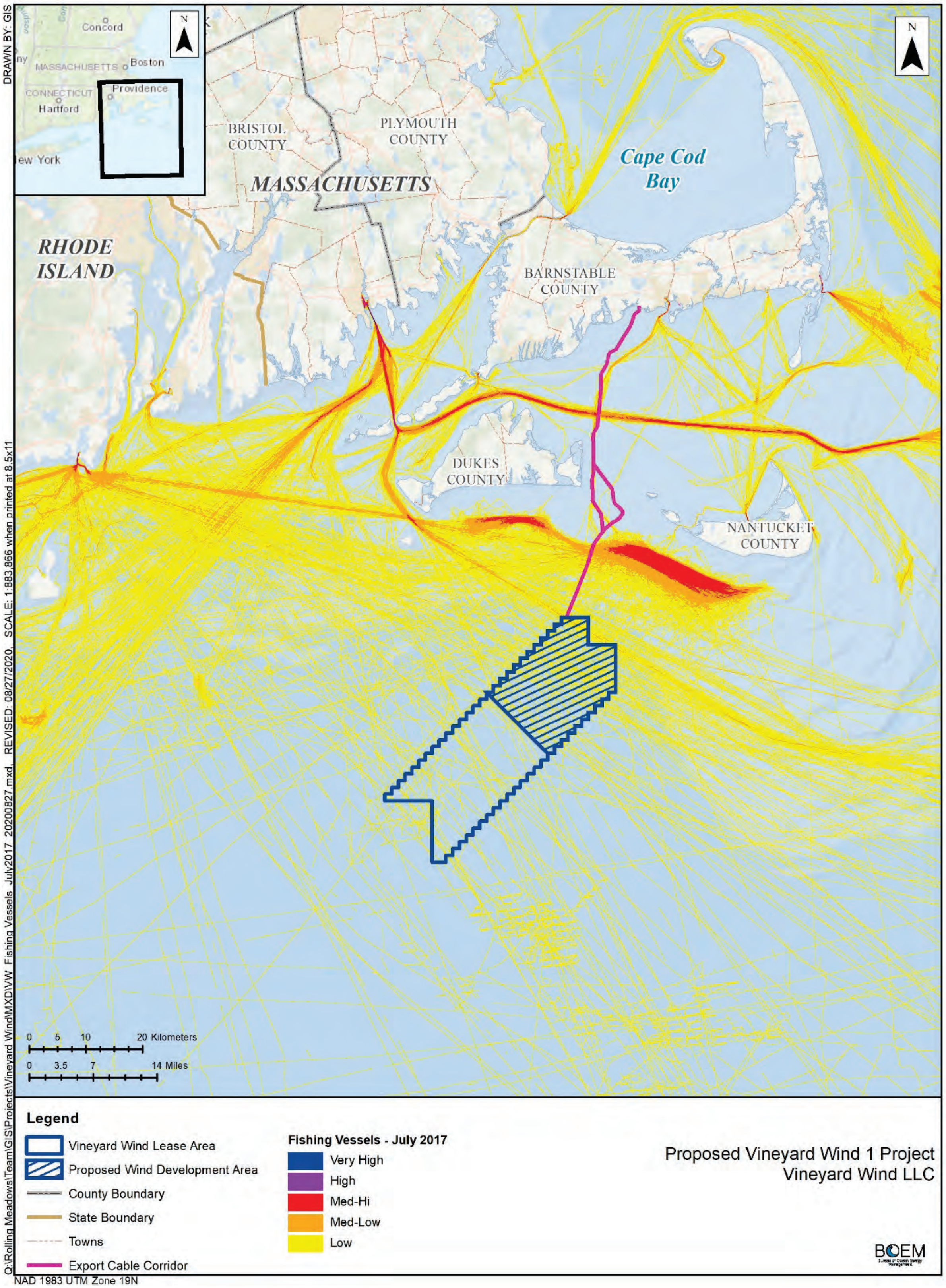


Figure 3.10-7: Massachusetts Ocean Management Plan Areas of High Commercial Fishing Effort and Value



Source: Northeast Ocean Council Data 2018

Figure 3.10-8: Fishing Monthly Vessel Transit Counts from 2016 AIS Northeast and Mid-Atlantic (July 2016)



Source: Northeast Ocean Council Data 2018

Figure 3.10-9: Fishing Monthly Vessel Transit Counts from 2017 AIS Northeast and Mid-Atlantic (July 2017)

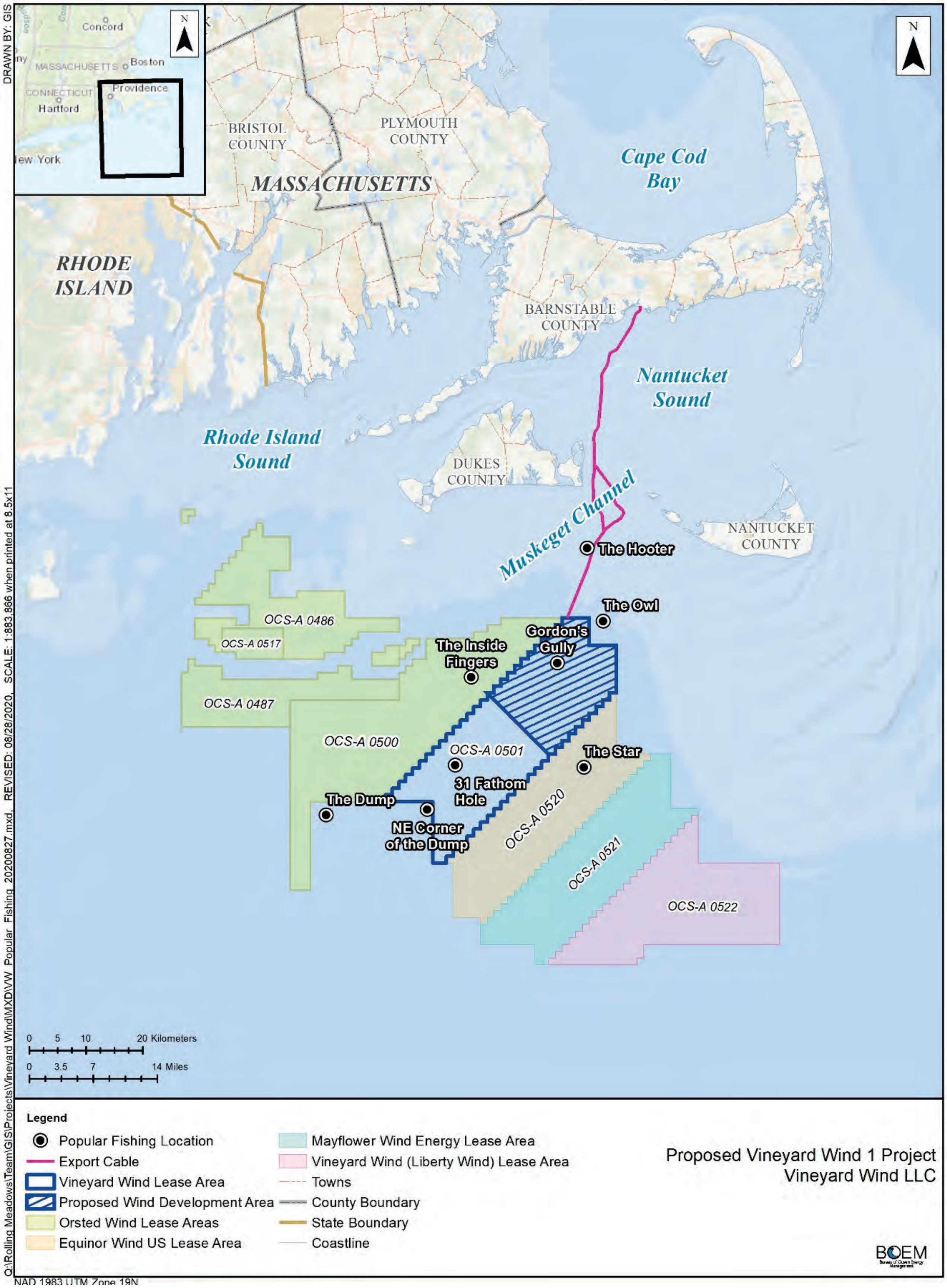
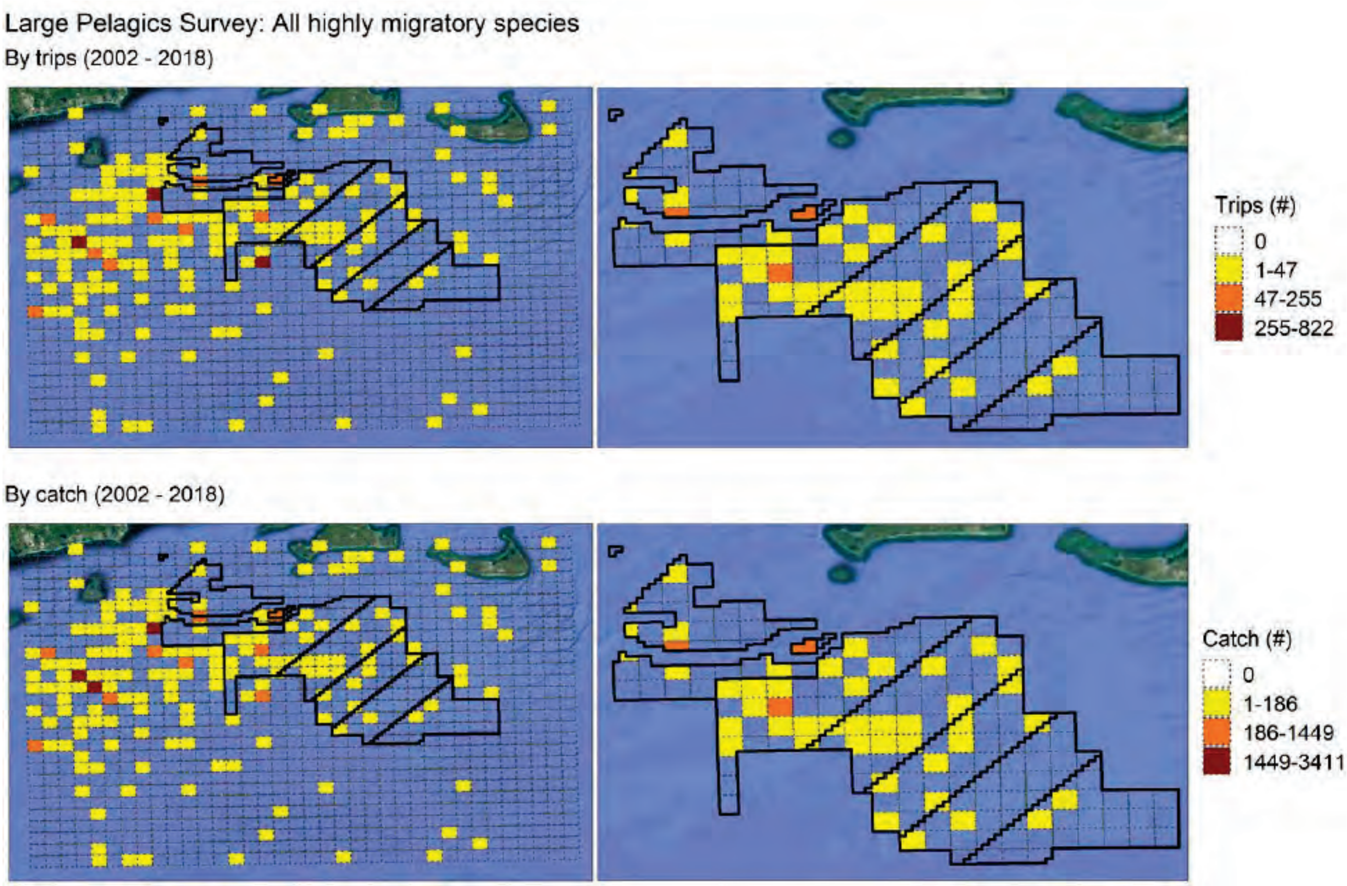


Figure 3.10-10: Popular Recreational Fishing Spots



Source: Kneebone and Capizzano 2020

Figure 3.10-11: Recreational Fishing Effort for Highly Migratory Species over the Southern New England Grid (left) and RI and MA Lease Areas (right), 2002-2018

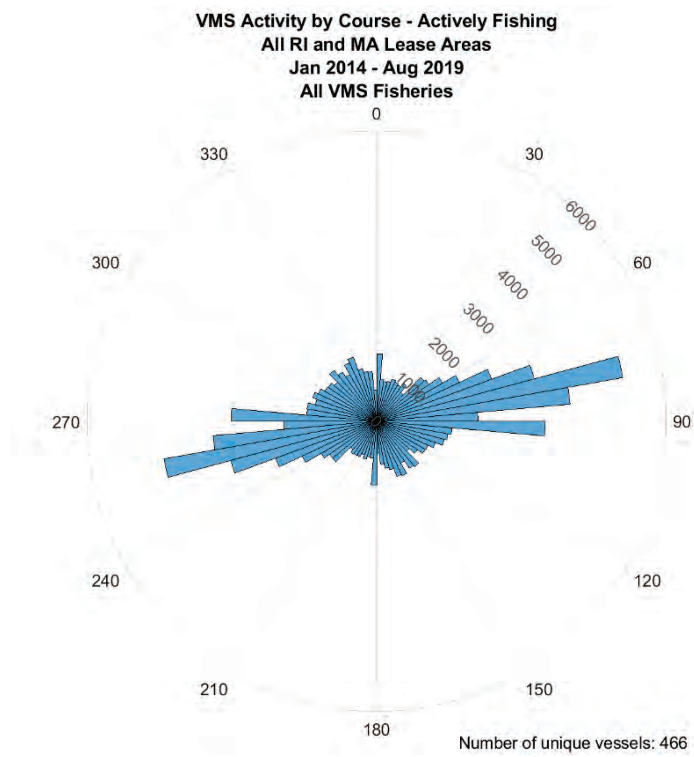


Figure 3.10-12: All VMS Fisheries in RI and MA Lease Areas—Fishing

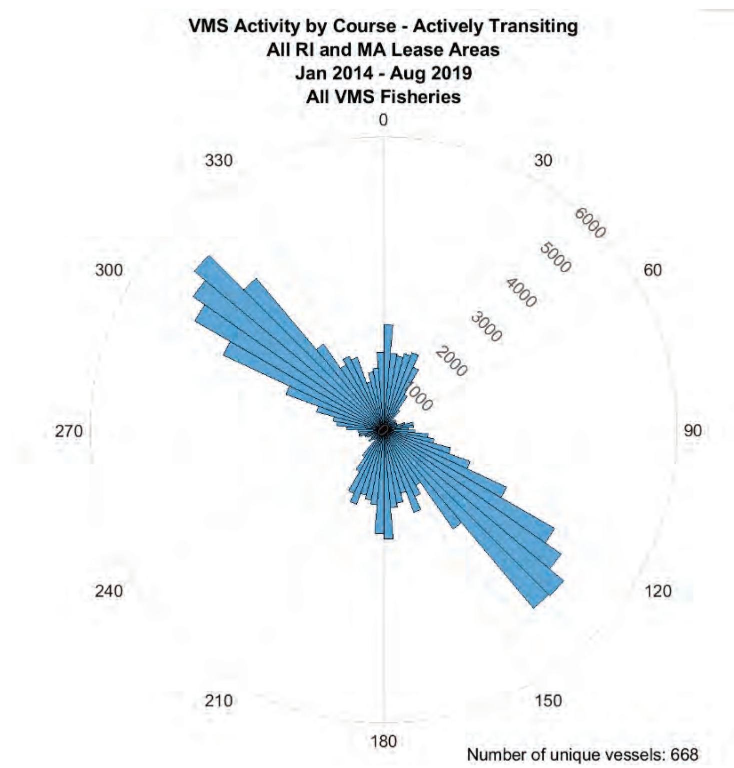


Figure 3.10-13: All VMS Fisheries in RI and MA Lease Areas—Transiting

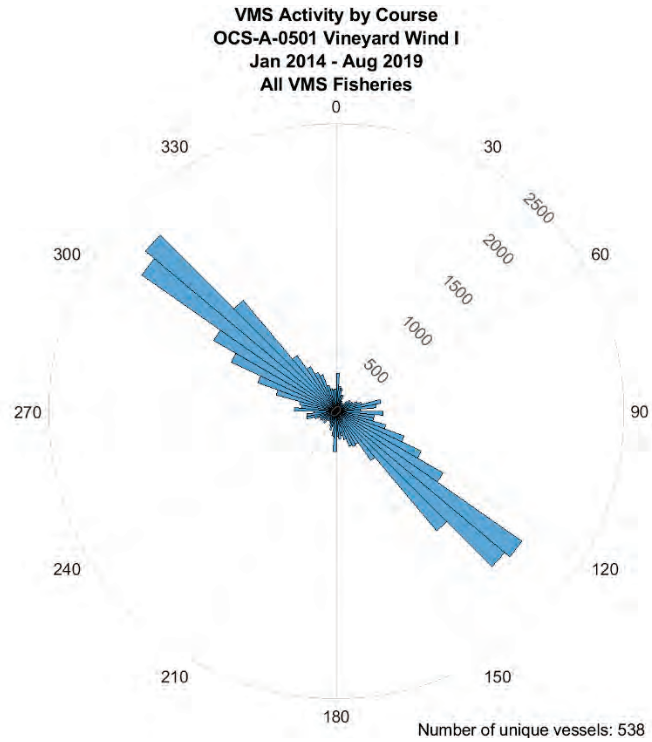


Figure 3.10-14: All VMS Fisheries in the WDA—Fishing and Transiting

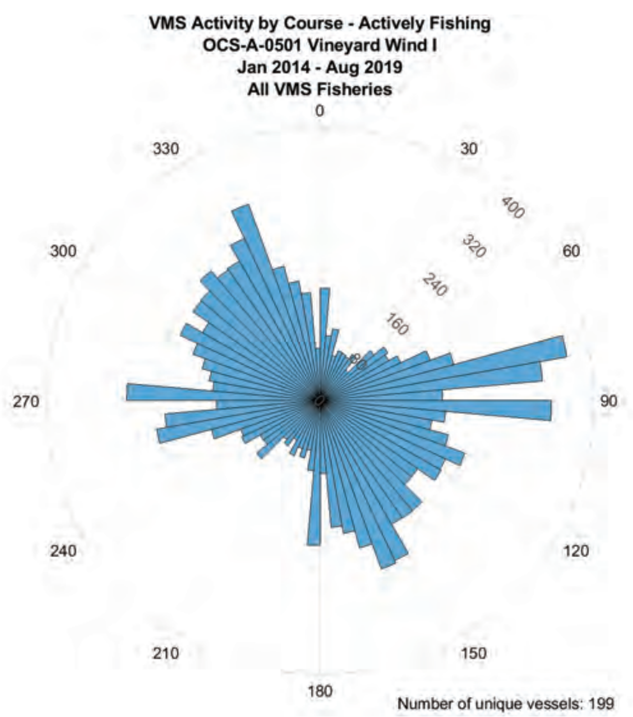


Figure 3.10-15: All VMS Fisheries in the WDA—Fishing

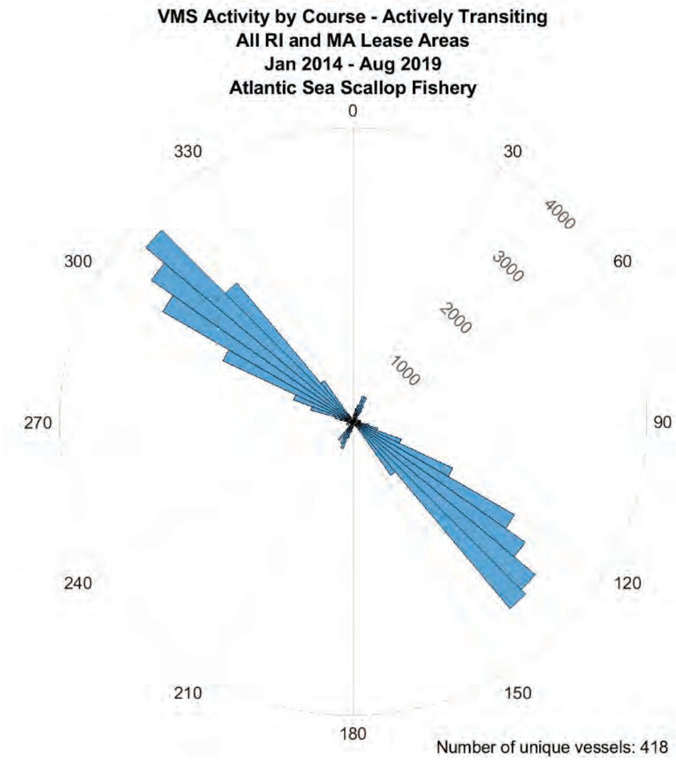


Figure 3.10-16: Sea Scallop Fishery in RI and MA Lease Areas—Transiting

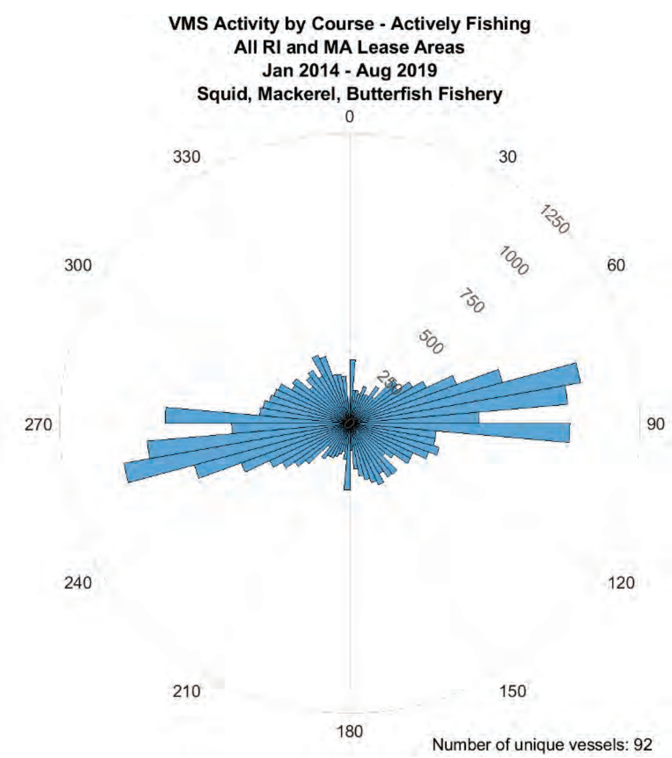


Figure 3.10-17: Squid, Mackerel, Butterfish Fishery in RI and MA Lease Areas—Fishing

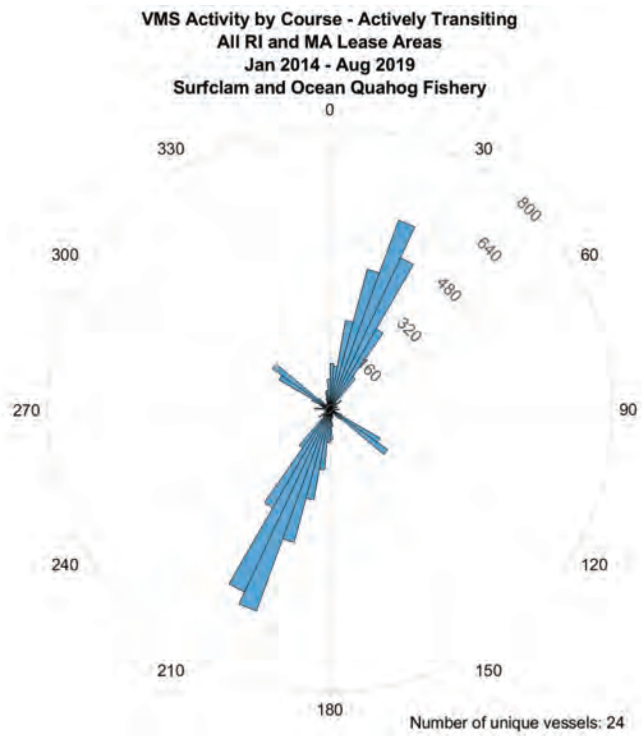
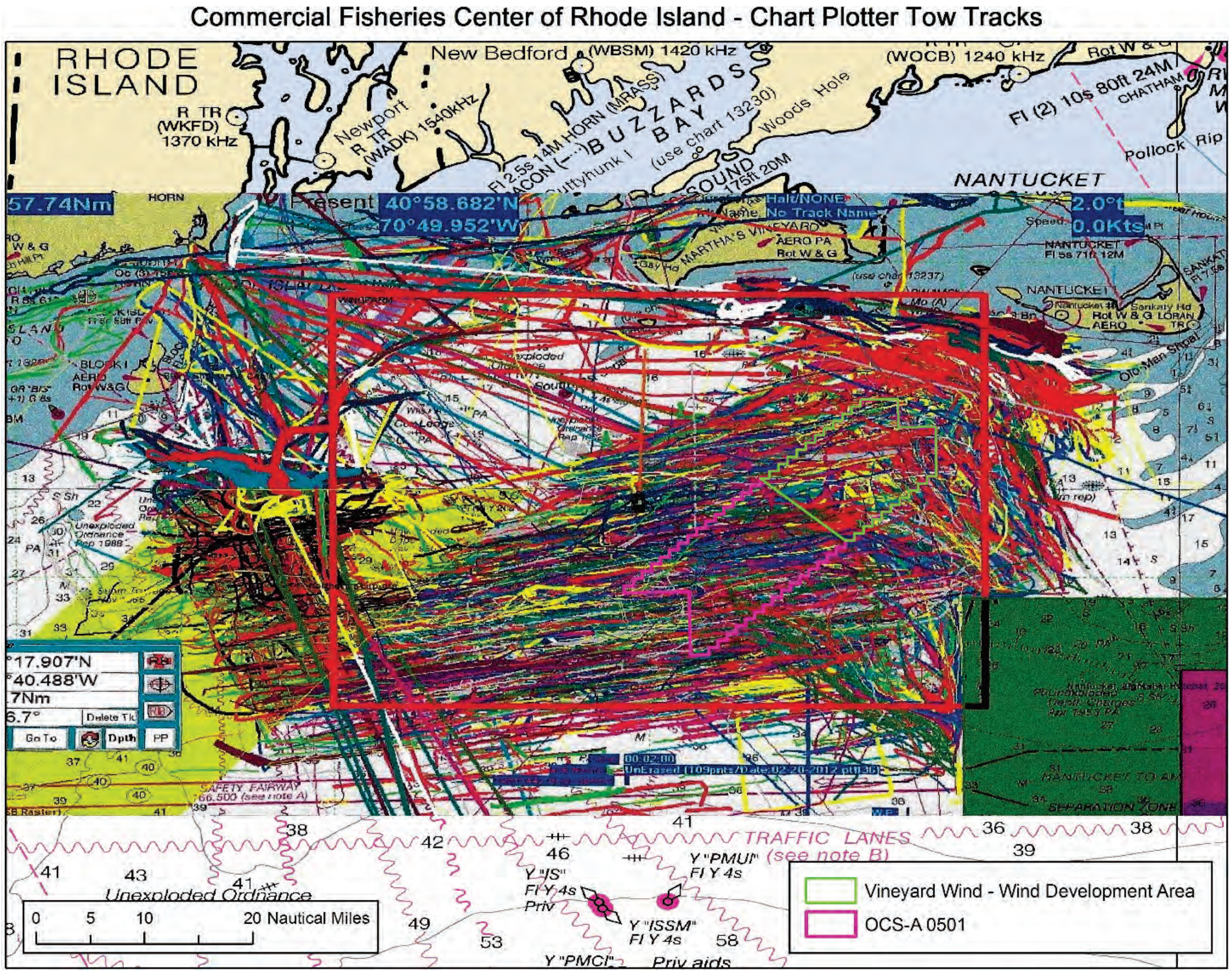


Figure 3.10-18: Surfclam and Ocean Quahog Fishery in RI and MA Lease Areas—Transiting



Source: Commercial Fisheries Center of Rhode Island comment submitted during the public scoping process

A general pattern of east-west or northeast-southwest (following Loran line orientation) fishing activity is apparent; however, a substantial number of tracks proceed in other directions.

Figure 3.10-19: Chart Plotter Tow Tracks near the Wind Development Area

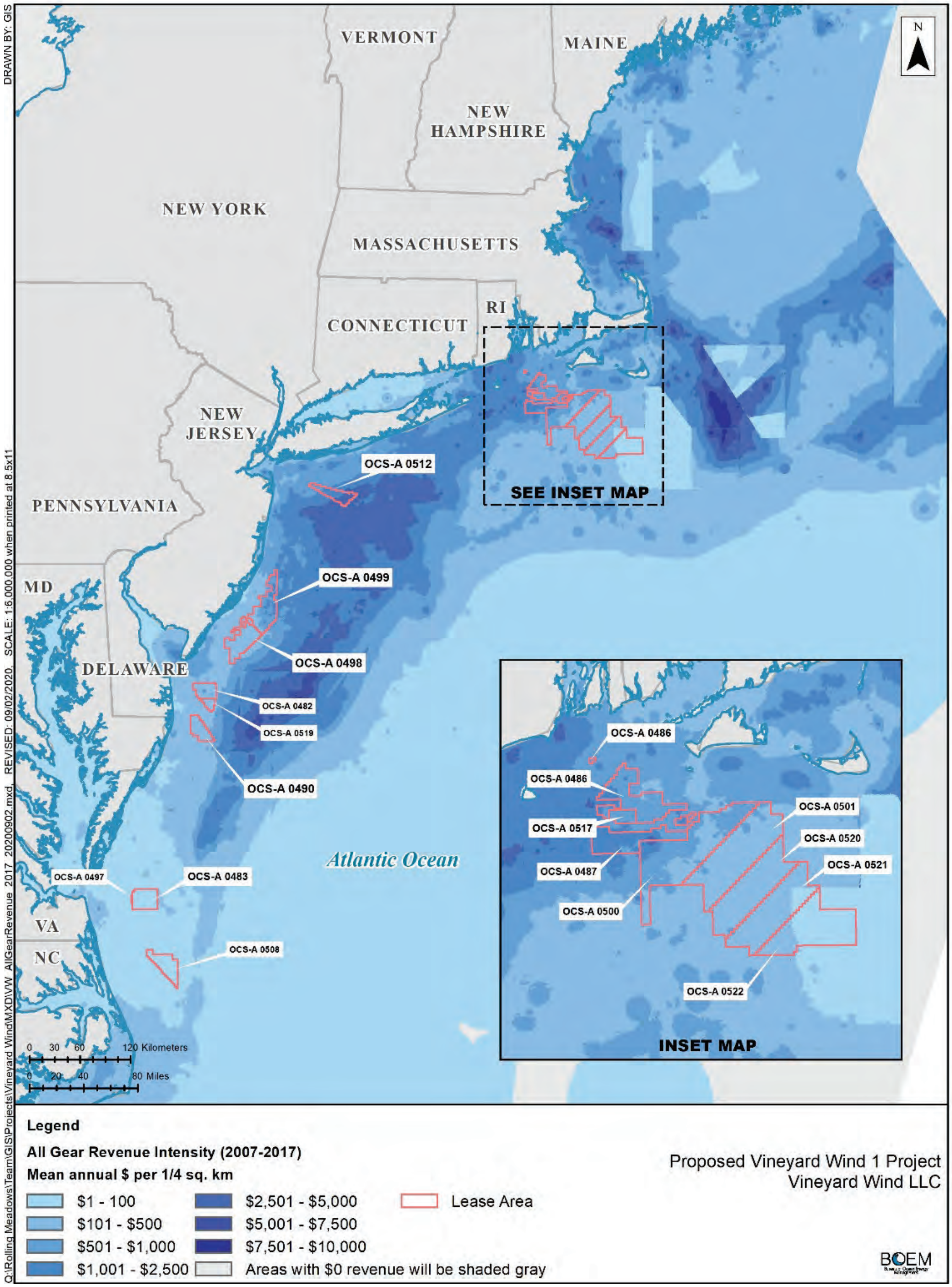
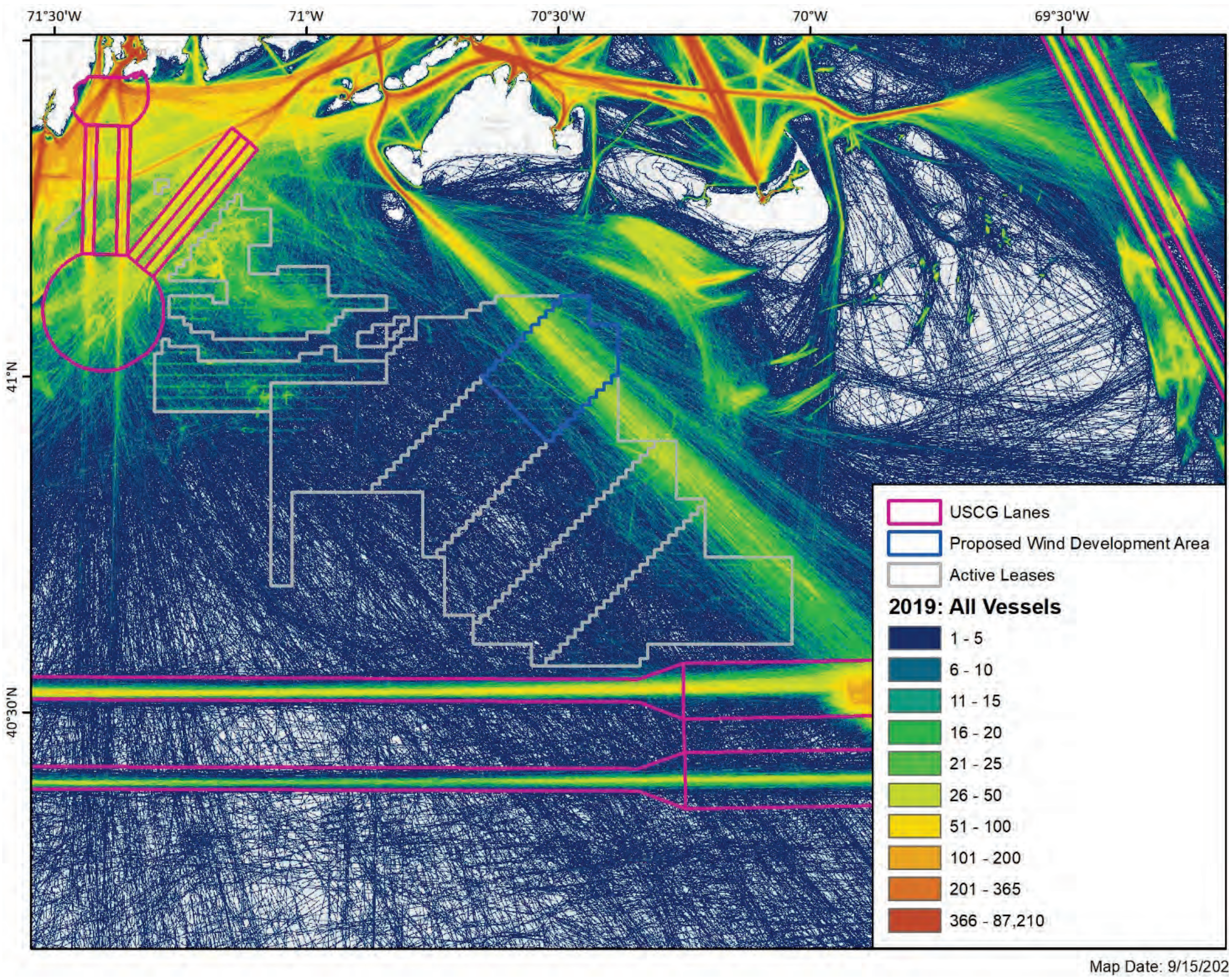
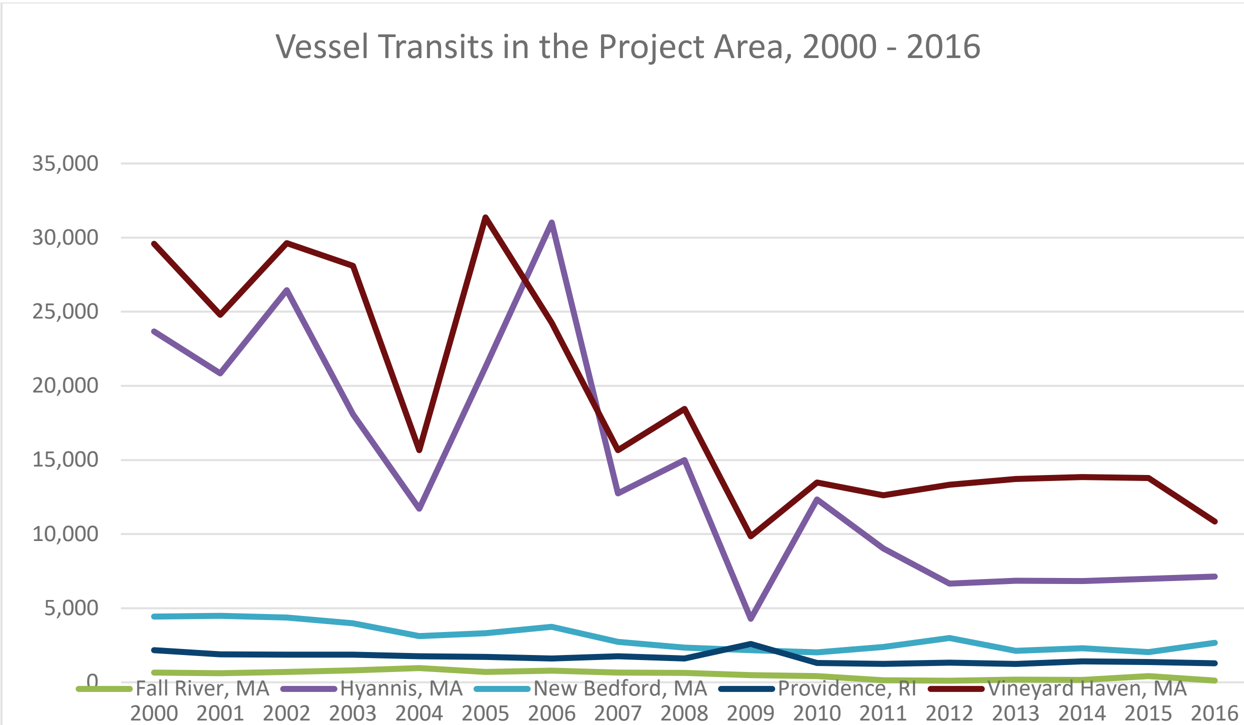


Figure 3.10-20: Relative Intensity of Commercial Fisheries in the Northeast and Mid-Atlantic Regions with Wind Energy Lease Areas



Source: Northeast Regional Ocean Council 2020

Figure 3.11-1: Vessel Traffic, 2019



Source: USACE 2018b

Figure 3.11-2: Vessel Traffic in the Project Area, 2000–2016

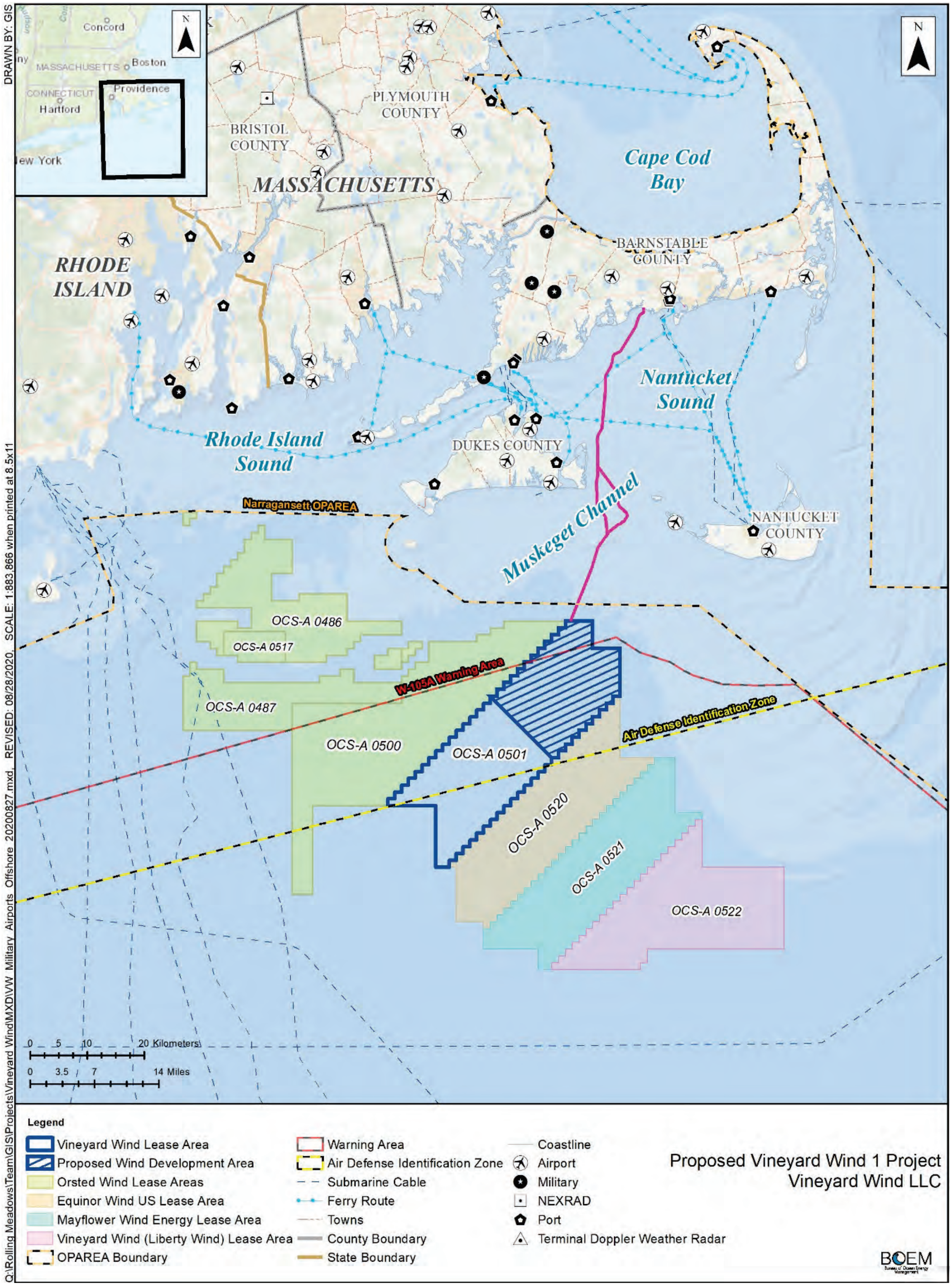


Figure 3.12-1: Military and National Security Uses, Aviation and Air Traffic, Radar, and Cables and Pipelines

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APPENDIX C

Other Required Analyses and Consultation and Coordination

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APPENDIX C. OTHER REQUIRED ANALYSES AND CONSULTATION AND COORDINATION

To comply with the page limits in the Department of the Interior's Secretarial Order 3355 and focus on the impacts of most concern, the Bureau of Ocean Energy Management (BOEM) has included in this appendix information related to consultation and coordination as well as a discussion on alternatives considered but not analyzed in detail. In addition, unavoidable adverse impacts associated with a proposed action, irreversible or irretrievable commitments of resources, and the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity are included, although these analyses are largely unchanged from the Draft Environmental Impact Statement (DEIS). As was the case in the DEIS, these analyses focus on the potential impacts of the Proposed Action. The potential effects of the action alternatives are characterized in Final Environmental Impact Statement (FEIS) Chapter 3 and Appendix A.

C.1. CONSULTATION AND COORDINATION

This chapter discusses public and agency involvement leading up to the preparation and publication of this FEIS, including formal consultations, cooperating agency exchanges, the public scoping comment period and correspondence. Interagency consultation, coordination, and correspondence throughout the development of this FEIS occurred primarily through virtual meetings, and teleconferences, and written communications (including email). BOEM coordinated with numerous agencies throughout the development of this document, as listed in Section C.1.3.2.

C.1.1. Background

BOEM began evaluating Outer Continental Shelf (OCS) wind energy offshore the Commonwealth of Massachusetts (Massachusetts) in 2009 by establishing an intergovernmental renewable energy task force comprised of elected officials from state, local, and tribal governments and affected federal agency representatives. After extensive consultation with the task force, BOEM removed some areas from further consideration for offshore wind leasing to reduce visual impacts, including areas within 12 nautical miles of inhabited land. BOEM then took the following steps concerning planning and leasing:

- In December 2010, BOEM published a Request for Interest (RFI) in the Federal Register to determine commercial interest in wind energy development in an area offshore Massachusetts (Commercial Leasing for Wind Power on the OCS Offshore Massachusetts–RFI, 75 Federal Register [Fed. Reg.] 82055 [December 29, 2010]). BOEM invited the public to provide information on environmental issues and data for consideration in the RFI area and also to express interest in offshore wind energy development. BOEM re-opened the comment period in March 2011 in response to requests from the public and Massachusetts. BOEM received 260 public comments and 11 indications of interest from ten companies interested in obtaining a commercial lease. In response to comments, BOEM made the planning area 50 percent smaller than noticed in the RFI, to address navigation and commercial fisheries concerns.
- In February 2012, BOEM published a Call for Information and Nominations (Call) in the Federal Register to solicit industry interest in acquiring commercial leases for developing wind energy projects in the Call area (Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore MA – Call for Information and Nominations, 77 Fed. Reg. 5821 [February 6, 2012]). In the same month, BOEM published a Notice of Intent to prepare an Environmental Assessment for commercial wind leasing and site assessment activities offshore Massachusetts. The comment period for the Call yielded 32 comments and ten nominations of commercial interest.
- In May 2012, BOEM publicly identified a Wind Energy Area (WEA) offshore Massachusetts, excluding additional areas from commercial leasing to address concerns highlighted in comments on the Call, including an area of high sea duck concentration and an area of high-value fisheries. After preparing an Environmental Assessment, BOEM issued a "Finding of No Significant Impact," which concluded that reasonably foreseeable environmental effects associated with the activities that would likely be performed following

lease issuance (e.g., site characterization surveys in the WEA and deployment of meteorological (met) towers or buoys) would not significantly impact the environment. The Revised Massachusetts Environmental Assessment (BOEM 2014) more fully describes the development of the WEA.

- In June 2014, BOEM published a Proposed Sale Notice identifying 742,974 acres (3,007 square kilometers [km^2]) offshore Massachusetts in federal waters that would be available for commercial wind energy leasing.
- After incorporating comments received on the Proposed Sale Notice, BOEM published a Final Sale Notice on November 24, 2014, which announced that a lease sale would be held on January 29, 2015.
- BOEM held a competitive lease sale under Title 30 Code of Federal Regulations (CFR) Section (§) 585.211 for the lease areas within the Massachusetts Wind Energy Area. Offshore MW LLC (subsequently renamed to Vineyard Wind LLC) won the competition for Lease Area OCS-A 0501 in the auction (FEIS Figure 1.1-1). This lease area is 166,886 acres (675 km^2).
- In December 2017, Vineyard Wind submitted to BOEM a Construction and Operations Plan (COP) for the proposed Project. Since the submittal in December 2017, Vineyard Wind has updated its COP and the latest version can be viewed at BOEM's project-specific website.[1] The COP proposes to develop approximately 800 megawatts (MW) of wind energy capacity in the northern portion of the Vineyard Wind Lease Area OCS-A-0501(lease area) (Figure 1.1-1), referred to as the Wind Development Area (WDA) amounting to 75,614 acres (306 km^2) of the 166,886 acre (675 km^2) lease area. Additional details regarding the proposed Project are set forth in Chapter 2.
- In June 2020, Vineyard Wind announced to BOEM that it has secured all the necessary permits for the Covell's Beach landfall location; therefore New Hampshire Avenue is no longer considered.
- In December 2020, Vineyard Wind informed BOEM that they were withdrawing their COP from BOEM's review and consideration until they had completed their due diligence review in connection with their selection of the Haliade-X wind turbine generator (WTG) to be used for the proposed Project.
- In December 2020, BOEM published a Federal Register Notice informing the public that "[t]he preparation of an EIS for the [COP] submitted by [Vineyard Wind] concerning the construction and operation of an 800-megawatt wind energy facility offshore Massachusetts (Vineyard Wind 1 Project) is no longer necessary and the process is hereby terminated."
- In January 2021, Vineyard Wind notified BOEM via letter that they had completed their technical and logistical due diligence review, which concluded that inclusion of the Haliade-X turbines did not warrant any modifications to the COP. Accordingly, Vineyard Wind informed BOEM that they were rescinding their temporary withdrawal and asked BOEM to resume its review of the COP.
- BOEM has published a Federal Register Notice noting that the National Environmental Policy Act (NEPA) process has resumed.

C.1.2. Consultations

The following section provides a summary and status of each consultation (ongoing, complete, and the opinion or finding of each consultation). The Bureau of Environmental Safety and Enforcement (BSEE), U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency are co-action agencies for the Endangered Species Act (ESA), Magnuson-Stevens Fishery Conservation and Management Act (MSA), and National Historic Preservation Act (NHPA) consultations.

C.1.2.1. Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) requires that federal actions within and outside the coastal zone that have reasonably foreseeable effects on any coastal use or natural resource of the coastal zone be consistent to the maximum extent practicable with the enforceable policies of a state's federally approved coastal management program. On April 6, 2018, Vineyard Wind voluntarily submitted a federal consistency certification with the Massachusetts Office of Coastal Zone Management (CZM) and the Rhode Island Coastal Resources Management

[1] The most recent version of the COP is available at https://www.boem.gov/Vineyard-Wind/

Council per 15 CFR § 930.76 Subpart E. Vineyard Wind's COP (Epsilon 2018, 2019, 2020a, 2020b) provided the necessary data and information under 15 CFR § 930.58. The states' concurrence is required before BOEM may approve, or approve with conditions, the COP in accordance with 30 CFR § 585.628(f) and 15 CFR § 930.130(1).

On February 28, 2019, the Rhode Island Coastal Resources Management Council concurred with the CZMA consistency certification filed by Vineyard Wind on April 6, 2018.[2] After multiple discussions and negotiations, Vineyard Wind agreed to provide fisheries mitigations as required by Rhode Island enforceable policies 11.10.5(C), (G), and (H), which include a $4.2 million fund for direct compensation to Rhode Island fishermen for loss of equipment or claims of direct impact. In addition, Vineyard Wind would provide Rhode Island with $12.5 million to establish the Rhode Island Fisheries Future Viability Trust administered by a non-profit entity independent of the State of Rhode Island and the Fishermen's Advisory Board. Finally, Vineyard Wind provided a commercial fisheries biological assessment monitoring plan summary as required by Rhode Island enforceable policies. On May 22, 2020, Massachusetts CZM concurred with the CZMA consistency certification filed by Vineyard Wind on April 6, 2018 (Massachusetts CZM 2020). With oversight of Massachusetts CZM and input from key stakeholders, Vineyard Wind voluntarily developed the Massachusetts Fisheries Compensatory Mitigation Plan and has entered into an agreement with the Massachusetts Executive Office of Energy and Environmental Affairs to establish two funds, the Compensatory Mitigation Fund ($19.2 million) and the Fisheries Innovation Fund ($1.75 million). The Compensatory Mitigation Fund will be used to compensate for any claims of economic impacts to Massachusetts vessels or fisheries interests and the Fisheries Innovation Fund will be used to support fisheries research and innovation. Additional details are provided in FEIS Section 3.10 and Table 3.10-13 in Appendix B.

C.1.2.2. Endangered Species Act

Section 7(a)(2) of the ESA of 1973, as amended (16 United States Code [USC] § 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (USFWS), depending upon the jurisdiction of the Services. Pursuant to 50 CFR § 402.07, BOEM has accepted designation as the lead federal agency for the purposes of fulfilling interagency consultation under Section 7 of the ESA for listed species under the jurisdiction of NMFS and USFWS. BOEM has initiated consultation on the proposed activities considered in this FEIS with both NMFS and USFWS for listed species under their respective jurisdictions. NMFS and USFWS have not designated any critical habitat in the Wind Development Area; thus, none would be affected. The sections below describe the status of consultations for each of the services.

C.1.2.2.1. National Marine Fisheries Service

On December 7, 2018, BOEM submitted a Biological Assessment (BA) to NMFS and requested formal consultation under Section 7 of the ESA on December 7, 2018 (BOEM 2018a). The Vineyard Wind 1 Project BA assesses impacts from all aspects of the proposed Project, including construction, operation, maintenance, and decommissioning on marine ESA-listed species (non-marine species consultation is discussed below). NMFS initiated formal consultation on the Vineyard Wind 1 Project April 10, 2019. BOEM subsequently transmitted a revised BA to NMFS in March 2019 (BOEM 2019a). BOEM subsequently transmitted additional information on the BA to NMFS on May 11, 2020, to account for modifications in the Vineyard Wind 1 Project Design Envelope (PDE). Formal consultation was completed with the issuance of a Biological Opinion (BO) on September 13, 2020. The scope of the BA and BO covers the entirety of potential effects on ESA-listed species and designated critical habitat associated with the proposed Project. BOEM, NMFS, and Vineyard Wind will further consult and coordinate to ensure that effects from post-construction monitoring activities are mitigated to the level of least practicable adverse impact. The analysis of effects and conclusions of the BO have been incorporated by

[2] More information regarding the consistency certification, including compensatory mitigation, is provided in FEIS Section 3.10 and at http://www.crmc.ri.gov/windenergy/vineyardwind.html

reference and summarized into the FEIS. BOEM has made the BA supplement materials and the final BO available here: https://www.boem.gov/Vineyard-Wind/.

C.1.2.2.2. U.S. Fish and Wildlife Service

On July 13, 2018, in preparation of the NEPA process and the BA for non-marine species such as birds and bats, BOEM used USFWS's Information for Planning and Consultation system[3] to determine if any ESA-listed, proposed, or candidate species may be present in the onshore and offshore proposed Project area. The report identified five ESA-listed species with potential to occur in the proposed Project area: northern long-eared bat (*Myotis septentrionalis*), Piping Plover (*Charadrius melodus*), Rufa Red Knot (*Calidris canutus rufa*), Roseate Tern (*Sterna dougallii dougallii*), and American chaffseed (*Schwalbea americana*) (USFWS 2018).

On December 7, 2018, BOEM submitted a BA to USFWS (BOEM 2018b); consultation with USFWS is ongoing and will be completed prior to issuance of the Record of Decision (ROD). The Vineyard Wind 1 Project BA assesses all aspects of the proposed Project, including construction, operation, maintenance, and decommissioning on USFWS-listed species. The analysis of effects and conclusions of the BA have been incorporated by reference and summarized in the FEIS (BOEM 2019b). The BA is available here: https://www.boem.gov/Vineyard-Wind/. BOEM updated the BA to address updates to the COP and submitted a revised BA to USFWS for their review and concurrence on September 3, 2020. On May 24, 2019, BOEM utilized the Information for Planning and Consultation tool and determined that tree clearing activities for the onshore substation complied with the USFWS's January 5, 2016, Programmatic BO, which satisfied USFWS responsibilities relative to the northern long-eared bat for this action under ESA Section 7(a)(2) (USFWS 2016; USFWS 2019). BOEM updated the determination with new information from the COP to clear an additional 0.2 acre (809 square meters) of forest. BOEM completed its consultation with USFWS. In a letter dated October 16, 2020, the USFWS concurred with the findings presented in the 2020 BA (BOEM 2020a); and as such, no further consultation pursuant to Section 7 of the ESA is required at this time (USFWS 2020).

C.1.2.3. Government-to-Government Tribal Consultation

Executive Order 13175 commits federal agencies to engage in government-to-government consultation with tribes when federal actions have tribal implications, and Secretarial Order No. 3317 requires U.S. Department of the Interior agencies to develop and participate in meaningful consultation with federally recognized tribes where a tribal implication may arise. A June 29, 2018, memorandum outlines BOEM's current tribal consultation policy. This memorandum states that "consultation is a deliberative process that aims to create effective collaboration and informed federal decision-making" and is in keeping with the spirit and intent of the NHPA and NEPA, Executive and Secretarial Orders, and Department of the Interior Policy. BOEM implements tribal consultation policies through formal government-to-government consultation, informal dialogue, collaboration, and other engagement.

BOEM invited Tribal Historic Preservation Officers (THPOs) to the NEPA scoping meetings scheduled for April 16 to 20, 2018. On April 24, 2018, BOEM initiated formal consultations with six tribes under the NHPA through individual letters mailed to THPOs and tribal leaders with the Mashantucket (Western) Pequot Tribal Nation, the Mashpee Wampanoag Tribe of Massachusetts, the Mohegan Indian Tribe of Connecticut, the Narraganset Indian Tribe, the Shinnecock Indian Nation of New York, and the Wampanoag Tribe of Gay Head (Aquinnah). BOEM then sent individual invitations to THPOs and Deputy THPOs to participate in a June 26, 2018, webinar on the proposed Project.

On July 30, 2018, BOEM sent another set of emails to tribal leaders and THPOs again requesting further government-to-government consultation as part of BOEM's ongoing effort to update the tribes on developments in offshore wind. The Narragansett Indian Tribe, the Mohegan Indian Tribe, and the Mashantucket Pequot Tribe responded to this request. BOEM held government-to-government meetings with the Narragansett Indian Tribe at tribal offices in Charlestown, Rhode Island, and jointly with the Mohegan Indian Tribe and the Mashantucket Pequot Tribe at Mashantucket, Connecticut, on August 21 and 22, 2018. All three tribes expressed interest in

[3] https://tinyurl.com/0501-ipac

continuing consultation for offshore wind, and all emphasized the importance of early consultation in Project development.

Between January 15 and 17, 2020, BOEM met again with the Mohegan Tribe of Connecticut, the Mashantucket Pequot Tribal Nation, and the Narragansett Indian Tribe to discuss multiple BOEM actions, including the Proposed Action. Tribal concerns include possible effects on marine mammals, other marine life, and the Nantucket Sound Traditional Cultural Property (TCP). A number of identified paleolandforms are likely contributing elements to the Nantucket Sound TCP due to their cultural significance to Native American tribes. One tribe emphasized the importance of open sea views to the east during sunrise, as well as the night sky, while others emphasized their long historical association with the sea and islands off southern New England and the critical role of fishing and shellfish gathering. All of the tribes emphasized the importance of understanding the interconnected nature of the human world, the sea, and the living things in both worlds. On July 21, 2020, BOEM and the BSEE conducted three separate meetings with the Mashantucket Pequot Tribal Nation, the Wampanoag Tribe of Gay Head (Aquinnah), and Mashpee Wampanoag Tribe. These meetings had different topics (discussed below), but all three meetings resulted in an understanding that a future meeting would be set up between BOEM and tribal representatives to discuss mitigation measures, funding, and best practices. The Mashantucket Pequot Tribal Nation wanted to discuss some concerns and questions they had on the July 8, 2020, meeting. Specifically, the Mashantucket Pequot Tribal Nation wanted more information on BOEM's references to tribal histories, tribal habitation on Nantucket Sound and the Coastal Plains, marine cultural surveys, and mitigation plans. BOEM also met with and the Wampanoag Tribe of Gay Head (Aquinnah) on July 21, 2020. Their meeting topics included the Vineyard Wind 1 Project, the Revolution Wind Project, and electrical transmission matters. BOEM and BSEE presented an overview of both Projects and the electrical transmission matters. Tribal concerns included project effects and layout, a desire to redefine the Nantucket Sound TCP boundaries, and recommendations for mitigation measures. The meeting with the Mashpee Wampanoag Tribe focused on the electrical transmission matters. The Tribe's concerns included aboriginal rights and titles, communication with developers, mitigation measures, cumulative effects of the present and future offshore wind projects in the area, and sample testing. Appendix D provides a list of proposed mitigation measures.

On July 27, 2020, BOEM held a government-to-government meeting with the Mashantucket Pequot Tribe, Mashpee Wampanoag Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah). The purpose of this meeting was to understand the tribes' concerns about the proposed Project. Concerns included site avoidance, tribal staffing, best practices, and additional tribal involvement. This meeting concluded with some action items for BOEM, including providing additional information on marine life and electrocution risk, terrestrial and marine analysis methods, a review of previous documents, scheduling a future meeting concerning environmental studies with the National Oceanic and Atmospheric Administration, and following up with the Advisory Council on Historic Preservation (ACHP). BOEM followed up with the ACHP regarding the process of conducting an NHPA Section 304 review on the sharing of submerged landform information with NHPA Section 106 consulting parties; the results of this discussion were shared on September 24, 2020, with the federally recognized Wampanoag Tribe of Gay Head (Aquinnah). BOEM has also shared with the tribes the electrocution studies and all other documents requested by the tribes following the July 27, 2020 meeting. In a follow-up meeting on August 20, 2020, BOEM consulted with the Delaware Tribe, Mashantucket Pequot Tribe, Mashpee Wampanoag Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) to discuss the impacts of offshore wind developments on marine mammals. This included an overview of the consultation process and environmental review, the BOEM Environmental Studies program and process, existing and upcoming studies related to the North Atlantic right whale, and the marine mammal analysis and findings noted in the Supplement to the DEIS (SEIS). The meeting concluded with some action items for BOEM, which included providing the above-referenced consulting parties with additional reports, and researching funding options to provide tuition assistance for tribal members interested in participating in the mammal spotter training certificate program. BOEM is currently investigating developing a program to provide Protected Species Observer training for qualified members of federally recognized tribes. Appendix D provides a list of proposed mitigation measures.

BOEM continues to consult with these and other tribes on developments in offshore wind.

C.1.2.4. National Historic Preservation Act

Section 106 of the NHPA (54 USC § 306108 et seq.) and its implementing regulations (36 CFR Part 800) require federal agencies to consider the effects of their undertakings on historic properties and afford the ACHP an opportunity to comment. BOEM has determined that the proposed Project is an undertaking subject to Section 106 review. The construction of WTGs and electrical service platforms, installation of electrical support cables, and development of staging areas are ground- or seabed-disturbing activities that may adversely affect archaeological resources. The presence of WTGs may also introduce visual elements out of character with the historic setting of historic structures or landscapes; in cases where historic setting is a contributing element of historic properties' eligibility for the National Register of Historic Places, the Project may adversely affect those historic properties. BOEM fulfilled public involvement requirements for Section 106 of the NHPA through the NEPA public scoping and public meetings process, pursuant to 36 CFR § 800.2(d)(3). The Scoping Summary Report (BOEM 2018c), available on BOEM's Project-specific website, summarizes comments on historic preservation issues.[4] On April 24, 2018, BOEM initiated consultation with six federally recognized tribes: the Mashantucket (Western) Pequot Tribal Nation, the Mashpee Wampanoag Tribe of Massachusetts, the Mohegan Indian Tribe of Connecticut, the Narraganset Indian Tribe, the Shinnecock Indian Nation of New York, and the Wampanoag Tribe of Gay Head (Aquinnah) (Section C.1.2.3). BOEM requested information on properties of historic/cultural significance that the proposed Project could affect, and offered BOEM's assistance in providing additional details and information on the proposed Project to the tribes.

On June 7, 2018, BOEM contacted representatives of local governments, state and local historical societies, economic development commissions, and other federal agencies to solicit information on historic properties and determine their interest in participating as consulting parties. On June 26, 2018, BOEM conducted a webinar for consulting parties, with the goals of discussing the undertaking, defining the area of potential effect (APE), and discussing BOEM's guidance for what constitutes a good faith effort to identify historic properties within the APE (BOEM 2017). On November 7, 2018, BOEM held a second Section 106 consultation meeting on the island of Nantucket, with the goal of discussing viewshed assessments, visual simulations, and assessing effects on historic properties.

On April 2, 2019, BOEM held a Section 106 consultation meeting in Hyannis, Massachusetts. The purpose of the meeting was to discuss mitigations for adverse effects on the Nantucket National Historic Landmark (NHL) and the Gay Head Light historic property; a framework Memorandum of Agreement (MOA) with treatment plans for resolving adverse effects on historic properties; and to present the results of the terrestrial and marine archaeological surveys conducted by Vineyard Wind to the consulting parties.

On April 10, 2019, BOEM notified the parties of its initial Finding of Adverse Effect (FoAE) for the COP on the Gay Head Light and the Nantucket Island NHL, pursuant to 36 CFR § 800.5. Because the identification of historic properties was, at that time, ongoing for both marine and terrestrial archaeological resources portions of the APE, BOEM continued consultation with the parties.

In May and June 2019, the state-recognized Chappaquiddick Wampanoag Tribe notified BOEM of potential impacts from the Proposed Action to Chappaquiddick Island, which the tribe considers a TCP. BOEM reviewed information provided by the tribe and continued consultation under Section 106 of the NHPA. As a result of this and other comments, BOEM revised its FoAE to incorporate additional identified historic properties that may be affected by the undertaking and to reflect comments received.

On June 26, 2019, BOEM held a meeting with representatives from the Mashpee Wampanoag, Wampanoag Tribe of Gay Head (Aquinnah), and the Mashantucket (Western) Pequot Tribal Nation in Hyannis, Massachusetts, to discuss options to mitigate adverse effects on the paleolandforms. During this meeting, the representatives from BOEM and the tribes discussed various options for mitigating adverse effects on paleolandforms that may be contributing elements to a tribal TCP. This included a proposal by BOEM for a study designed to collect data from submerged paleolandscapes to develop a paleoenvironmental reconstruction of the subaerially exposed area when it was occupied by Native American populations.

[4] https://www.boem.gov/Vineyard-Wind/

On April 24, 2020, BOEM sent a letter via email to all consulting parties, notifying them that the Vineyard Wind 1 Project NHPA Section 106 consultation process would resume during the upcoming months. In addition, BOEM requested information regarding consulting parties' specific limitations and challenges as a result of the coronavirus disease 2019 (COVID-19) pandemic that would affect their ability to participate in the NHPA Section 106 consultations, any changes to their preferred means of communication, and how they preferred to receive documents.

On May 11, 2020, BOEM made follow-up phone calls to the consulting parties who had not provided responses to the COVID-19 update email.

On July 8, 2020, BOEM held a Section 106 consultation meeting webinar, the first of three planned meetings, to discuss a number of topics that included:

- Changes to the PDE since the last meeting
- A review of the Historic Properties Visual Impact Assessment and the Historic Properties Cumulative Visual Effects Assessment reports
- The status of the paleolandscape mitigation proposal
- A review of the *Best Practices for Drafting Mitigation Proposals to Resolve Adverse Visual Effects as Part of the National Historic Preservation Act Section 106 Review Process* document created by BOEM

During the meeting's discussion periods, a number of consulting parties voiced concerns about the process and raised additional questions about the Historic Properties Visual Impact Assessment and the Historic Properties Cumulative Visual Effects Assessment studies. At the conclusion of this meeting, BOEM emphasized that revised mitigation proposals were due July 22, 2020. In response to concerns about the tight schedule and outstanding issues pertaining to the Project's visual simulations, BOEM proposed to organize a conference call with BOEM's landscape architect. This would allow consulting parties to ask questions about visual impact assessment methodologies and techniques, visual simulations, geographic information system-based viewshed modeling, and other topics related to assessing visual impacts.

On July 20, 2020, BOEM held a facilitated question-and-answer session via video conference call with the consulting parties to address a number of issues and concerns raised during the July 8, 2020, consultation meeting and answer any additional questions. This session was led and attended by subject matter experts from BOEM, ERM, Vineyard Wind, Saratoga Associates, and Epsilon Associates, Inc.

On August 18, 2020, BOEM held a facilitated discussion with the federally and state-recognized tribes, and the Massachusetts Historical Commission to discuss BOEM's proposal to mitigate the adverse effects on the 16 ancient landforms affected by the Project. This discussion was used as an opportunity for BOEM to introduce three additional potential mitigation measures and receive feedback from the tribes about these proposals. Several tribal consulting parties offered comments about the proposed mitigation options and also requested that additional archaeological investigations be conducted. The meeting concluded with an understanding that discussions would continue within the respective consulting parties' organizations and additional comments would be offered upon further review of the newly proposed mitigation options.

On November 13, 2020, BOEM notified the parties of its revised FoAE for the COP on the Gay Head Light and the Nantucket Island NHL, the Chappaquiddick Island TCP, and submerged ancient landforms that are contributing elements to the Nantucket Sound TCP, as well as submerged ancient landforms on the OCS outside the Nantucket Sound TCP, pursuant to 36 CFR § 800.5. BOEM retransmitted the same Finding to consulting parties on February 3, 2021. Pursuant to 36 CFR § 800.6, BOEM is continuing consultation with the parties.

BOEM intends to continue consultations with the goal of developing an MOA to resolve adverse effects on the Nantucket NHL, Gay Head Light historic property, the Chappaquiddick Island TCP, and submerged paleolandforms with the potential to contain pre-contact period sites. As previously discussed, BOEM must execute the MOA before issuance of the ROD.

Due to the presence of the Nantucket NHL within the APE for the Proposed Action, BOEM is currently in the process of completing its requirements under Section 110(f) of the NHPA (54 USC § 306107 et seq.) and 36 CFR § 800.10(a). Section 110(f) of the NHPA requires federal agencies, "to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to NHLs that may be directly and adversely affected by an undertaking." Section 110(f) of the NHPA and 36 CFR § 800.10 also require federal agencies to request that the ACHP participate in the consultation, require the agency official to notify the Secretary of the Interior (Secretary) of any consultation involving an NHL, and invite the Secretary to participate in the consultation where there may be an adverse effect.

To comply with Section 110(f) of the NHPA, BOEM has analyzed, and continues to analyze, alternatives and mitigation measures to minimize adverse visual effects of the Proposed Action on the Nantucket NHL. To reduce or minimize daytime visual effects, the Proposed Action would use paint schemes that lower the visual contrast of the WTGs against the background, and to minimize nighttime effects, would use an aircraft detection light system. BOEM also included Alternative C in its analysis of alternatives to further reduce visual effects on the Nantucket NHL, and Alternative C has been identified as a component of BOEM's Preferred Alternative. Alternative C would exclude the six WTGs nearest to the Nantucket NHL and relocate them to the southern portion of the Wind Development Area, further reducing both daytime and nighttime effects. BOEM is currently considering additional mitigation measures in consultation with consulting parties to further mitigate the adverse effects as part of the NHPA Section 106 review of the Proposed Action.

In addition to BOEM's actions to minimize harm to the Nantucket NHL, BOEM requested ACHP participation in the NHPA Section 106 review for the Proposed Action in a June 17, 2018, letter. The ACHP accepted BOEM's request and has continued to participate throughout the NHPA Section 106 review process. BOEM, in consultation with consulting parties, will make final determinations on measures to resolve adverse effects on the Nantucket NHL as part of the NHPA Section 106 review for the Proposed Action. ACHP will then review the proposed measures to resolve adverse effects, as well as consulting party comments, in order to fulfill their role in Section 110(f).

To comply with the requirement to notify the Secretary of any consultations involving an NHL, BOEM has consulted with the National Historic Landmarks Program (NHLP) of the National Park Service (NPS).[5] BOEM requested that the NPS participate in the NHPA Section 106 review for the Proposed Action in a June 17, 2018, letter, and the NPS began participating in the NHPA Section 106 review consultation at that time. BOEM also identified and invited the then-acting director of the NHLP to participate in the consultation in an October 12, 2018, letter. At the November 27, 2018, consultation meeting, representatives from the NPS attended and participated in the consultation, during which the adverse effect on the Nantucket NHL was discussed. The adverse effect on the Nantucket NHL was subsequently submitted to the NPS in BOEM's initial FoAE for the Proposed Action, dated April 10, 2019, and BOEM's revised FoAE, dated June 20, 2019. BOEM will continue to consult with the NPS throughout the NHPA Section 106 review consultations for the Proposed Action.

C.1.2.5. Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the MSA, federal agencies are required to consult with NMFS on any action that may result in adverse effects on Essential Fish Habitat (EFH). NMFS regulations implementing the EFH provisions of the MSA can be found at 50 CFR Part 600. As provided for in 50 CFR § 600.920(b), BOEM has accepted designation as the lead agency for the purposes of fulfilling EFH consultation obligations under Section 305(b) of the MSA. Certain Outer Continental Shelf activities authorized by BOEM may result in adverse effects on EFH and, therefore, require consultation with NMFS. BOEM developed an EFH Assessment concurrent with the DEIS, and transmitted the findings of that EFH Assessment to NMFS on December 7, 2018. Subsequently, BOEM prepared an expanded EFH Assessment for Alternative A (BOEM 2019c), as well as a new addendum to evaluate changes to the PDE and the new Alternative F on EFH species (BOEM 2020b); the FEIS summarizes and discusses the assessment's key findings and incorporates the entire assessment by reference. BOEM's EFH Assessment determined that the Proposed Action would adversely affect quality and quantity of EFH for several species of managed fish. BOEM received EFH conservation recommendations from NFMS on June 27, 2019, and additional comments on July 27, 2020. On November 25, 2020, BOEM responded to NMFS' EFH conservation recommendations, concluding the consultation. NMFS provided additional comments to

[5] The Secretary has delegated the authority for responsibility under 36 CFR § 800.10(c) to the NPS NHLP.

BOEM by letter on December 11, 2020. BOEM followed up with NMFS on the additional comments and incorporated them as appropriate into the FEIS.

C.1.2.6. Marine Mammal Protection Act

Section 101(a) of the Marine Mammal Protection Act (MMPA) (16 USC § 1361) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 USC § 1372(a) (l), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give NMFS the authority to authorize the incidental but not intentional take[6] of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. Incidental Take Authorizations (ITAs) may be issued as either (1) regulations and associated Letters of Authorization or (2) an Incidental Harassment Authorization (IHA).[7] Letters of Authorizations may be issued for up to a maximum period of 5 years, and IHAs may be issued for a maximum period of 1 year. NMFS has also promulgated regulations to implement the provisions of the MMPA governing the taking and importing of marine mammals (50 CFR Part 216) and has published application instructions that prescribe the procedures necessary to apply for an ITA. U.S. citizens seeking to obtain authorization for the incidental take of marine mammals under NMFS' jurisdiction must comply with these regulations and application instructions in addition to the provisions of the MMPA.

Once NMFS determines an application is adequate and complete, NMFS has a corresponding duty to determine whether and how to authorize take of marine mammals incidental to the activities described in the application. To authorize the incidental take of marine mammals, NMFS evaluates the best available scientific information to determine whether the take would have a negligible impact on the affected marine mammal species or stocks and an unmitigable impact on their availability for taking for subsistence uses. NMFS must also prescribe the "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, and on the availability of those species or stocks for subsistence uses, as well as monitoring and reporting requirements.

On September 7, 2018, NMFS received a request from Vineyard Wind for an IHA pursuant to the MMPA for the take of marine mammals incidental to the proposed Project's construction. Based on the review of the initial application received, NMFS required and requested additional information from Vineyard Wind. Vineyard Wind complied with NMFS requests and submitted revised versions of the application on October 11, 2018, and January 28, 2019. NMFS deemed Vineyard Wind's final application adequate and complete on February 15, 2019. Because serious injury or mortality to marine mammals is not expected to result from Vineyard Wind's construction activities for the proposed Project, NMFS determined an IHA is appropriate and published a proposed IHA in the Federal Register (84 Fed. Reg. 18346) on April 30, 2019, for public review. NMFS expects to issue a final ITA within 90 days of the ROD.

While reviewing the Project proponent's request for an IHA, NMFS has an independent responsibility to comply with NEPA. NMFS is relying on the information and analyses in this Environmental Impact Statement (EIS), as NMFS intends to adopt this EIS and sign a ROD, if NMFS determines this EIS to be sufficient to support NMFS's separate Proposed Action and decision under the MMPA.

C.1.3. Development of the Final Environmental Impact Statement

This section provides an overview of the development of this FEIS, including public scoping for the NEPA process, cooperating agency involvement, distribution of the DEIS and SEIS for public review and comment, and distribution of this FEIS.

[6] The term "take" means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 USC § 1362(3)(13)). The incidental take of a marine mammal falls under three categories: mortality, serious injury, or harassment (i.e., injury and/or disruption of behavioral patterns). Harassment, as defined in the MMPA for non-military readiness activities (Section 3(8)(A)), is any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns (Level B harassment). Disruption of behavioral patterns includes, but is not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

[7] Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant).

C.1.3.1. Scoping

On March 30, 2018, BOEM issued a Notice of Intent (NOI) to prepare an EIS consistent with the regulations implementing NEPA (42 USC § 4321 et seq.) to assess the potential impacts of the Proposed Action and Alternatives (Notice of Intent to Prepare an Environmental Impact Statement for Vineyard Wind's Proposed Wind Energy Facility, 83 Fed. Reg. 13777 [March 30, 2018]). The NOI commenced the public scoping process for identifying issues and potential alternatives for consideration in the EIS. BOEM held five public scoping meetings in the vicinity of the proposed Project area to solicit feedback and to identify issues and potential alternatives for consideration in the EIS. Throughout the scoping process, federal agencies, state, local, and tribal governments, and the general public had the opportunity to help BOEM identify potential significant resources and issues, impact-producing factors, reasonable alternatives (e.g., size, geographic, seasonal, or other restrictions on construction and siting of facilities and activities), and potential mitigation measures to be analyzed in the EIS, as well as provide additional information. BOEM used the NEPA scoping process to initiate the Section 106 consultation process under the NHPA (54 USC § 300101 et seq.), as permitted by 36 CFR § 800.2(d)(3), and sought public input through the NOI regarding historic properties and potential effects on historic properties from activities associated with the COP. BOEM also used this scoping process to begin informal ESA consultation. The formal scoping period lasted from March 30 through April 30, 2018.

BOEM accepted comment submissions on the NOI via the following mechanisms:

- Electronic submissions received via www.Regulations.gov on docket number BOEM-2018-0015
- Electronic submissions received via email to a BOEM representative
- Hard-copy comment letters submitted to BOEM via traditional mail
- Hard-copy comment cards and/or letters received during each of the public scoping meetings
- Comments submitted verbally at each of the public scoping meetings

BOEM held five public scoping meetings at the following locations and dates:

- April 16, 2018—Fairfield Inn and Suites, Waypoint Event Center, New Bedford, Massachusetts
- April 17, 2018—Martha's Vineyard Hebrew Center, Vineyard Haven, Massachusetts
- April 18, 2018 (a.m.)—Nantucket Middle School, Nantucket, Massachusetts
- April 18, 2018 (p.m.)—Double Tree Hotel, Hyannis, Massachusetts
- April 19, 2018—University of Rhode Island Ryan Center, Kingston, Rhode Island

BOEM reviewed and addressed, as appropriate, all scoping comments in the development of the DEIS, and used the comments to identify alternatives for analysis. A Scoping Summary Report (BOEM 2018c) summarizing the submissions received and the methods for analyzing them is available on BOEM's website at https://www.boem.gov/Vineyard-Wind/. In addition, all public scoping submissions received can be viewed online at http://www.regulations.gov by typing "BOEM-2018-0015" in the search field. As detailed in the Scoping Summary Report, the resource areas or NEPA topics most referenced in the scoping comments include commercial fisheries and for-hire recreation fishing, Lewis Bay, the Project description, socioeconomics, alternatives, and others.

C.1.3.2. Cooperating Agencies

BOEM also used the NEPA scoping process to invite other federal agencies and state, tribal, and local governments to consider becoming cooperating agencies in the preparation of the DEIS. According to Council on Environmental Quality (CEQ) guidelines, qualified agencies and governments are those with "jurisdiction by law or special expertise" (CEQ 1981). BOEM asked potential cooperating agencies to consider their authority and capacity to assume the responsibilities of a cooperating agency, and to be aware that an agency's role in the environmental analysis neither enlarges nor diminishes the final decision-making authority of any other agency involved in the NEPA process. BOEM offered to provide potential cooperating agencies with a written summary of expectations for cooperating agencies, including time schedules and critical action dates, milestones, responsibilities, scope, and detail of cooperating agencies' contributions, and availability of pre-decisional information. BOEM also asked agencies to consider the "Factors for Determining Cooperating Agency Status" in Attachment 1 to CEQ's January 30, 2002, Memorandum for the Heads of Federal Agencies (CEQ 2002). BOEM held interagency meetings in 2018 on March 20, June 20, August 2, and October 15 to discuss the environmental review process, schedule, responsibilities, and consultation.

The following have supported preparation of the DEIS, SEIS, and FEIS as cooperating agencies:

- BSEE
- U.S. Environmental Protection Agency
- NMFS
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- Massachusetts CZM
- Narragansett Indian Tribe
- Rhode Island Coastal Resource Management Council
- Rhode Island Department of Environmental Management

NMFS is serving as a cooperating agency pursuant to 40 CFR § 1501.6 because the scope of the Proposed Action and alternatives involve activities that have the potential to affect marine resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to the MMPA, as amended (16 USC § 1361 et seq.); the regulations governing the taking and importing of marine mammals (50 CFR § 216); the ESA (16 USC § 1531 et seq.); and the regulations governing the taking, importing, and exporting of threatened and endangered species (50 CFR §§ 222–226). In accordance with 50 CFR Part 402, NMFS also serves as the Consulting Agency under Section 7 of the ESA for federal agencies proposing action that may affect marine resources listed as threatened or endangered. NMFS has additional responsibilities to conserve and manage fishery resources of the United States, which includes the authority to engage in consultations with other federal agencies pursuant to the MSA and 50 CFR Part 600 when proposed actions may adversely affect EFH.

C.1.3.3. Distribution of the Draft Environmental Impact Statement for Review and Comment

On December 7, 2018, BOEM published a Notice of Availability for the DEIS consistent with the regulations implementing NEPA to assess the potential impacts of the Proposed Action and alternatives (Notice of Availability of a Draft Environmental Impact Statement for Vineyard Wind LLC’s Proposed Wind Energy Facility Offshore Massachusetts, 83 Fed. Reg. 63184–63185 [December 7, 2018]). The DEIS was made available in electronic form for public viewing at https://www.boem.gov/Vineyard-Wind, and hard copies and/or compact discs (CDs) were delivered to libraries and other entities as specified in the DEIS Appendix E. The Notice of Availability commenced the public review and comment period of the DEIS. As described below, BOEM held five public hearings in the vicinity of the proposed Project area to solicit feedback and identify issues for consideration in preparing the FEIS. Throughout the public review and comment period, federal agencies; state, local, and tribal governments; and the general public had the opportunity to provide comments on the DEIS in various ways including the following:

- Electronic submissions via www.Regulations.gov on docket number BOEM-2018-0069;
- Electronic submissions via email to a BOEM representative;
- Hard-copy comment letters submitted to BOEM via traditional mail;
- Hard-copy comment cards and/or letters received during each of the public hearings; and
- Comments submitted verbally at each of the public hearing meetings.

Initially, BOEM’s 45-day public comment period was scheduled to close on January 22, 2019; however, due to the government shutdown, BOEM extended the comment period until February 22, 2019, and the public hearings were rescheduled as follows:

- February 11, 2019—Nantucket Atheneum, Nantucket, Massachusetts
- February 12, 2019—Martha’s Vineyard Hebrew Center, Vineyard Haven, Massachusetts
- February 13, 2019—Double Tree Hotel, Hyannis, Massachusetts
- February 14, 2019—Fairfield Inn and Suites, Waypoint Event Center, New Bedford, Massachusetts
- February 15, 2019—Narragansett Community Center, Narragansett, Rhode Island

The topics most referenced during the DEIS comment period included commercial fisheries and for-hire recreational fishing, cumulative impacts, mitigation, finfish, invertebrates, and EFH, and purpose and need. BOEM reviewed and has considered all public submissions in the development of this FEIS. BOEM's evaluation of public submissions focused on those comments within the submissions that were identified as substantive. Appendix K describes the public comment processing methodology and definitions, and also includes responses to the substantive comments received on the DEIS. In addition, all public comment submissions received on the DEIS can be viewed online at http://www.regulations.gov by typing "BOEM-2018-0069" in the search field.

C.1.3.4. Distribution of the Supplemental Environmental Impact Statement for Review and Comment

As mentioned above, comments received from stakeholders and cooperating agencies on the DEIS requested BOEM to expand the cumulative impact analysis for the proposed Project. Considering such comments, and taking into account recent state offshore wind procurement announcements since DEIS publication, BOEM expanded its planned action analysis based on the determination that a greater build out of offshore wind capacity is reasonably foreseeable than was analyzed in the DEIS.

On June 12, 2020, BOEM published a Notice of Availability for the SEIS consistent with the regulations implementing NEPA (42 USC § 4321 et seq.) to analyze reasonably foreseeable effects from an expanded planned action scenario for offshore wind development, previously unavailable fishing data, a new transit lane alternative, and changes to the COP since publication of the DEIS (Notice of Availability of a Supplement to the DEIS for Vineyard Wind LLC's Proposed Wind Energy Facility Offshore Massachusetts and Public Meetings, 85 Fed. Reg. 35952 [June 12, 2020]). The SEIS was made available in electronic form for public viewing at https://www.boem.gov/Vineyard-Wind/, and hard copies and/or CDs were delivered to libraries and other entities as specified in the SEIS Appendix F. The Notice of Availability commenced the 45-day public review and comment period of the SEIS. Throughout the public review and comment period, federal agencies, state, local, and tribal governments, and the general public had the opportunity to provide comments on the SEIS in various ways including the following:

- Electronic submissions via www.Regulations.gov on docket number BOEM-2020-0005;
- Electronic submissions via email to a BOEM representative;
- Hard-copy comment letters submitted to BOEM via traditional mail; and
- Comments submitted verbally at each of the public hearing meetings.

Due to the COVID-19 pandemic, BOEM held five virtual public meetings via Zoom on the following dates:

- June 26, 2020
- June 30, 2020
- July 2, 2020
- July 7, 2020
- July 9, 2020

The topics most referenced during the SEIS comment period included commercial fisheries and for-hire recreational fishing, planned action analysis impacts, employment and economics, alternatives, and purpose and need. BOEM reviewed and considered all public submissions in the development of this FEIS. BOEM's evaluation of public submissions focused on those comments within the submissions that were identified as substantive. Appendix K describes the public comment processing methodology and definitions, and also includes responses to the substantive comments received on the SEIS. In addition, all public comment submissions received on the SEIS can be viewed online at http://www.regulations.gov by typing "BOEM-2020-005" in the search field.

C.1.4. Distribution of the Final Environmental Impact Statement for Review and Comment

This FEIS is available in electronic form for public viewing at https://www.boem.gov/Vineyard-Wind/. BOEM has delivered hard copies and/or CDs of this FEIS to the entities listed in Appendix J. Publication of this FEIS initiates a minimum 30-day mandatory waiting period, during which BOEM is required to pause before issuing a ROD. The ROD will state clearly whether BOEM intends to approve, approve with conditions, or disapprove the COP for construction, operation, and eventual decommissioning of the proposed Project.

C.2. Unavoidable Adverse Impacts of the Proposed Action

The CEQ's NEPA-implementing regulations (40 CFR § 1502.16) require that an EIS evaluate the potential unavoidable adverse impacts associated with a proposed action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. Table C.2-1 provides a listing of such impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. FEIS Chapter 3 and Appendix A provide additional information on the potential impacts listed below.

All impacts from past, present, and reasonably foreseeable future activities are still expected to occur as described in the No Action Alternative analysis in this FEIS and the DEIS and SEIS, regardless of whether or not the Proposed Action is approved.

Table C.2-1: Potential Unavoidable Adverse Impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Air Quality	• Air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation
Water Quality	• Increase in suspended sediments due to seafloor disturbance during construction, maintenance, and decommissioning activities
Terrestrial and Coastal Fauna	• Habitat-alteration-induced impacts, avoidance behavior, and individual mortality due to clearing and grading activities
Birds and Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs
Coastal Habitats	• Increase in suspended sediments and habitat-quality effects due to seafloor disturbance
Benthic Resources	• Increase in suspended sediments and resulting effects due to seafloor disturbance • Habitat quality impacts including reduction in habitat as a result of seafloor surface alternations • Disturbance, displacement, and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic • Individual mortality due to construction activities • Conversion of soft-bottom habitat to new hard-bottom habitat
Finfish, Invertebrates, and Essential Fish Habitat	• Increase in suspended sediments and resulting effects due to seafloor disturbance • Habitat quality alterations or loss of habitat • Displacement, disturbance, and avoidance behavior due to habitat loss/alteration, equipment noise, vessel traffic, increased turbidity, sediment deposition, and electromagnetic fields • Individual mortality due to construction activities
Marine Mammals	• Displacement, disturbance, and avoidance behavior due to habitat loss/alteration, equipment and vessel noise, and vessel traffic during construction and operations • Temporary loss of acoustic habitat and increased potential for vessel strikes • Increased risk for injury or mortality associated with fisheries gear
Sea Turtles	• Disturbance, displacement, and avoidance behavior due to habitat loss/alteration, equipment noise • Increased potential for vessel strikes • Increased risk for injury or mortality associated with fisheries gear

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Demographics, Employment, and Economics	• Disruption of commercial fishing, for-hire recreational fishing, and marine recreational businesses during offshore construction and cable installation • Hindrances to ocean economy sectors due to the presence of the offshore wind facility, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses
Environmental Justice	• Loss of employment or income due to disruption to commercial fishing, for-hire recreational fishing, or marine recreation businesses • Hindrances to subsistence fishing due to offshore construction and operation of the offshore wind facility
Cultural, Historical, and Archaeological Resources	• Impacts on viewsheds of and to historic properties • Damage to underwater paleolandform features
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access • Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from construction of offshore Project elements • Temporary disruption to the marine environment and marine species important to fishing and sightseeing due to turbidity and noise • Hindrances to some types of recreational fishing, sailing, and boating within the area occupied by WTGs during operation
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption to access or temporary restriction in harvesting activities due to construction of offshore project elements • Disruption to harvesting activities during operations of offshore wind facility • Changes in vessel transit and fishing operation patterns
Land Use and Coastal Infrastructure	• Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays • Potential for accidental releases during construction
Navigation and Vessel Traffic	• Changes in vessel transit patterns • Congestion in port channels • Increased navigational complexity, vessel congestion, and allision risk within the offshore WDA • Hindrances to search and rescue missions within the offshore WDA
Other Uses	• Disruption to offshore scientific research and surveys and species monitoring and assessment • Increased navigational complexity for military or national security vessels operating within the offshore WDA • Need for changes in vessel transit patterns for military or national security vessels • Changes to aviation and air traffic navigation patterns • Impacts on marine-based radar systems when close to the WTGs

WDA = Wind Development Area; WTG = wind turbine generator

C.3. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

CEQ's NEPA-implementing regulations (40 CFR § 1502.16) require that an EIS review the potential impacts on irreversible or irretrievable commitments of resources resulting from implementation of a proposed action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts of nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs due to the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

Table C.3-1 provides a listing of potential irreversible and irretrievable impacts by resource area. FEIS Chapter 3 and Appendix A provide additional information on the impacts summarized below.

Table C.3-1: Irreversible and Irretrievable Commitment of Resources by Resource Area

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Air Quality	No	No	BOEM expects air emissions to comply with permits regulating air quality standards, and emissions would be temporary during construction activities. If the Proposed Action displaces fossil-fuel energy generation, overall improvement of air quality would be expected.
Water Quality	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands. Turbidity impacts in the marine and coastal environment would be short-term.
Terrestrial and Coastal Fauna	Yes	Yes	Removal of habitat associated with clearing and grading activities, as well as construction of the substation, could potentially create minor irreversible and irretrievable impacts.
Birds and Bats	Yes	No	Irreversible impacts on birds and bats could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of being displaced from foraging habitat.
Coastal Habitats	No	No	Any turbidity impacts would be short-term and not lead to irreversible or irretrievable impacts. Changes in seabed composition/habitat as a result of cable protection could result in negligible to minor beneficial impacts.
Benthic Resources	No	No	Although local mortality could occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality could occur, BOEM does not anticipate population-level impacts. The Vineyard Wind 1 Project could alter habitat during construction and operations, but could restore the habitat after decommissioning.
Marine Mammals	No	Yes	Irreversible impacts on marine mammals could occur if one or more individuals of species listed under the ESA were injured or killed; however, implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for such impacts on listed species. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Project area.
Sea Turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed; however, implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for impacts on listed species. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Project area.
Demographics, Employment, and Economics	No	Yes	A temporary increase of contractor needs, housing needs, and supply requirements could occur during construction activities. This could lead to an irretrievable loss of workers for other projects, and increased housing and supply costs.
Environmental Justice	No	Yes	Impacts on environmental justice communities could occur due to loss of income or employment for low-income workers in marine industries; this could be reversed by project decommissioning or by other employment, but income lost during Project operations would be irretrievable.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Cultural, Historical, and Archeological Resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of previously unidentified cultural resources onshore and offshore could result in irreversible and irretrievable impacts.
Recreation and Tourism	No	No	Construction activities near the shore could result in a minor, temporary loss of use of the land for recreation and tourism purposes.
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and operations, BOEM does not anticipate impacts on commercial fisheries to result in irreversible impacts. The Vineyard Wind 1 Project could alter habitat during construction and operations, limit access to fishing areas during construction, or reduce vessel maneuverability during operations. However, the decommissioning of the Project would reverse those impacts. Irretrievable impacts could occur due to the loss of use of fishing areas at an individual permit level.
Land Use and Coastal Infrastructure	Yes	Yes	Land use required for construction and operation activities, such as the land proposed for the substation, could result in a minor irreversible impact. Construction activities could result in a minor irretrievable impact due to the temporary loss of use of the land for otherwise typical activities. Onshore facilities may or may not be decommissioned.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and operations, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in transit routes, which could be less efficient during the life of the Project.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during proposed Project construction, operations, and decommissioning activities.

BOEM = Bureau of Ocean Energy Management; ESA = Endangered Species Act; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service; WTG = wind turbine generator

C.4. Relationship Between the Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

CEQ's NEPA-implementing regulations (40 CFR § 1502.16) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action would result in detrimental effects on long-term productivity of the affected areas or resources.

As assessed in FEIS Chapter 3 and Appendix A, BOEM anticipates that the majority of the potential adverse effects associated with the Proposed Action would occur during construction activities, and would be short-term in nature and minor or moderate. These effects would cease after decommissioning activities. In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the long-term benefits of the Proposed Action, which include:

- Promotion of clean and safe development of domestic energy sources and clean energy job creation;
- Promotion of renewable energy to help ensure geopolitical security, combat climate change, and provide electricity that is affordable, reliable, safe, secure, and clean;
- Delivery of power to the New England energy grid to contribute to Massachusetts' renewable energy requirements, particularly, the Commonwealth's mandate that distribution companies jointly and competitively solicit proposals for offshore wind energy generation; and
- Increased habitat for certain fish species.

Based on the anticipated potential impacts evaluated in this FEIS and both the DEIS and SEIS that could occur during Proposed Action construction, operations, maintenance, and decommissioning, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment. Removal or disturbance of habitat associated with onshore activities (e.g., construction of the proposed substation) could create long-term irreversible impacts. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in C.3, Irreversible and Irretrievable Commitment of Resources would be long-term. After completion of the Proposed Action's operations and decommissioning phases, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.

C.5. ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

Several alternatives have been considered but eliminated from detailed study. These alternatives were identified through coordination with state and federal agencies and input from the public and potentially affected stakeholders through the DEIS scoping process and the SEIS development process. BOEM evaluated the alternatives described below and excluded them from further consideration because they did not meet the purpose and need and/or did not meet the screening criteria. These alternatives are presented below with a brief discussion of the reasons for their elimination as prescribed in Council on Environmental Quality (CEQ) regulations at 40 CFR § 1502.14(a) and Department of the Interior regulations at 43 CFR § 46.420(b-c). The screening criteria used included:

- Consistency with law and regulations
- Operational, technical, and economic feasibility
- Environmental impact
- Geographical considerations

Alternative Wind Turbine Foundation Types: BOEM received comments suggesting the use of suction bucket foundations, gravity-based foundations, mobile jack-up platforms, or floating wind turbine foundation types to reduce impacts on marine mammals, sea turtles, and fish from pile driving associated with monopile and jacket foundations. These foundation types are not feasible within the Project area due to, among other things, the seafloor substrate and water depths:

- The dense soils beneath an upper loose surficial layer of sand may prevent the full penetration required for stability of suction bucket foundations.
- The loose upper layer of sandy sediment also presents a settlement risk for gravity-based foundations.
- The water depths are too shallow in portions of the lease area for floating foundations, which is a technology that is unproven for a project the size of what is proposed by Vineyard Wind.

While these foundation types would not require pile driving, the larger footprint of suction bucket and gravity-based foundations would increase seabed disturbance. Additionally, these foundation types would create less room for fishing activities between turbines when compared to monopile or jacket foundations. Moreover, site preparation and dredging activities for suction bucket and gravity-based foundations could increase potential environmental impacts when compared to monopile or jacket foundations. Overall, these alternative foundation types are not feasible in the lease area and may increase long-term environmental impacts over those from monopile or jacket foundations within the lease area.

Alternative Landfall Location: BOEM received comments suggesting a cable landfall at Brayton Point instead of New Hampshire Avenue or Covell's Beach. If a high-voltage direct-current transmission line were used, installation of a midway converter station and associated equipment would be required; this, in turn, would increase the offshore footprint of the proposed Project and introduce additional technical risk. Even if a high-voltage AC transmission line were used and an additional converter station were not required, it would likely have greater net environmental impacts due to the longer length of the OECC. Additional length of cable required for the offshore export cables could also increase impacts on fishing activities due to greater risk of snags for fishing gear. The Brayton Point location is therefore less operationally feasible and increases environmental impacts offshore.

Offshore Regional Transmission Network: Several commenters suggested that BOEM mandate the use of an offshore regional transmission cable system for the proposed Project. This alternative is unfeasible primarily because such a system does not yet exist, and BOEM has issued no ROWs for such a system. BOEM has received unsolicited proposals for the development of two open-access offshore transmission systems from Anbaric Development Partners LLC. One is named the New York and New Jersey Ocean Grid and the other is named the Southern New England Ocean Grid. The New York/New Jersey proposal would not connect to the WDA or Massachusetts, though the Southern New England proposal could. However, there is no proposed timeline for when this could occur. Furthermore, it is unclear who would pay for transmission capacity in excess of what would be required for the Proposed Action. The proposed Project timeline would be substantially delayed by the time needed to properly plan a regional transmission network that would not reduce system resiliency or pose capacity issues for onshore substations. In addition, mandating the use of an offshore regional transmission cable system would not alter the need for Vineyard Wind to construct and maintain an offshore export cable, whose impacts are considered in the applicable analyzed alternatives. At the present time, these factors outweigh any potential future decrease in cumulative seabed disturbance that may result from having multiple projects sharing one regional cable network.

Shared Cable Corridor: Some commenters suggested that BOEM mandate the use of a shared cable corridor as the OECC. BOEM considers this alternative unnecessary at the present time because construction of a cable within the OECC would not foreclose the future installation of cables for other offshore wind facilities along the same route. BOEM can authorize multiple cable easements and ROWs in parallel and in relatively close proximity. For example, 30 CFR § 585.302(b) states that the rights granted under a ROW for a transmission cable would not prevent the granting of other rights by the United States, either before or after the granting of the ROW, provided a subsequent authorization would not unreasonably interfere with the activities or existing operations. Moreover, as discussed above, requiring the construction of cables that accommodate future offshore wind facilities as part of the proposed Project could create capacity issues for onshore substations, and is it is unclear who would pay for transmission capacity in excess of what would be required for the Proposed Action. At this time, these factors outweigh any potential future decrease in collective seabed disturbance that may result from having multiple projects sharing one cable corridor.

Alternative Location for the Wind Energy Facility Outside of Lease OCS-A 0501: Locating the wind energy facility outside of lease area OCS-A 0501 would constitute a new Proposed Action, and would not address BOEM's regulatory need to respond to Vineyard Wind's proposal to build a large-scale commercial wind energy facility within a defined geographic area on Lease OCS-A 0501. BOEM would consider proposals on other existing leases through a separate regulatory process. Other potential lease areas may be considered at a later date. This alternative would therefore not meet the purpose and need of the proposed Project, and would effectively be the same as selecting Alternative G (No Action).

Alternative Location for the Wind Energy Facility Further Offshore in Lease OCS-A 0501: Several commenters have suggested that BOEM consider a project that is on Lease OCS-A 0501 but moves the entire project further offshore or further southwest, or both, extending outside the WDA. This alternative would decrease the potential for viewshed conflicts as compared to Alternative A, the Proposed Action, but the benefits of this alternative to visual impacts would likely be outweighed by increased seabed disturbance from a longer export cable, including the potential addition of a converter station, and longer vessel trips to the WDA during construction and operations. The evidence also does not indicate that moving the entire proposed Project further offshore within the lease area would reduce impacts on biological resources or commercial fishing. Moving the proposed Project further offshore would also severely impact the proposed Project's feasibility for several reasons. Particularly, it would delay permitting and heighten Project risk because additional surveys would be needed for some or all of the WDA. That delay and risk could potentially make the proposed Project economically infeasible. This alternative essentially constitutes a different proposal and, thus, is not consistent with the goals of the applicant. This alternative would therefore not meet the purpose and need of the proposed Project, and would effectively be the same as selecting Alternative G (No Action).

Alternative Spacing between Wind Energy Turbines: Several commenters have suggested an alternate spacing of 1.5 to 2 nautical miles or greater between WTGs, which would result in turbines outside the lease area. While this alternative could reduce impact on fishing opportunities within the WDA, it would result in placing turbines outside the lease area (Figure C.5-1) and would essentially constitute a different proposal. In addition, increased environmental impacts could occur from longer cabling required. This alternative would not meet the purpose and need of the proposed Project, and would effectively be the same as selecting Alternative G (No Action).

Eighty-Four Wind Energy Turbines with Alternative Spacing: Several commenters suggested that BOEM should analyze in detail an alternative that contemplates the use of 84, 9.5 MW WTGs, spaced with 1.5 nautical miles between them. Analysis of AIS data indicates that 1-nautical-mile spacing between WTGs is sufficient for fishing vessels to turn and navigate within the WDA (COP Volume III, Appendix III-I; Epsilon 2020b, and no other available information indicates that increased spacing between WTGs would enhance maneuverability of vessels fishing within the WDA. In addition, the submitted Vineyard Wind COP assumes a range in WTG sizes, and BOEM does not see a need to require the use of a specific turbine size. This alternative was not analyzed in detail because of this information and because BOEM expects it to result in more expected impacts than other alternatives being fully analyzed due to the increased spacing between WTGs that would translate to increased cabling and longer vessel trips.

Phased Development and Monitoring: Several commenters recommended an alternative under which BOEM would require phased development of the proposed Project. Under this alternative, BOEM would allow initial construction of only a portion of the turbines, require the first phase to be studied for several years, and then only permit the remainder of the turbines to be constructed if deemed environmentally acceptable (or subject to additional terms and conditions) based on the results of those studies. While this alternative might have the eventual effect of reducing some environmental impacts, a phased approach could present permitting challenges. This alternative would also, by its nature, create permitting delays and project risk that could potentially foreclose its economic feasibility. This alternative would essentially constitute a different proposal and would not meet the goals of the applicant. This alternative would therefore effectively be the same as selecting Alternative G (No Action).

Project Configuration that Does Not Interfere with Existing Public Views: Several commenters recommended an alternative where the proposed Project could not be seen from the coast of Nantucket or in views that are culturally significant to tribes. No other specifics for this alternative were provided; therefore, based on the description provided, this alternative would require the proposed Project be built at a distance of greater than 38.4 miles (33.4 nautical miles, 31.8 kilometers) for it not to be viewed from the coast of Nantucket, based on the curvature of the earth. Thus, this alternative would require eliminating all 106 turbine placement locations proposed under Vineyard Wind's COP, would require a longer OECC, and would result in increased duration of vessel trips during construction and operations. Furthermore, this alternative would allow for less than 80 WTGs within the southern portion of lease area OCS-A 0501. These technical challenges would potentially foreclose the proposed Project's economic feasibility. This alternative would essentially constitute a different proposal and would not meet the goals of the applicant. Therefore, this alternative would effectively be the same as selecting Alternative G (No Action).

Locate Project Outside Known Habitat for Federal or State-Listed Species. The entirety of Vineyard Wind's lease as well as other OCS areas in the vicinity include habitat for species listed as endangered or threatened under federal or state laws as well as habitat for non-listed species. Development elsewhere in the OCS that does not contain habitat for listed species is likely not feasible, possibly not even identifiable, and would not meet the purpose and need of the proposed Project. This alternative would effectively be the same as selecting Alternative G (No Action).

Project Limited to 50 WTGs: Limiting the proposed Project to 50 WTGs would only allow for a project of a maximum of 700 MW, assuming the use of the 14 MW WTGs. A 700 MW project would not meet the purpose and need of the proposed Project and would impact the proposed Project's ability to meet the requirements of its power purchase agreements, potentially threatening its economic feasibility. This alternative would essentially constitute a different proposal and would not meet the goals of the applicant. This alternative would effectively be the same as selecting Alternative G (No Action).

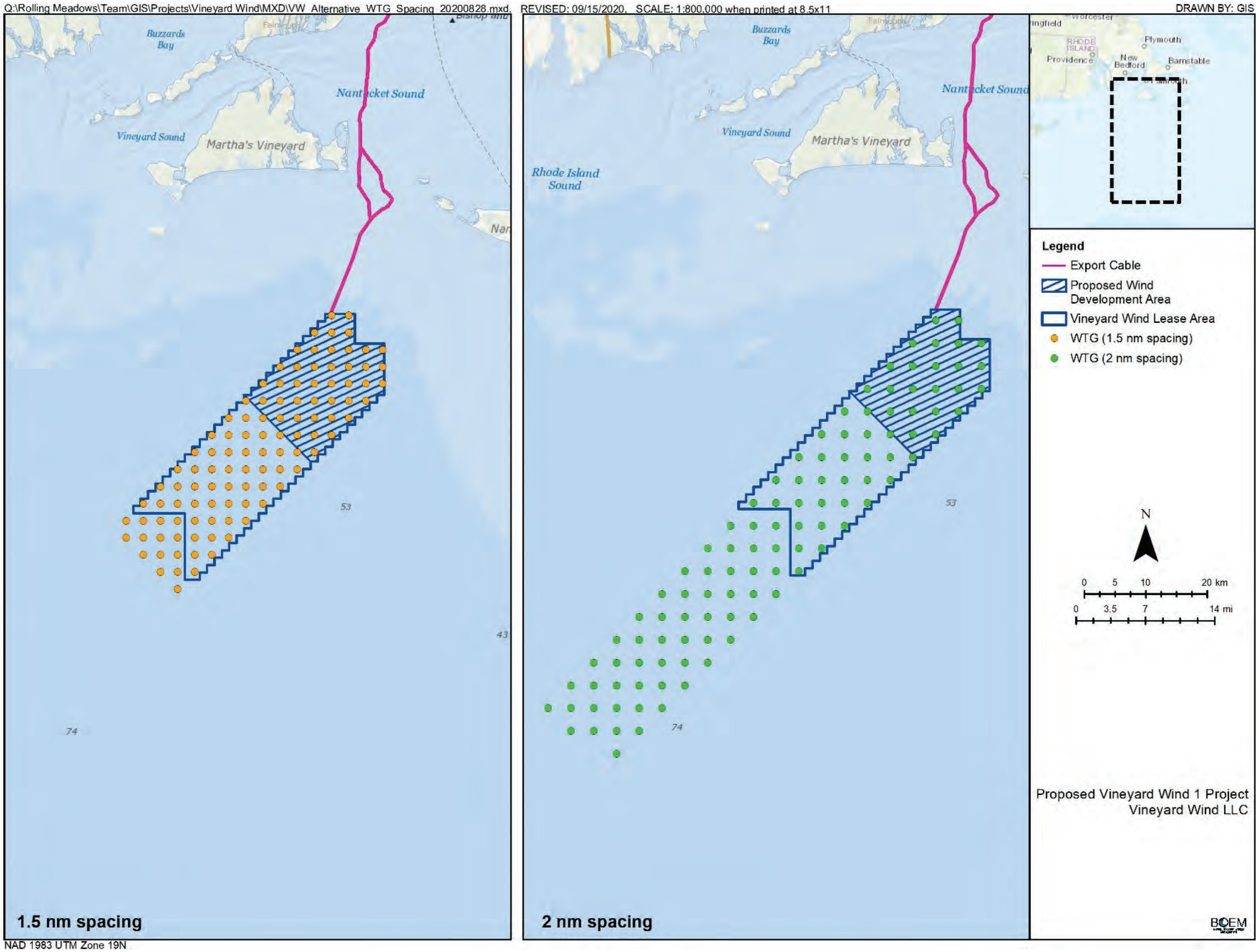

Figure C.5-1: Alternative Spacing Between Wind Energy Turbines

Transit Lane Alternative with Widths other than 2 and 4 Nautical Miles: An analysis of a range of transit lanes between 2 and 4 nautical miles or greater than 4 nautical miles is not needed to address stakeholder concerns. The primary transit lane widths identified through stakeholder discussions were 2 and 4 nautical miles. In addition, BOEM's subject matter experts believe, based on information available to them at this time, that an analysis of additional transit lane widths other than those analyzed in the DEIS and the SEIS (0.7 to 1 nautical mile in Alternative A; 2 to 4 nautical miles in Alternative F) would not provide the Secretary of the Interior significantly different information regarding impacts on affected resources when compared to the information obtained by the transit lanes BOEM is analyzing in this FEIS. BOEM's subject matter experts believe that the widths selected for analysis provide a representative view of the impacts and benefits that could result from establishing transit lanes ranging from 0.7 to 4 nautical miles.

Although some interested parties have suggested vessel transit lanes in the combined RI and MA Lease Areas with widths in excess of 4 nautical miles, BOEM is unaware of any studies justifying that width. The closest metric to that suggestion that BOEM has seen (from U.K. Maritime Guidance MGN 543; U.K. 2016) is that routes should be wide enough to allow for a 20-degree course variation in rough conditions. For the 15-nautical-mile-long diagonal through the RI and MA Lease Areas, this would be a lane of 5.5 nautical miles. However, the context of MGN 543 indicates that this metric is intended for larger commercial vessels with less responsive steering and that are more heavily impacted by wind, such as the vessels moving through New York Harbor that are in excess of 800 feet. The fishing vessels transiting the RI and MA Lease Areas are much smaller, with the largest licensed fishing vessel in the area being 138 feet (42.1 meters). Nearby lanes intended for deep-draft traffic include the Traffic Separation Schemes for Narragansett Bay (11.5 nautical miles long and 4 nautical miles wide) and Boston (127.5 nautical miles long and 4 nautical miles wide). These Traffic Separation Schemes see both a larger traffic volume and larger individual vessel size than the entirety of the RI and MA Lease Areas, and include a separation zone of 1 to 2 nautical miles in the middle of the lane. Therefore, BOEM does not believe that an analysis of this alternative is necessary.

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APPENDIX D

Mitigation and Monitoring

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APPENDIX D. MITIGATION AND MONITORING

As part of the proposed Vineyard Wind 1 Offshore Wind Energy Project (Project), Vineyard Wind LLC (Vineyard Wind) has voluntarily committed to measures to avoid, reduce, mitigate, and/or monitor[1] impacts on the resources discussed in Chapter 3 and Appendix A of the Final Environmental Impact Statement (FEIS). The mitigation and monitoring measures are summarized in the Construction and Operations Plan (COP) Volume III, Table 4.2-1 and 4.2-2 (Epsilon 2020b). In addition, some of these measures are included in Table D-1 if they were meaningful in the analysis of impacts on the resources. The Bureau of Ocean Energy Management (BOEM) considers as part of the Proposed Action only those measures that Vineyard Wind has committed to in the COP. BOEM may select alternatives and/or require additional mitigation or monitoring measures to further protect and monitor these resources. Additional mitigation and monitoring measures have resulted from reviews under several environmental statutes (National Historic Preservation Act, Magnuson-Stevens Fisheries Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act), as discussed in FEIS Section 2.1. The mitigation and monitoring measures that Vineyard Wind has committed to implement (in addition to those defined in the COP (Epsilon 2018, 2019, 2020a, 2020b), as well as those that may result from reviews under these statutes, are shown in Table D-1. Please note that not all of these mitigation measures are within BOEM's statutory and regulatory authority but could potentially be adopted and imposed by other governmental entities. Table D-1 provides descriptions of mitigation or monitoring measures described above, as well as those that BOEM identified for analysis in the FEIS. If the COP is approved or approved with conditions, mitigation measures that are required under various consultations and permits (e.g., Endangered Species Act and Marine Mammal Protection Act) will be included in an attachment to the Record of Decision (ROD). In addition, BOEM will continue to work with cooperating agencies in the implementation of any outstanding recommendations or measures.

If BOEM decides to approve the COP, its ROD will state which of the additional mitigation and monitoring measures identified by BOEM in Table D-1 have been adopted, and if not, why they were not. The ROD will identify those final measures. If they differ substantially from those listed in Table D-1, BOEM will evaluate whether effects analyses need to be modified to address those changes. Thus, the ROD would compel compliance with or execution of identified mitigation and monitoring measures (40 Code of Federal Regulations [CFR] § 1505.3). Vineyard Wind would be required to certify compliance with certain terms and conditions, as required under 30 CFR § 585.633(b).

Monitoring measures may be required to evaluate the effectiveness of a mitigation measure or to identify if resources are responding as predicted to impacts from the Proposed Action. Monitoring programs would continue to be developed in coordination with BOEM and agencies with jurisdiction over the resource to be monitored. The information generated by monitoring may be used to (1) adapt how a mitigation measure identified in the COP or ROD is being implemented, (2) develop or modify future mitigation measures for the decommissioning of the proposed Project or for all stages of future projects, and/or (3) contribute to regional efforts intended to gain a better understanding of the impacts and benefits resulting from offshore wind energy projects in the Atlantic. BOEM has updated this appendix to include additional details related to mitigation and monitoring that have become available since publication of the Draft Environmental Impact Statement (DEIS), as well as comments received during the comment period for the DEIS and Supplement to the DEIS. Unless specified, the proposed mitigation and monitoring measures described below would not change the impact ratings on the affected resource, as described in FEIS Chapter 3 and Appendix A, but would reduce expected impacts or inform the development of addition mitigation measures if required.

[1] According to the Council on Environmental Quality, monitoring is "fundamental for ensuring the implementation and effectiveness of mitigation commitments, meeting legal and permitting requirements, and identifying trends and possible means for improvement" (CEQ 2011).

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Table D-1: Mitigation Measures and Monitoring Efforts Analyzed

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
1.	Dust-control plans for onshore construction and laydown areas	Develop dust-control plans for onshore construction areas to minimize impacts from fugitive dust resulting from construction activities.	Air Quality (A.8.1)	Construction	Mitigation	Development and implementation of dust control plans would further reduce the expected **negligible** to **minor** temporary impacts on air quality by reducing the amount of particulate matter associated with onshore construction.	Voluntary by Vineyard Wind
2.	Bird deterrent devices	Install bird deterrent devices to minimize bird attraction to operating turbines and on the ESP(s), where appropriate and where Vineyard Wind determines such devices can be employed safely.	Birds (A.8.3)	Construction, Operations, and Maintenance	Mitigation	Use of bird deterrent devices would further reduce the expected **negligible** to **minor** long-term impacts on birds by minimizing the potential attraction to operating WTGs.	USFWS
3.	Piping Plover Protection Plan	Installation of export cable conduits are not expected to be initiated between April 1 and August 31. If HDD activities are initiated between April 1 and August 31, or if work is re-initiated after a 48-hour work stoppage during the Piping Plover nesting season (the aforementioned time period), the Massachusetts NHESP, USFWS, and BOEM must be notified with the reason, anticipated duration of the work, and any additional information requested by NHESP, USFWS, and BOEM.	Birds (A.8.3)	Construction	Mitigation/ Notification	Initiation of HDD activities prior to April 1 would further reduce the expected **negligible** temporary impact on nesting Piping Plovers by avoiding the time of year when breeding pairs are establishing nesting territories.	NHESP
4.	Pre-construction monitoring	If HDD activities are initiated between April 1 and August 31, or if work is re-initiated after a 48-hour work stoppage during the Piping Plover nesting season (the aforementioned time period), follow the measures outlined in the PPPP. As depicted in the PPPP, a qualified biologist will perform surveys to determine the presence/absence of any nesting Piping Plovers within 200 yards (182.9 meters) of the work zone. If no nests, scrapes, or territorial pairs are identified within 200 yards (182.9 meters) of the work zone, the shorebird monitor will document the findings, report to NHESP and Vineyard Wind, and Vineyard Wind will be cleared to mobilize into the area within 48 hours, with no further monitoring activities required. If nests, scrapes, or territorial pairs are observed within 200 yards (182.9 meters) of the work zone, locations will be recorded and the following monitoring will be required, based on nests and/or chick proximity to the work zone: • ≥100 yards (91.4 meters) from work zone—nest monitored once per day at dawn (before 0600 hours) during appropriate weather conditions; • 50–100 yards (45.7–91.4 meters) from work zone—nest monitored twice per day at dawn and dusk (before 0600 hours and after 1900 hours) during appropriate weather conditions; and • < 50 yards (45.7 meters) to the work zone—no equipment may be mobilized to Covell's Beach parking lot unless specifically permitted by the NHESP.	Birds (A.8.3)	Construction	Monitoring	This monitoring measure would not reduce the expected **negligible** temporary impacts on nesting Piping Plovers but would aid in limiting construction impacts on nesting Piping Plovers and/or other state-listed species, if any, as a result of HDD operations.	NHESP
5.	Coastal beach disturbance	In the unlikely event that disturbance associated with HDD activities to coastal beach occurs, a qualified biologist will survey the site in advance of any equipment access to the beach and will ensure no remedial actions will interfere with nesting Piping Plovers or other state-listed species.	Birds (A.8.3)	Construction	Monitoring	While the expected **negligible** temporary impacts on nesting Piping Plovers would not change, this monitoring measure would aid in limiting construction impacts on nesting Piping Plovers and/or other state-listed species, if any, as a result of HDD operations.	NHESP
6.	Personnel training	The PPPP will be provided to construction personnel prior to HDD operations so that proper implementation of the plan can be achieved.	Birds (A.8.3)	Construction	Mitigation	This mitigation measure would not reduce the expected **negligible** temporary impact rating for Piping Plover, but would prompt an accurate identification of Piping Plovers in or near the HDD work zone.	NHESP

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
7.	ADLS	Require use of FAA-approved-ADLS, which will only activate the FAA hazard lighting when an aircraft is in the vicinity of the wind facility, to reduce the visibility of nighttime lighting and thus reduce nighttime visual impacts.	Birds (A.8.3); Cultural Resources (3.8); Recreation and Tourism (3.9)	Operations and Maintenance	Mitigation	Use of ADLS would further reduce the expected **minor** long-term impacts on birds by reducing the potential for attraction to operating WTGs and the **minor** long-term impacts on cultural and scenic resources by reducing the amount of time WTGs would be visible at night. See Appendix B for additional details related to FAA's review of ADLS for the proposed Project	Voluntary by Vineyard Wind NHPA Section 106
8.	Avian and bat post-construction monitoring program	A framework for an avian and bat post-construction monitoring program will be developed and implemented in coordination with applicable federal and state resource agencies (see Appendix F for details). The framework will include, at a minimum: • Acoustic monitoring for birds and bats; • Installation of Motus receivers on WTGs in the WDA and support with upgrades or maintenance of two onshore Motus receivers; • Deployment of up to 150 Motus tags per year for up to 3 years to track Roseate Terns, Common Terns, and/or nocturnal passerine migrants; • Pre- and post-construction boat surveys; • Avian behavior point count surveys at individual WTGs; and • Annual monitoring reports that will be used to assess the need for reasonable revisions (based on subject matter expert analysis) to the monitoring plan and may include new technologies as they become available for use in offshore environments. • Vineyard Wind will work with BOEM to ensure the data is publicly available.	Birds (A.8.3) and Bats (A.8.4)	Operations and Maintenance	Monitoring	This monitoring measure would not reduce the expected **negligible** to **minor** long-term impacts on birds, but the data gathered would be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	USFWS
9.	Annual bird mortality reporting	Require an annual report of any dead or injured birds discovered on Project vessels or structures. Report will contain the following information: species, photos to confirm species, location, date, and other relevant information. Carcasses with federal or research bands must be reported to the U.S. Geological Survey Bird Band Laboratory, BOEM, and USFWS.	Birds (A.8.3)	Construction, Operations, Maintenance, and Decommissioning	Monitoring/ Notification	This monitoring measure would not reduce the expected **negligible** to **minor** long-term impacts on birds, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	BOEM
10.	Tree clearing time-of-year restriction	Require that trees greater than 3 inches (7.6 centimeters) diameter at breast height not be cleared from June 1 to July 31. If presence/probable absence surveys are conducted pursuant to current USFWS protocols and no northern long-eared bats are documented, this measure may not be necessary for ESA compliance relative to this species.	Bats (A.8.4)	Construction	Mitigation	If implemented, tree-clearing time-of-year restrictions would minimize the expected **negligible** temporary impacts on bats, if present, by limiting impacts on the time of year when both adults and young of the year are able to leave the area when tree clearing occurs.	USFWS
11.	Dredging and cable installation methods and timing	Require dredging and cable installation activities to use the least environmentally harmful method that will be effective in each area and to use updated habitat information (Measure #15) to avoid/minimize impacts on benthic habitat to the maximum extent practicable. Require all vessels deploying anchors to use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor. Require nearshore cable-laying activities to avoid high concentrations of fishing activities and natural resource events (spawning and egg laying). The non-HDD cable laying operations in the northern part of the offshore export cable area within Nantucket Sound waters will occur outside of April to June. Should cable laying be required in the northern part of the export cable route within Nantucket Sound in April to June due to environmental or technical reasons, Vineyard Wind must provide justification to BOEM, MassDEP, Massachusetts Division of Marine Fisheries, and NMFS.	Coastal Habitats (3.1); Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction	Mitigation	The use of the least environmentally harmful installation method would further reduce the expected **minor** to **moderate** temporary impacts on coastal habitats and **moderate** impacts on benthic resources and finfish, invertebrates, and EFH by minimizing the degree of disturbance. Limiting the cable installation to certain times of year would further reduce the expected **moderate** impacts on finfish, invertebrates, and EFH by avoiding high concentrations of fishing activities and natural resource events. Vineyard Wind has indicated that their planned schedule for cable installation activities would meet this requirement.	MassDEP 401 Water Quality Certification NMFS EFH

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
12.	Anchoring plan	Require an anchoring plan for all areas where anchoring is being used to avoid construction impacts on sensitive habitats, including hard bottom and structurally complex habitats. Require that Vineyard Wind consider any new data on benthic habitats (Measure #15) to avoid/minimize impacts on benthic habitat to the maximum extent practicable. The anchoring plan must include the planned location of anchoring activities, sensitive habitats and locations, seabed features, potential hazards, and any related facility installation activities such as cables, WTGs, and ESPs, as appropriate. Require all vessels deploying anchors to use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor. The anchoring plan must be provided for BOEM and NOAA review and comment before construction begins.	Coastal Habitats (3.1); Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	This measure would further reduce the expected **minor** to **moderate** impacts on coastal habitats and benthic resources and the expected **minor** impacts on finfish, invertebrates, and EFH, by minimizing potential adverse impacts.	BOEM
13.	Benthic monitoring plan	Require that Vineyard Wind consider any new data on benthic habitats when refining the plan. Require that Vineyard Wind consult with NMFS and the MassDEP and the Massachusetts Division of Marine Fisheries and address any agency comments before finalizing and implementing the monitoring plan. If recovery is not observed within 5 years, Vineyard Wind, BOEM, and NMFS will confer regarding potential additional monitoring. The monitoring plan must evaluate if the cable protection (including different types of cable projection) used is mitigating negative impacts on juvenile cod HAPC. In addition, per the Nantucket Order of Conditions (Nantucket Conservation Commission 2019), for the portion of the proposed work in Town of Nantucket waters: (1) Vineyard Wind must obtain the approval of MassDEP for the final benthic monitoring plan, (2) Vineyard Wind must provide an annual report to the Nantucket Conservation Commission demonstrating the condition of the area in and around the cable installation to clearly demonstrate any impacts, and (3) if a report shows any adverse impact, Vineyard Wind must provide a detailed mitigation or restoration plan to the Conservation Commission. In addition, Vineyard Wind must provide an annual report to MassDEP, the Massachusetts Division of Marine Fisheries, NMFS, and BOEM discussing the type(s) and scale(s) of any impacts identified.	Coastal Habitats (3.1); Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction	Monitoring	This monitoring measure would not reduce the expected **moderate** impacts on coastal habitats or finfish, invertebrates, and EFH, or the **negligible** to **moderate** impacts on benthic resources, but the data gathered could be used to evaluate impacts and lead to additional mitigation measures, if required (30 CFR § 585.633(b)), and could be used to inform Vineyard Wind's decommissioning procedures, as well as to help others planning similar future projects select the least impactful method(s).	MassDEP 401 Water Quality Certification BOEM
14.	Final cable protection in hard bottom	Cable protection measures within complex hard-bottom habitat as defined in the COP, EFH Assessment (BOEM 2019, 2020, and additional data from Measure #15 will consist of natural or engineered stone that does not inhibit epibenthic growth and provides three-dimensional complexity, both in height and in interstitial spaces. Vineyard Wind will also be required to consider nature-inclusive designs for optimized cable protection (Hermans et al. 2020). Additionally, per the Nantucket Order of Conditions (Nantucket Conservation Commission 2019), cable protection, where required in Town of Nantucket waters, must consist of natural materials that mimic the surrounding seafloor. Require that Vineyard Wind consult with NMFS and BOEM prior to the implementation of hard-bottom cable protection measures. BOEM will make recommendations regarding the final selection of engineered stone in consultation with NMFS. The effectiveness of natural and engineered stone as a mitigation measure to minimize impacts on juvenile cod HAPC will be evaluated/monitored as a component of a finalized benthic monitoring plan (Measure #13).	Coastal Habitats (3.1); Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction	Mitigation	This measure would further reduce the expected **moderate** impacts and improve the possible **minor beneficial** impacts on coastal habitats; would further reduce the expected **minor** to **moderate** impacts and improve the possible **minor beneficial** impacts on benthic resources; and would further reduce the expected **negligible** to **moderate** impacts on finfish, invertebrates, and EFH by increasing the probability of recolonization by organisms and use of the introduced substrate as habitat. This measure could also improve possible moderate beneficial impacts on structure-oriented finfish and invertebrates.	Massachusetts CZM BOEM

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
15.	Evaluation of additional benthic habitat data prior to cable laying	At a minimum, Vineyard Wind will process 75 benthic grabs over the entire length of the OECC (with approximately 42 in the eastern Muskeget section) and 60 underwater video transects over the entire length of the OECC (with 28 transects in the eastern Muskeget section). This information will be used to update habitat maps to resolve and delineate seafloor habitats consistent with NOAA's May 2020 Recommendations for Mapping Fish Habitat (NOAA 2020). Based on this review, Vineyard Wind will use the additional data to avoid eelgrass, hard bottom, and structurally complex habitats (including juvenile cod HAPC) to the maximum extent practicable while also maintaining a feasible route.	Coastal Habitats (3.1); Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction	Mitigation	This measure would allow for impacts on sensitive bottom habitats and EFH to be avoided and minimized to the maximum extent practicable. However, it is not anticipated to change the impact level rating in most cases.	BOEM
16.	Dredge disposal sites	Where dredging is necessary, Vineyard Wind will clearly identify a limited number of dredge disposal sites within known sand wave areas, and to the maximum extent practicable, ensure that these sites do not contain resources that will be damaged by sediment deposition. To do this Vineyard Wind will use the additional habitat data collected under Measure #15. In addition, Vineyard Wind shall report the locations of dredge disposal sites to BOEM, NOAA, MassDEP, and Massachusetts CZM within 30 days of disposal of materials. These locations must be reported in latitude and longitude degrees to the nearest 10 thousandth of a decimal degree (roughly the nearest meter), or as precise as practicable.	Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction	Mitigation and Monitoring	Ensuring the proper disposal of dredged materials could minimize the expected **minor** impacts on benthic resources and finfish, invertebrates, and EFH. In addition, documenting the location of dredge disposal sites would allow for a better understanding and management of impacted resources and for the identification of potential remedial efforts if misplacement of materials were to occur.	USACE MassDEP Massachusetts CZM
17.	Bottom profiling	Per the Nantucket Order of Conditions (Nantucket Conservation Commission 2019), prior to cable installation in Town of Nantucket waters, Vineyard Wind shall provide updated bottom profiling detailing pre-construction bottom composition, sediment profiles, species composition, and topography of the area to be disturbed during cable installation, and shall include at a minimum high-resolution video monitoring.	Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction	Monitoring	This monitoring measure would not reduce the expected **negligible** to **moderate** impacts on benthic resources and **moderate** impacts on finfish, invertebrates, and EFH, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	Town of Nantucket Order of Conditions
18.	Post-installation cable monitoring	Vineyard Wind must provide BOEM and NOAA with a cable monitoring report within 45 calendar days following each inter-array and export cable inspection to determine cable location, burial depths, state of the cable, and site conditions. An inspection of the inter-array cable and export cable is expected to include HRG methods, such as a multi-beam bathymetric survey equipment, and identify seabed features, natural and man-made hazards, and site conditions along federal sections of the cable routing. In federal waters, the initial inter-array and export cable inspection will be carried out within 6 months of commissioning and subsequent inspections will be carried out at years 1, 2, and every 3 thereafter, and after a major storm event. Major storm events are defined as when metocean conditions at the facility meet or exceed the 1 in 50-year return period calculated in the metocean design basis, to be submitted to BOEM with the FDR. Post-storm surveys will be focused on areas of concern following an analysis of the Distributed Temperature Sensing (DTS) System data. If conditions warrant adjustment to the frequency of inspections following the Year 2 survey, a revised monitoring plan may be provided to BOEM for review. In addition to inspection, the export cable will be monitored continuously with the as-built DTS System. If DTS data indicate that burial conditions have deteriorated or changed significantly and remedial actions are warranted, the DTS data, a seabed stability analysis, and report of remedial actions taken or scheduled must be provided to BOEM within 45 calendar days of the observations.	Benthic Resources (3.2); Commercial Fisheries and For-Hire Recreational Fishing (3.10)	Operations and Maintenance	Monitoring	This monitoring measure would not reduce the expected **minor** to **moderate** impacts on benthic resources, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)). Furthermore, monitoring of the OECC cable and cable protection, where applicable, would further reduce the expected **minor** to **major** impacts on commercial fisheries by ensuring that the cable remains buried and that cable protection is intact, thereby reducing the potential for mobile fishing gear hangs.	BOEM

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		The DTS data, cable monitoring survey data, and cable conditions analysis for each year must be provided to BOEM as part of the Annual Compliance Reports, required by 30 CFR § 585.633(b).					
19.	Optical surveys of benthic invertebrates and habitat	Require Vineyard Wind to conduct optical surveys. Stations will be placed on a 0.9-mile (1.5-kilometer) grid, with four samples taken at each station twice per year. The drop camera surveys emulate the drop camera survey conducted in the lease area in 2012 and 2013 to support a BACI study design (SMAST 2019). The survey methodology may be adapted over time based on the results obtained and feedback from various stakeholders. Require that Vineyard Wind consult with NMFS and BOEM prior to conducting surveys and address any agency comments in the survey plan.	Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction, Operations, and Maintenance	Monitoring	This monitoring measure would not reduce the expected **minor** to **moderate** impacts on benthic resources or the **negligible** to **moderate** impacts on finfish, invertebrates, and EFH, but the data gathered could be used to refine current knowledge of regional finfish, invertebrate, and EFH resources and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	NOAA EFH CRs #10 and #11 Voluntary by Vineyard Wind
20.	Monitoring and minimizing foundation scour protection	Vineyard Wind will conduct post-construction monitoring to document habitat disturbance and recovery at offshore wind turbine foundations per the benthic habitat monitoring plan #13. Additionally, Vineyard Wind will inspect scour protection performance at 20% of locations every 3 years starting Year 3. Require that Vineyard Wind consult with NMFS and BOEM prior to conducting inspections and address any agency comments prior to implementation. As appropriate, based on Project design and engineering, Vineyard Wind will apply foundation scour protection to only the minimum area needed for sufficient protection.	Benthic Resources (3.2); Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction, Operations	Mitigation	This mitigation measure would monitor impacts and further reduce the expected **negligible** to **minor** impacts and possibly **minor beneficial** impacts of habitat conversion on benthic resources and the **moderate** impacts of habitat conversion on finfish, invertebrates, and EFH by reducing the area affected by scour protection. This measure could also improve possible moderate beneficial impacts on structure-oriented finfish and invertebrates.	Voluntary by Vineyard Wind BOEM
21.	Adaptive refinement of exclusion zones and monitoring protocols	Reduce unanticipated impacts on marine trust resources through near-term refinement of exclusion zones by refining pile-driving monitoring protocols based on monthly and/or annual monitoring results, in coordination with BOEM and NMFS. The NMFS BO (NMFS 2020) and draft IHA (NMFS 2019) identify minimum sizes of exclusion zones and any modifications will be to increase the zones and not decrease the zones.	Marine Mammals (3.4); Sea Turtles (3.5)	Construction	Mitigation	This mitigation measure would further reduce the expected **negligible** to **moderate** temporary impacts on marine mammals due to the potential application of additional mitigation measures, if applicable, developed in response to ongoing pre- and post-construction monitoring. This mitigation measure would further reduce the expected **negligible** to **moderate** temporary impacts on sea turtles due to the potential application of additional mitigation measures, if applicable, developed in response to ongoing pre- and post-construction monitoring.	NMFS BO T&C 6d (portion of) NOAA IHA Section 4
22.	Plankton surveys	Plankton surveys will be conducted to estimate the relative abundance and distribution of planktonic species such as larval lobster using a towed neuston net to allow for comparison with 2019 baseline sampling (SMAST 2020). Plankton tows will be conducted at each survey location concurrently with the ventless trap surveys, i.e., two times per month from May 15 to October 31. The survey methodology may be adapted over time based on the results obtained and feedback from various stakeholders.	Finfish, Invertebrates, and Essential Fish Habitat (3.3)	Construction, Operations, and Maintenance	Monitoring	This monitoring measure would not reduce the expected **negligible** to **moderate** impacts on finfish, invertebrates, and EFH, but the data gathered could be used to refine current knowledge of regional finfish, invertebrate, and EFH resources for future offshore wind energy projects as well as to evaluate proposed-Project impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	Voluntary by Vineyard Wind
23.	PAM	Use PAM buoys or autonomous PAM devices to record ambient noise and marine mammal species vocalizations in the lease area (before, during, and after construction [at least 2 years of operation]) to monitor impacts including vessel noise, pile driving, WTG operation, and large whale detections in the WDA. Results must be provided within 90 days of buoy collection and again within 90 days of the 1-year and 2-year anniversary of collection. The underwater acoustic monitoring must follow standardized measurement and processing methods and visualization metrics developed by the Atlantic Deepwater Ecosystem Observatory Network (ADEON) for the U.S. Mid- and South Atlantic Outer Continental Shelf (see https://adeon.unh.edu/). At least	Finfish, Invertebrates, and Essential Fish Habitat (3.3); Marine Mammals (3.4)	Construction, Operations, Maintenance, and Decommissioning	Monitoring	This monitoring measure would not reduce the expected **minor** impacts on finfish, invertebrates, and EFH nor the **negligible** to **moderate** impacts on marine mammals, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	BOEM

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		two buoys must be independently deployed within the lease area or one or more buoys must be deployed in coordination with other acoustic monitoring efforts in the RI and MA Lease Areas.					
24.	Periodic underwater surveys, reporting, and monofilament and other fishing gear cleanup around WTG foundations	Monitor indirect impacts associated with charter and recreational gear lost from expected increases in fishing around WTG foundations. Surveys by remotely operated vehicles, divers, or other means will inform frequency and locations of debris removal to decrease ingestion by and entanglement of marine species. The results of the surveys will be reported to BOEM (renewable_reporting@boem.gov) by April 30 for the preceding calendar year in which the survey is performed. Reports will be submitted in Word format. Photographic and videographic materials will be provided on a drive in a lossless format such as TIFF or Motion JPEG 2000. Reports will include daily survey reports that include the date, contact information of the operator, location and pile identification number, photographic and/or video documentation of the survey and debris encountered, any animals sighted, and the disposition of any located debris (i.e., removed or left in place). Required data and reports may be archived, analyzed, published, and disseminated by BOEM.	Finfish, Invertebrates, and Essential Fish Habitat (3.3); Marine Mammals (3.4), Sea Turtles (3.5); Birds (A.8.3)	Operations and Maintenance	Mitigation	The removal of fishing gear would further reduce the expected **negligible** long-term impacts on finfish, invertebrates, and EFH, marine mammals, and birds, as well as the expected minor long-term impacts on sea turtles by reducing the potential for habitat modification as well as hooking, entrapment, injury, and death from lost fishing gear.	Voluntary by Vineyard Wind
25.	Trawl survey for finfish and squid	To support a BACI analysis, sampling will occur before, during, and 1 year after construction both within the Project footprint as well as at control sites. A total of 40 tows, 20 in the Project area, and 20 in control areas, will be conducted four times per year. Vineyard Wind will collect and process stomach and otolith samples from sampling and provide this information to BOEM and NOAA. The survey methodology may be adapted over time based on the results obtained and feedback from various stakeholders.	Finfish, Invertebrates, and Essential Fish Habitat (3.3); Commercial Fisheries and For-Hire Recreational Fishing (3.10); Other Uses (3.12)	Construction, Operations, and Maintenance	Monitoring	This monitoring measure would not reduce the expected **negligible** to **moderate** impacts on finfish, invertebrates, and EFH or the **minor** to **major** impacts on commercial or for-hire recreational fisheries, but data gathered could be used to refine the current knowledge of regional finfish and invertebrate resources and to evaluate proposed-Project impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	Voluntary by Vineyard Wind
26.	Ventless trap surveys	Ventless trap surveys will be conducted to allow for comparison with 2019 baseline sampling. Surveys will occur before, during, and 1 year after construction. The ventless trap survey will follow the protocols of the coast-wide ventless trap survey, with six traps alternating between vented and ventless; this method has been adopted by New York and all New England states with the exception of Maine and has been accepted by the Atlantic States Marine Fisheries Commission. There will be 15 sampling sites in the 501N Study Area and 15 in the Control Area, for a total of 30 stations. Each location will be sampled two times per month from May 15 to October 31 with a target soak time of 3 to 5 days. To alleviate concerns relative to North Atlantic right whales (NARWs), the traps will use weak-link technology to minimize whale entanglement and no sampling will occur between November and early May, when NARWs may be in the area. Additionally, Vineyard Wind will be required to tag lobsters, which it is currently doing voluntarily, and to record all reported recaptures of tagged lobsters. Vineyard Wind is currently equipping some pots with sensors to record bottom temperature, salinity, pH, and dissolved oxygen, and Vineyard Wind will be required to discuss these data in survey reports. The survey methodology may be adapted over time based on the results obtained and feedback from various stakeholders.	Finfish, Invertebrates, and Essential Fish Habitat (3.3); Commercial Fisheries and For-Hire Recreational Fishing (3.10); Other Uses (3.12)	Construction, Operations, and Maintenance	Monitoring	This monitoring measure would not reduce the expected **negligible** to **moderate** impacts on finfish, invertebrates, and EFH or the **minor** to **major** impacts on commercial or for-hire recreational fisheries, but the data gathered could be used to refine current knowledge of regional finfish and invertebrate resources and to evaluate proposed-Project impacts and could potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	Voluntary by Vineyard Wind

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
27.	Soft start for pile driving	Vineyard Wind must implement soft-start techniques for impact pile driving. The soft start must include an initial set of three strikes from the impact hammer at reduced energy, followed by a 1-minute waiting period. This process must be repeated a total of three times prior to initiation of pile driving. Soft start is required for any impact driving, including at the beginning of the day, and at any time following a cessation of impact pile driving of 30 minutes or longer.	Finfish, Invertebrates, and Essential Fish Habitat (3.3); Marine Mammals (3.4): Sea Turtles (3.5)	Construction	Mitigation	The establishment of soft-start protocols would reduce the expected **minor** temporary impacts on finfish, invertebrates, and EFH, the expected **minor** to **moderate** temporary impacts on marine mammals, and the expected **moderate** temporary impacts on sea turtles by allowing time for mobile animals to leave the affected area before hammer energy is gradually increased to potentially injurious levels, ensuring that no marine mammals are close enough to pile-driving acoustic impacts on suffer mortal injury.	NOAA IHA Section 4
28.	Pile-driving sound source verification plan	To ensure that the required 6 dB re 1 µPa noise attenuation is met, field verification during pile driving will be conducted. A Sound Source Verification Plan will be submitted to the USACE, BOEM at renewable_reporting@boem.gov, and NMFS at incidental.take@noaa.gov for review 90 days prior to the commencement of field activities for pile driving. Sound source verification must be carried out for the first monopile and first jacket foundation to be installed. Should larger diameter piles be installed, or greater hammer size or energy used, additional field measurements must be conducted. The plan must describe how Vineyard Wind will ensure that the location selected is representative of the rest of the piles of that type to be installed and, in the case that it is not, how additional sites will be selected for sound source verification or how the results from the first pile can be used to predict actual installation noise propagation for subsequent piles. The plan must describe how the effectiveness of the sound attenuation methodology will be evaluated based on the results. The plan must be sufficient to document sound propagation from the pile and distances to isopleths for potential injury and harassment. The measurements must be compared to the Level A and Level B harassment zones for marine mammals (and the injury and behavioral disturbance zones for sea turtles and Atlantic sturgeon).	Finfish, Invertebrates, and Essential Fish Habitat (3.3); Marine Mammals (3.4); Sea Turtles (3.5)	Construction	Monitoring	This monitoring measure would not reduce the expected **minor** temporary impacts on finfish, invertebrates, and EFH, the **minor** to **moderate** temporary impacts on marine mammals, or the **moderate** temporary impacts on sea turtles as a result of pile-driving activities but would ensure that the deployed noise reduction technologies are effective.	NMFS BO T&C 6a, 6b, 6c NOAA IHA Section 5
29.	Pile-driving time-of-year restriction	No pile-driving activities will occur from January 1 to April 30.	Marine Mammals (3.4)	Construction	Mitigation	Time of year restrictions on pile-driving activities would further reduce the expected **minor** to **moderate** temporary impacts on marine mammals by avoiding the time of year when NARW may be present in the proposed Project area.	NOAA IHA Section 4
30.	Pile-driving weather and time restrictions	To minimize the effects of sun glare on visibility, no pile driving may begin until at least 1 hour after (civil) sunrise to ensure effective visual monitoring can be accomplished in all directions. To minimize the effects of sun glare on visibility and to minimize the potential for pile driving to continue after sunset when visibility will be impaired, no pile driving may begin within 1.5 hours of (civil) sunset. Pile driving must only commence when all exclusion zones are fully visible (i.e., are not obscured by darkness, rain, fog, etc.) for at least 30 minutes. If conditions (e.g., darkness, rain, fog, etc.) prevent the visual detection of marine mammals in the exclusion zones, construction activities must not be initiated until the full extent of all exclusion zones are fully visible. The lead PSO will make a determination as to when there is sufficient light to ensure effective visual monitoring can be accomplished in all directions. Vineyard Wind must develop and implement measures for enhanced monitoring in the event that poor visibility conditions unexpectedly arise and pile driving cannot be stopped due to safety or operational feasibility. Vineyard Wind must	Marine Mammals (3.4); Sea Turtles (3.5)	Construction	Monitoring	Time of day visibility and weather restrictions would further reduce the expected **minor** to **moderate** temporary impacts by allowing PSO observers to visually establish required exclusion zones.	NMFS BO T&C 4a, 4b, 4c NOAA IHA Section 5

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		prepare and submit an Alternative Monitoring Plan to NMFS and BOEM for NMFS' review and approval at least 90 days prior to the planned start of pile driving. This plan may include deploying additional observers, alternative monitoring technologies (i.e., night vision, thermal, infrared), and/or use of PAM with the goal of ensuring the ability to maintain all exclusion zones for all ESA-listed species in the event of unexpected poor visibility conditions.					
31.	Pile-driving monitoring plan and PSO requirements	A pile-driving monitoring plan must be submitted to BOEM and NMFS for review and approval a minimum of 90 days prior to the commencement of pile-driving activities. The plan must: • Contain information on the visual and PAM components of the monitoring plan; • Ensure that the full extent of the harassment distances from piles are monitored for marine mammals and sea turtles to ensure that all potential take is documented; • Include number of PSOs and/or Native American monitors that will be used, the platforms and/or vessels upon which they will be deployed, and contact information for the PSO provider(s); and • Include measures for enhanced monitoring capabilities in the event that poor visibility conditions unexpectedly arise, and pile driving cannot be stopped. The plan may also include deploying additional observers, use of night vision goggles, or use of PAM with the goal of ensuring the ability to maintain all exclusion zones in the event of unexpected poor visibility conditions. A communication plan detailing the chain of command, mode of communication, and decision authority must be described. PSOs must be previously approved by NMFS to conduct mitigation and monitoring duties for pile-driving activity. An adequate number of PSOs must be used to adequately monitor the area of the exclusion zone. The size of the exclusion zone may vary with specific time-of-year requirements for NARWs and should be described in the plan.	Marine Mammals (3.4)	Construction	Mitigation	This monitoring measure would not reduce the expected **minor** to **moderate** impacts on marine mammals, but would increase the effectiveness of the required mitigation and monitoring measures for pile driving.	NMFS BO T&C 7 NHPA Section 106
32.	Pile-driving monitoring plan and PSO reporting requirements for sea turtles	A pile-driving monitoring plan must be submitted to BOEM and NMFS for review and approval a minimum of 90 days prior to the commencement of pile-driving activities. The plan must: • Ensure that the full extent of the harassment distances (175 dB RMS) from piles are monitored for sea turtles to ensure that all potential take is documented; • Include (1,640 feet [500 meters]) exclusion zones and exclusion zone modification protocols and approvals required; • Include number of PSOs and/or Native American monitors that will be used, the platforms and/or vessels upon which they will be deployed, and contact information for the PSO provider(s); and • Include measures for enhanced monitoring capabilities in the event that poor visibility conditions unexpectedly arise, and pile driving cannot be stopped. The plan may also include deploying additional observers, use of night vision goggles with the goal of ensuring the ability to maintain all exclusion zones in the event of unexpected poor visibility conditions. A communication plan detailing the chain of command, mode of communication, and decision authority must be described. PSOs must be previously approved by NMFS to conduct mitigation and monitoring duties for pile-driving activity. An	Finfish, Invertebrates, and Essential Fish Habitat (3.3); Sea Turtles (3.5)	Construction	Mitigation and Monitoring	The use of visual surveys prior to the initiation of daily pile-driving activities would further reduce the **moderate** temporary impacts on sea turtles by identifying individuals that may be adversely affected by acoustic impacts from pile driving. This measure would not reduce the expected **minor** impacts on finfish, invertebrates, and EFH or **moderate** impacts on sea turtles, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	NMFS BO T&C 7 NOAA IHA Sections 4 and 5

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		adequate number of PSOs must be used to adequately monitor the area of the exclusion zone. Daily PSO forms, including electronic effort, survey, and sightings forms, must be submitted to BOEM at renewable_reporting@boem.gov monthly on the 15th day of each month for the previous calendar month of activities. Required data and reports may be archived, analyzed, published, and disseminated by BOEM.					
33.	Pile-driving noise reporting and clearance zone adjustment	Before driving any additional piles following underwater noise measurements, Vineyard Wind must review the initial field measurement results and make any necessary adjustments to the sound attenuation system and/or the exclusion or monitoring zones as detailed below. If the initial field measurements indicate that the isopleths of concern are larger than those considered, in coordination with BOEM, NMFS, and USACE, Vineyard Wind must ensure that additional sound attenuation measures are put in place before additional piles are installed. Additionally, the exclusion and monitoring zones must be expanded to match the actual distances to the isopleths of concern. If the exclusion zones are expanded beyond 4,921.3 feet (1,500 meters), additional observers must be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180 degrees an area with a radius no greater than 0.93 mile (1.5 kilometers). The exclusion zones established in the Proposed Action must be considered minimum exclusion zones and may not be reduced based on sound source verification results. Vineyard Wind must provide the initial results of the field measurements to NMFS, USACE, and BOEM as soon as they are available; NMFS, USACE, and BOEM will discuss these as soon as feasible with a target for that discussion within two business days of receiving the results. BOEM and NMFS will provide direction to Vineyard Wind on whether any additional modifications to the sound attenuation system or changes to the exclusion or monitoring zones are required. BOEM must also discuss with NMFS the potential need for re-initiation of consultation if appropriate.	Sea Turtles (3.5)	Construction	Monitoring	This monitoring measure would not reduce the expected **moderate** temporary impacts on sea turtles as a result of pile-driving activities but would ensure that the deployed noise reduction technologies are effective.	NMFS BO T&C 6d
34.	Pile-driving exclusion zones (no-go zones) for sea turtles	To ensure that pile-driving operations are carried out in a way that minimizes the exposure of listed sea turtles to noise that may result in injury or behavioral disturbance, PSOs will establish a 1,640.4-foot (500-meter) exclusion zone for all pile-driving activities.	Sea Turtles (3.5)	Construction	Mitigation	The use of PSO visual monitoring would further reduce the expected **negligible** to **moderate** temporary impacts on sea turtles by establishing exclusion zones that must be free of sea turtles for pile-driving activities to commence.	NMFS BO T&C 2
35.	Protocol when marine mammals are sighted during pre-pile driving exclusion	If a marine mammal is observed entering or within the relevant exclusion zones prior to the initiation of pile-driving activity, pile-driving activity must be delayed (unless activities must proceed for human safety or installation feasibility) until: • The animal is verified to have voluntarily left and heading away from the exclusion area; or • When 30 minutes have elapsed without re-detection (for mysticetes, sperm whales, Risso's dolphins and pilot whales); or • 15 minutes have elapsed without re-detection of other marine mammals.	Marine Mammals (3.4)	Construction	Mitigation	The establishment and maintenance of marine mammal exclusion zones would further reduce the expected **minor** to **moderate** temporary impacts by limiting marine mammal exposure to pile driving.	NOAA IHA Section 4
36.	Enhanced time-of-year pile-driving shutdown and restart procedures for NARWs (May 1 to May 14 and November 1 to December 31)	Should a NARW be observed/detected within the exclusion zone, pile-driving activities must stop (unless activities must proceed for human safety or installation feasibility concerns) and may not resume until: • The following day, or until a follow-up aerial or vessel-based survey is able to confirm all NARW(s) have departed the 6.2-mile (10-kilometer) extended exclusion zone, as determined by the lead PSO after a full day of	Marine Mammals (3.4)	Construction	Mitigation	The establishment of enhanced time-of-year requirements for NARWs would further reduce the expected **minor** to **moderate** temporary impacts by limiting marine mammal exposure to pile driving.	NOAA IHA Section 4

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		monitoring to confirm NARW(s) have left the 6.21-mile (10-kilometer) exclusion zone (May 1 to 14); • Confirmation that all NARW(s) have left the 6.21-mile (10-kilometer) exclusion zone (November 1 to December 31); or • Confirmation that all of NARW(s) have left the 0.62-mile (1-kilometer) exclusion zone after 60 minutes of monitoring (May 15 to October 31).					
37.	Submittal of raw field data collection of marine mammals and sea turtles in the pile-driving exclusion zone	If a marine mammal and/or sea turtle in the exclusion zone results in a shutdown or a power-down, it should be reported to BOEM within 24 hours at renewable_reporting@boem.gov. In addition, the data report, which is the raw data collected in the field, must be submitted by the PSO provider and include the daily form, including the date, time, species, pile identification number, GPS coordinates, time and distance of the animal when sighted, time the shutdown or power-down occurred, behavior of the animal, direction of travel, time the animal left the exclusion zone, time the pile driver was restarted or powered back up, and any photographs that may have been taken. This data report must be submitted to BOEM at renewable_reporting@boem.gov monthly on the 15th day of each month for the previous calendar month of activities.	Marine Mammals (3.4); Sea Turtles (3.5)	Construction	Monitoring	This monitoring measure would not reduce the expected **minor** to **moderate** impacts on marine mammals, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)). This monitoring measure would not reduce the expected **moderate** impacts on sea turtles, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	BOEM
38.	PSO and reporting requirements for pile driving	PSOs must be previously approved by NMFS to conduct mitigation and monitoring duties for pile-driving activity. An adequate number of PSOs must be used to adequately monitor the area of the exclusion zone. Daily PSO forms, including electronic effort, survey, and sightings forms, must be submitted to BOEM at renewable_reporting@boem.gov monthly on the 15th day of each month for the previous calendar month of activities. Required data and reports may be archived, analyzed, published, and disseminated by BOEM. **Detection Information for Protected Species** • Date (YYYY-MM-DD) • Sighting ID (V01, V02 or sequential sighting number for that day) (multiple sightings of same animal or group should use the same ID) • Date and Time at first detection in UTC (YY-MM-DDT HH:MM) • Time at last detection in UTC (YY-MM-DDT HH:MM) • PSO Name(s) (Last, First) • Effort (On=source on; Off = source off) • Latitude (decimal degrees dd.ddddd), Longitude (decimal degrees dd.ddddd) • Compass heading of vessel (degrees) • Water depth (meters) • Swell height (meters) • Beaufort scale • Precipitation • Visibility (km) • Cloud coverage (%) • Glare • Sightings including common name, scientific name, or family • Certainty of identification • Number of adults • Number of juveniles • Total number of animals	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, and Maintenance	Monitoring	This mitigation measure would not reduce the expected **minor** to **moderate** impacts on marine mammals or sea turtles, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	BOEM NOAA IHA Section 5 NMFS BO 8d

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		• Bearing to animal(s) when first detected (ship heading + clock face) • Range from vessel (reticle distance in meters) • Description (include features such as overall size; shape of head; color and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow, etc.) • Detection narrative (note behavior, especially changes in relation to survey activity and distance from source vessel) • Direction of travel / first approach (relative to vessel) • Behaviors observed: Indicate behaviors and behavioral changes observed in sequential order (use behavioral codes) • If any bow-riding behavior observed, record total duration during detection (HH:MM) • Initial heading of animal(s) (degrees) • Final heading of animal(s) (degrees) • Source activity at initial detection • Source activity at final detection (on or off) • Exclusion zone size during detection (meters) • Was the animal inside the exclusion zone? • Closest distance to vessel (reticle distance in meters) • Time at closest approach (UTC HH:MM) • Time animal entered exclusion zone (UTC HH:MM) • Time animal left exclusion zone (UTC HH:MM) • If observed/detected during ramp up / power up: First distance (reticle distance in meters). Closest distance (reticle distance in meters), Last distance (reticle distance in meters), Behavior at final detection • Shut-down or power-down occurrences • Detections with PAM **Monitoring Effort Information for Pile Driving** • Date • Effort (ON=source on; OFF= source off) • If visual, how many PSOs on watch at one time? • PSOs (Last, First) • Start time of observations • End time of observations • Duration of visual observation • Wind Speed (knots), from direction • Beaufort scale • Swell (meters) • Water depth (meters) • Visibility (km) • Glare severity • Block name and number • Location: Latitude and Longitude					
39.	Injured/protected species reporting	Any potential takes, strikes, or dead/injured protected species regardless of the cause, should be reported immediately to NMFS Protected Resources Division, incidental.take@noaa.gov; NOAA Fisheries 24-hour Stranding Hotline number (866-755-6622); and BOEM at renewable_reporting@boem.gov.	Finfish, Invertebrates, and Essential Fish Habitat (3.3), Marine Mammals	Construction, Operations, Maintenance, and Decommissioning	Monitoring	This monitoring measure would not reduce the expected **minor** to **moderate** temporary impacts on marine mammals or sea turtles, nor the expected **minor** temporary impacts on finfish, invertebrates, and EFH as a result of pile-driving activities or vessel operations but would ensure that the amount of take that potentially occurs does not exceed the exempted take under the ESA and MMPA. The data gathered could be used to evaluate	NMFS BO T&C 8b, 8c NOAA IHA Section 5

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		In the event that an injured or dead marine mammal or sea turtle is sighted, Vineyard Wind must report the incident to NMFS Protected Resources Division, incidental.take@noaa.gov; NOAA Fisheries 24-hour Stranding Hotline number (866-755-6622); and BOEM at renewable_reporting@boem.gov as soon as feasible, but no later than 24 hours from the sighting. The report must include the following information: (1) time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable); (2) species identification (if known) or description of the animal(s) involved; (3) condition of the animal(s) (including carcass condition if the animal is dead); (4) observed behaviors of the animal(s), if alive; (5) if available, photographs or video footage of the animal(s); and (6) general circumstances under which the animal was discovered. Staff responding to the hotline call will provide any instructions for handling or disposing of any injured or dead animals by individuals authorized to collect, possess, and transport sea turtles. In the event of a suspected or confirmed vessel strike of a sea turtle by any Project vessel, Vineyard Wind must report the incident to NMFS Protected Resources Division, incidental.take@noaa.gov; NOAA Fisheries 24-hour Stranding Hotline (866-755-6622); and BOEM at renewable_reporting@boem.gov as soon as feasible. The report must include the following information: (1) time, date, and location (latitude/longitude) of the incident; (2) species identification (if known) or description of the animal(s) involved; (c) vessel's speed during and leading up to the incident; (4) vessel's course/heading and what operations were being conducted (if applicable); (5) status of all sound sources in use; (6) description of avoidance measures/ requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike; (7) environmental conditions (e.g., wind speed and direction, Beaufort scale, cloud cover, visibility) immediately preceding the strike; (8) estimated size and length of animal that was struck; (9) description of the behavior of the animal immediately preceding and following the strike; (11) estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and (12) to the extent practicable, photographs or video footage of the animal(s). In addition, any occurrence of dead non-ESA-listed fish of 10 or more individual fish within established exclusion and/or monitoring zones must also be reported to BOEM at renewable_reporting@boem.gov as soon as feasible.	(3.4); Sea Turtles (3.5)			impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	
40.	AIS on all Project construction and operations vessels, turbines, and ESPs	Install operational AIS on all vessels associated with the construction and operation of the Project. Use AIS to mark the location of each WTG and ESP as required by the USCG. AIS will be required to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements. As well as make identification of infrastructure easier for non-Project vessels.	Marine Mammals (3.4); Sea Turtles (3.5); Commercial Fisheries and For-Hire Recreational Fishing (3.10); Navigation and Vessel Traffic (3.11); Other Uses (3.12)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The use of AIS would further reduce the expected **minor** impacts on commercial fisheries by monitoring the number of vessels and traffic patterns during the course of proposed-Project construction, operations and maintenance, and decommissioning as well as make the identification and avoidance of proposed-Project infrastructure easier; and the expected **minor** impacts on marine mammals and sea turtles due to vessel strike by ensuing that proposed-Project vessels comply with speed restrictions.	USCG

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
41.	Marine debris awareness and elimination	Marine debris is defined by BSEE as any object or fragment of wood, metal, glass, rubber, plastic, cloth, paper, or any other manmade item or material that is lost or discarded in the marine environment. Vineyard Wind must ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the COP are briefed on marine debris prevention. BOEM must ensure that Vineyard Wind employees and contractors receive training to understand and implement best practices to ensure that debris is not intentionally or accidentally discharged into coastal or marine environments. Training must occur for all employees and contract personnel on the proper storage and disposal practices at-sea to reduce the likelihood of accidental discharge of marine debris at all at-sea and dockside operations that can impact protected species through entanglement or incidental ingestion. Training must include the environmental and socioeconomic impacts associated with marine trash and debris, as well as their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into coastal and marine environments. In the event that any materials unexpectedly enter the water, personnel must follow best practices to recover it if conditions are safe to do so, or notify the appropriate officials if conditions are unsafe. Briefing materials on marine debris awareness, prevention, and protected species are available at https://www.bsee.gov/debris	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, and Maintenance	Mitigation	Training of crew and personnel would further reduce the overall **negligible** impacts on marine mammals and sea turtles through educational and training materials.	BOEM BSEE
42.	Exclusion zones (no-go zones) for marine mammals	Reduce impact on marine mammals through the use of continuous PAM, visual monitoring by PSOs, and/or Native American monitors during pile-driving activities following standard protocols and data collection requirements specified by BOEM. PSOs will establish the following exclusion zones for NARWs 60 minutes prior to pile-driving activities through 30 minutes post-completion of pile-driving activity: • At all times of year that pile driving takes place, for purposes of monitoring the exclusion zone, any large whale sighted by a PSO within 3,281 feet (1,000 meters [a NARW exclusion zone]) that cannot be identified to species must be treated as if it were a NARW. Additionally, a NARW observation at any distance from the pile must be treated as an observation within the exclusion zone and trigger any required delays or shutdowns in pile installation. • From November 1 to December 31 and May 1 to May 14, establish a 6.21-mile (10-kilometer) exclusion zone for NARWs (Vineyard Wind has the option to use aerial or vessel-based surveys from May 1 to May 14). • For any piles driven May 15 to May 31, the exclusion zone must be extended from 3,281 feet (1,000 meters) to 6,562 feet (2 kilometers) for monopiles and 5,249 feet (1,600 meters) for jacket (i.e., half distance to Level B threshold) to minimize the extent of any take of NARWs. • For any pile driving June 1 to October 31, establish a 5,249-foot (1-kilometer) clearance zone for NARW with the exception as follows. Where the predicted Level B harassment zone will overlap with a DMA or Right Whale Slow Zone, the exclusion zone must be extended from 3,281 feet to 6,562 feet (1 kilometer to 2 kilometers) for monopiles and 5,249 feet (1,600 meters) for jacket piles (i.e., half distance to Level B threshold) to minimize the extent of any take of NARWs. For all pile-driving activity, Vineyard Wind must designate clearance zones with radial distances as follows: • All other mysticete whales (including humpback, fin, sei, and minke whale): 1,649-foot (500-meter) exclusion zone at all times;	Marine Mammals (3.4)	Construction	Mitigation	The use of PAM and PSO visual monitoring would further reduce the expected **minor** to **moderate** temporary impacts on marine mammals by establishing exclusion zones that must be free of marine mammals for pile-driving activities to commence.	NMFS BO T&C 3a, 3c, portion of 3d NOAA IHA Section 4

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		• Harbor porpoise: 394-foot (120-meter) exclusion zone at all times; and • All other marine mammals not listed above (including dolphin and pinnipeds): 164-foot (50-meter) exclusion zone at all times. Monitoring for marine mammals must occur over the entire Level B distance for all marine mammals to document impacts and any potential take.					
43.	NARW PAM monitoring	A PAM plan describing all equipment, procedures, and protocols must be prepared and submitted to BOEM and NMFS at least 90 days prior to initiation of pile-driving activities. The PAM system must be designed such that detection capability extends to 6.21 miles (10 kilometers) from the pile-driving location. If the PAM operator has at least 75 percent confidence that a vocalization originated from a NARW within 6.21 miles (10 kilometers) of the pile-driving location, the PAM operator must determine that a NARW has been detected. Vineyard Wind must continue to deploy the PAM system that is in place for May 1- May 14 through May 31 and implement an extended PAM monitoring zone of 6.21 miles (10 kilometers) around any pile to be driven with all detections of NARWs provided to the visual PSO to increase situational awareness and to be considered as pile driving is planned. At all times of year that pile driving takes place, any PAM detection of a NARW within the clearance/exclusion zone (May 1–May 14: radius 6.2 miles [10,000 meters]; May 15–May 31: 1.24 miles [2,000 meters] for monopiles, 1 mile [1,600 meters] for jacket; June 1–October 31: radius 0.62 miles [1,000 meters] with the exceptions noted below; November 1–December 31: radius 6.2 miles [10,000 meters]) surrounding a pile must be treated the same as a visual observation and trigger any required delays in pile installation. Between June 1 and October 31, if a DMA or Right Whale Slow Zone is designated that overlaps with a predicted Level B harassment zone (monopile foundation: 13,520 feet [4,121 meters], jacket foundation: 10,564 feet [3,220 meters]) from a pile to be installed, the PAM system in place during this period must be extended to the largest practicable detection zone to increase situational awareness of the visual PSOs and for purposes of planning pile installation. At all times of year any visual or PAM detection in the seasonal exclusion zones must be treated the same as a visual observation and trigger any required delays or shutdowns in pile installation.	Marine Mammals (3.4)	Construction	Mitigation	The use of PAM and PSOs would further reduce the expected **minor** to **moderate** temporary impacts on marine mammals by establishing exclusion zones that must be free of marine mammals for pile-driving activities to commence.	NMFS BO T&C 3b, portions of 3e, 3f NOAA IHA Section 4
44.	Protocols for shutdown and power-down when marine mammals are sighted during pile driving	If a marine mammal is observed entering or within the relevant exclusion during pile driving, the hammer must be shut down (unless activities must proceed for human safety or installation feasibility) until: • The animal is verified to have voluntarily left and heading away from the exclusion area; or • When 30 minutes have elapsed without re-detection (for mysticetes, sperm whales, Risso's dolphins, and pilot whales); or • 15 minutes have elapsed without re-detection of other marine mammals; or • Enhanced time-of-year NARW protocols are followed. If shutdown is called for but Vineyard Wind determines shutdown is not technically feasible due to human safety concerns or to maintain installation feasibility, reduced hammer energy must be implemented, when the lead engineer determines it is technically feasible.	Marine Mammals (3.4)	Construction	Mitigation	The establishment and shutdown and power-down protocols would further reduce the expected **minor** to **moderate** temporary impacts by ensuring that no marine mammals are close enough to pile-driving acoustic impacts on suffer mortal injury.	NOAA IHA Section 4 NMFS BO T&C 3c

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
45.	Weekly and monthly pile-driving reports	During the pile driving/construction period, Vineyard Wind must compile and submit weekly reports that document start and stop of all pile driving daily, the start and stop of associated observation periods by the PSOs, details on the deployment of PSOs, and a record of all observations of marine mammals and sea turtles. These weekly reports must be submitted by the POS providers to BOEM at renewable_reporting@boem.gov and NMFS at incidental.take@noaa.gov and can consist of raw data. Weekly reports are due on Wednesday for the previous week (Sunday–Saturday). Required data and reports may be archived, analyzed, published, and disseminated by BOEM. PSO data must be reported weekly (Sunday through Saturday) from the start of visual and/or PAM effort during construction activities, and every week thereafter until the final reporting period. Weekly reports are due on Wednesday for the previous week. Any editing, review, and quality assurance checks must only be completed by the PSO provider prior to submission. Monthly summary reports must be submitted by the Vineyard Wind in coordination with PSO providers as needed. Qualified PSOs must monitor watch and exclusion zones when using geological and geophysical equipment that may adversely affect protected species. **<u>Reporting Instructions</u>** Vineyard Wind must submit a monthly summary report of construction activities on the 15th of each month including summaries of pile driving, vessel operations (including port departures, number, type of vessel, and route), protected species sightings, vessel strike-avoidance measures taken, and any shutdowns or takes that may have potentially occurred. • Vineyard Wind must require PSO providers to submit PSO data in Excel format every 7 days. • Data must be collected in accordance with standard reporting forms, software tools, or electronic data forms approved by BOEM for the particular activity. • Forms must be filled out for each vessel with PSOs aboard. • Do not use NA for unfilled cells; leave them empty. • Submit report in Word and Excel formats (do not submit a pdf). • All dates must be entered as YYYY-MM-DD. • All times must be entered in 24 Hour UTC as HH:MM. • Please note that new entries should be made on the Effort form each time a pile segment or weather conditions change, and at least once an hour as a minimum. • Both weekly and monthly reports must be submitted to BOEM at renewable_reporting@boem.gov. Always check forms for completeness and resolve any problems before submittal. Name the file: Lease#_ ProjectName_PSOData_YearMonthDay to YearMonthDay.xls The following Project, Operations, Detection, and Effort data fields required to be reported in Excel format as weekly reports during construction. These data may be generated through software applications or otherwise recorded electronically by PSOs. Applications developed to record PSO data are encouraged as long as the data fields listed below can be recorded and exported to Excel. Alternatively, BOEM has developed an Excel spreadsheet with all the necessary data fields that is available upon request. **<u>Project Information for Pile Driving</u>** • Project Name	Marine Mammals (3.4); Sea Turtles (3.5)	Construction	Monitoring	This monitoring measure would not reduce the expected **minor** to **moderate** impacts on marine mammals and **moderate** impacts on sea turtles, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	NMFS BO T&C 8d, 8e NOAA IHA Section 5

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		• Lease Number • State Coastal Zones • PSO Contractor(s) • Vessel Name(s) • Reporting dates • Sound sources including hammer type(s) and power levels used • Visual monitoring equipment used (e.g., bionics, magnification, IR cameras, etc.) • Distance finding method used • PSO names and training • Observation height above sea surface **<u>Operations Information for Pile Driving</u>** • Date • Hammer type (make and model) • Greatest hammer power used for each pile • Pile identifier and pile number for the day (e.g., pile 2 of 3 for the day) • Pile diameters • Pile length • Pile locations (latitude and longitude) • Time pre-exclusion visual monitoring began in UTC (HH:MM) • Time pre-exclusion monitoring ended in UTC (HH:MM) • Time pre-exclusion PAM monitoring began in UTC (HH:MM) • Time PAM monitoring ended in UTC (HH:MM) • Duration of pre-exclusion and PAM visual monitoring • Time power up/ramp up began • Time equipment full power was reached • Duration of power up/ramp up • Time pile driving began (hammer on) • Time pile-driving activity ended (hammer off) • Duration of activity • Did a shutdown/powerdown occur? • Time shutdown was called for (UTC) • Time equipment was shutdown (UTC) • Record any habitat or prey observations • Record any marine debris sighted **<u>Detection Information for Protected Species</u>** • Date (YYYY-MM-DD) • Sighting ID (V01, V02, or sequential sighting number for that day) (multiple sightings of same animal or group should use the same ID) • Date and time at first detection in UTC (YY-MM-DDT HH:MM) • Time at last detection in UTC (YY-MM-DDT HH:MM) • PSO name(s) (Last, First) • Effort (On=source on; Off = source off) • Latitude (decimal degrees dd.ddddd), longitude (decimal degrees dd.ddddd) • Compass heading of vessel (degrees) • Water depth (meters) • Swell height (meters) • Beaufort scale • Precipitation					

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		• Visibility (km) • Cloud coverage (%) • Glare • Sightings including common name, scientific name, or family • Certainty of identification • Number of adults • Number of juveniles • Total number of animals • Bearing to animal(s) when first detected (ship heading + clock face) • Range from vessel (reticle distance in meters) • Description (include features such as overall size; shape of head; color and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow, etc.) • Detection narrative (note behavior, especially changes in relation to survey activity and distance from source vessel) • Direction of travel/first approach (relative to vessel) • Behaviors observed: indicate behaviors and behavioral changes observed in sequential order (use behavioral codes) • If any bow-riding behavior observed, record total duration during detection (HH:MM) • Initial heading of animal(s) (degrees) Final heading of animal(s) (degrees) • Source activity at initial detection • Source activity at final detection (on or off) • Exclusion zone size during detection (meters) • Was the animal inside the exclusion zone? • Closest distance to vessel (reticle distance in meters) • Time at closest approach (UTC HH:MM) • Time animal entered exclusion zone (UTC HH:MM) • Time animal left exclusion zone (UTC HH:MM) • If observed/detected during ramp up/power up: first distance (reticle distance in meters), closest distance (reticle distance in meters), last distance (reticle distance in meters), behavior at final detection • Shut-down or power-down occurrences • Detections with PAM **Monitoring Effort Information for Pile Driving** • Date • Effort (ON=source on; OFF= source off) • If visual, how many PSOs on watch at one time? • PSOs (Last, First) • Start time of observations • End time of observations • Duration of visual observation • Wind speed (knots), from direction • Swell (meters) • Water depth (meters) • Visibility (km) • Glare severity • Block name and number • Location: Latitude and Longitude					

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
46.	Monthly reporting for protected species	The following data fields for geological and geophysical surveys are required to be reported in Excel format. Monthly reporting of survey activities must be submitted by the PSO provider on the 15th of each month for each vessel until the last reporting period for a survey. Any editing, review, and quality assurance checks must only be completed by the PSO provider prior to submission. These data may be generated through software applications or otherwise recorded electronically by PSOs. Applications developed to record PSO data are encouraged as long as the data fields listed below can be recorded and exported to Excel. Alternatively, BOEM has developed an Excel spreadsheet with all the necessary data fields that is available upon request. Final reports should be submitted by Vineyard Wind in coordination with PSO Providers 90 days following completion of a survey. Final reports must contain departure and return ports, PSO names and training certifications, the PSO provider contact information, dates of the survey, a vessel track, a summary of all PSO sightings, shutdowns that occurred, vessel strike-avoidance measures taken, takes that occurred, and any injured or dead protected species that were observed. PSOs must be approved by NMFS prior to the start of a survey. Application requirements to become a NMFS-approved PSO for geological and geophysical surveys can be obtained by sending an inquiry to nmfs.psoreview@noaa.gov. PSO names and training must be provided in all reports and Vineyard Wind must provide to BOEM, upon request, documentation of NMFS approval for individual PSOs. **<u>Project Information for Surveys</u>** • Project Name • Lease Number • State Coastal Zones • Survey Contractor • Vessel Name • Survey Type (typically HRG) • Reporting start and end dates • Sound sources including equipment type, power level, and frequencies used • Greatest RMS source level • Visual monitoring equipment used (e.g., bionics, magnification, IR cameras, etc.) • Distance finding method used • PSO names and training • Observation height above sea surface • Operations Information for Surveys • Date • Time pre-exclusion visual monitoring began in UTC (HH:MM) • Time pre-exclusion monitoring ended in UTC (HH:MM) • Duration of pre-exclusion visual monitoring • Was pre-exclusion conducted during day or night? • Time power up/ramp up began • Time equipment full power was reached • Duration of power up/ramp up • Time survey activity began (equipment on) • Time survey activity ended (equipment off) • Duration of activity	Marine Mammals (3.4): Sea Turtles (3.5)	Construction, Operations, and Maintenance	Monitoring	This mitigation measure would not reduce the impacts on marine mammals, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	BOEM

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		• Did a shutdown/powerdown occur? • Time shutdown was called for (UTC) • Time equipment was shutdown (UTC) • Vessel positions must be logged every 30 seconds • Record any habitat or prey observations • Record any marine debris sighted • Detection Information for Protected Species • Date (YYYY-MM-DD) • Sighting ID (V01, V02, or sequential sighting number for that day; multiple sightings of same animal or group should use the same ID) • Date and Time at first detection in UTC (YY-MM-DDT HH:MM) • Time at last detection in UTC (YY-MM-DDT HH:MM) • PSO Name(s) (Last, First) • Effort (On=source on; Off = source off) • Latitude (decimal degrees dd.ddddd), Longitude (decimal degrees dd.ddddd) • Compass heading of vessel (degrees) • Water depth (meters) • Swell height (meters) • Beaufort scale Precipitation • Visibility (km) Cloud coverage (%) • Glare • Sightings including common name, scientific name, or Family • Certainty of identification • Number of adults • Number of juveniles • Total number of animals • Bearing to animal(s) when first detected (ship heading + clock face) • Range from vessel (reticle distance in meters) • Description (include features such as overall size; shape of head; color and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow, etc.) • Detection narrative (note behavior, especially changes in relation to survey activity and distance from source vessel) • Direction of travel/first approach (relative to vessel) • Behaviors Observed: Indicate behaviors and behavioral changes observed in sequential order. • If any bow-riding behavior observed, record total duration during detection (HH:MM) • Initial heading of animal(s) (degrees) • Final heading of animal(s) (degrees) • Source activity at initial detection • Source activity at final detection (on or off) • Exclusion zone size during detection (meters) • Was the animal inside the exclusion zone? • Closest distance to vessel (reticle distance in meters) • Time at closest approach (UTC HH:MM) • Time animal entered exclusion zone (UTC HH:MM) • Time animal left exclusion zone (UTC HH:MM)					

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		• If observed/detected during ramp up/power up: first distance (reticle distance in meters), closest distance (reticle distance in meters), last distance (reticle distance in meters), behavior at final detection • Shutdown or power-down? • Detected with IR? (Y/N) • Monitoring Effort Information for Surveys • Date • Effort (ON=source on; OFF= source off) • If visual, how many PSOs on watch at one time? • PSOs (Last, First) • Start time of observations • End time of observations • Duration of visual observation • Wind speed (knots), from direction • Swell (meters) • Water depth (meters) • Visibility (km) • Glare severity • Block name and number • Location: Latitude and Longitude					
47.	PSO training requirements	PSOs must be provided by a third-party provider. PSOs must have no tasks other than to conduct observational effort, collect and report data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards). PSOs and/or PAM operators must have completed a commercial PSO training program for the Atlantic with an overall examination score of 80% or greater (Baker et. al 2013). Training certificates for individual PSOs must be provided to BOEM upon request. PSOs and PAM operators must be approved by NMFS prior to the start of a survey. Application requirements to become a NMFS-approved PSO for construction activities can be found at https://www.fisheries.noaa.gov/new-england-mid-atlantic/careers-and-opportunities/protected-species-observers or for geological and geophysical surveys by sending an inquiry to nmfs.psoreview@noaa.gov. Vineyard Wind must provide to BOEM upon request, documentation of NMFS approval for individual PSOs. For the following activities, lead PSOs must be deployed as part of the minimum number of PSOs as follows: at least one lead PSO must be on duty at any given time as the lead PSO or PSO monitoring coordinator during pile driving; at least one lead PSO must be present on each HRG survey vessel; PSOs on transit vessels must be trained, but do not need to be authorized as a lead PSO. Any required lead PSOs must have prior approval from NMFS to be a lead or unconditionally approved PSO. PSOs on duty must be clearly listed on daily data logs for each shift. A sufficient number of PSOs, consistent with the NMFS BO (NMFS 2020) and as prescribed in the final IHA, must be deployed to record data in real time and effectively monitor the affected area for the Project, including visual surveys in all directions around a pile, PAM, and continuous monitoring of sighted NARWs in the area to meet the number of PSOs required for enhanced seasonal monitoring requirements.	Marine Mammals (3.4)	Construction, Operations, and Maintenance, and Decommissioning	Mitigation	The mitigation measure would further reduce the expected **minor** to **moderate** impacts on the large whale species, and the expected **negligible** to **minor** impacts on all other marine mammal species resulting from vessel interactions and pile driving.	BOEM NOAA IHA Section 4

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		PSOs must not be on watch for more than 4 consecutive hours, with at least a 2-hour break after a 4-hour watch. PSOs must not work for more than 12 hours in any 24-hour period (NMFS 2013) unless an alternative schedule is approved by BOEM. Visual monitoring must occur from the most appropriate vantage point on the associated operational platforms that allows for 360-degree visual coverage around a vessel. Vineyard Wind must ensure that suitable equipment is available to PSOs including binoculars, range-finding equipment, a digital camera, and electronic data recording devices (e.g., a tablet) to adequately monitor the distance of the watch and exclusion zones, to determine the distance to protected species during surveys, to record sightings and verify species identification, and to record data. Observations must be conducted while free from distractions and in a consistent, systematic, and diligent manner.					
48.	Vessel crew training requirements	Project-specific training must be conducted for all vessel crew prior to the start of in-water construction activities. Confirmation of the training and understanding of the requirements must be documented on a training course log sheet. The log sheets must be provided to BOEM upon request. All vessel crewmembers must be briefed in the identification of sea turtles and marine mammals and in regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all Project vessels for identification of sea turtles and marine mammals. The expectation and process for reporting of sea turtles and marine mammals (including live, entangled, and dead individuals) must be clearly communicated and posted in highly visible locations aboard all Project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so.	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, and Maintenance, and Decommissioning	Mitigation	Training of crew and personnel would further reduce the overall **moderate** temporary impacts on sea turtles by increasing the effectiveness of mitigation and monitoring measures through educational and training materials. The mitigation measure would further reduce the expected **minor** to **moderate** impacts on the large whale species, and the expected **negligible** to **minor** impacts on all other marine mammal species resulting from vessel interactions.	NMFS BO T&C 5d NOAA IHA Section 4 BOEM BSEE
49.	Daily pre-construction surveys	PAM and visual surveys must be conducted each day before pile driving begins to establish the numbers, surface presence, behavior, and travel directions of protected species in the area. These surveys will follow standard protocols and data collection specified by BOEM. In addition to standard daily surveys, Vineyard Wind must include an enhanced survey plan for November–December and May 1–May 31 to minimize risk of exposure of NARWs to pile-driving noise that includes daily pre-construction surveys.	Marine Mammals (3.4); Sea Turtles (3.5)	Construction	Monitoring	The use of PAM and visual surveys prior to the initiation of daily pile-driving activities would further reduce the expected **minor** to **moderate** temporary impacts on marine mammals and sea turtles by identifying individuals that may be adversely affected by acoustic impacts from pile driving.	NOAA IHA Sections 4 and 5
50.	Vessel strike avoidance of marine mammals (non-geophysical survey vessels)	Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal as long as it is safe to do so. Vessel speeds must be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed within the path of the vessel. Large whales: Avoidance measures must occur for listed whales or any other unidentified whale sighted within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard) at a distance of 1,640 feet (500 meters) or less from a survey vessel. Trained crew or PSOs must notify the vessel captain of any whale within 1,640 feet (500 meters) of vessel within this area. The vessel captain must immediately implement strike-avoidance procedures to maintain a separation distance of 1,640 feet	Marine Mammals (3.4)	Construction, Operations, Maintenance, and Decommissioning	Mitigation and Monitoring	The mitigation and monitoring measure would further reduce the expected moderate impacts on large whale species, and the expected **negligible** to **minor** impacts on all other marine mammal species resulting from vessel interactions.	BOEM NOAA IHA Section 4

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		(500 meters) from all listed species of whales including changing vessel direction or reducing vessel speed to allow the animal to travel away from the vessel. Any time a listed whale is within 656 feet (200 meters) of an underway vessel, a full stop is required if safety permits. If a whale is observed but cannot be confirmed as a species other than a NARW, the vessel operator must assume that it is a NARW and take appropriate action to avoid the animal. Small cetaceans and seals: For small cetaceans and seals, all vessels must maintain a minimum separation distance of 164 feet (50 meters) to the maximum extent practicable with an exception made for those animals that approach the vessel. When marine mammals are sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distance, e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area. If marine mammals are sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area.					
51.	Vessel strike avoidance of sea turtles (non-geophysical survey vessels)	During all phases of the Project, vessel operators and crews must maintain a vigilant watch for all sea turtles and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any sea turtles as long as it is safe to do so. All vessels must maintain a minimum separation distance of 328 feet (100 meters) from sea turtles whenever possible. Trained crew lookouts must monitor seaturtlesightings.org daily and prior to each trip to note and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. If a sea turtle is sighted within 328 feet (100 meters) of the operating vessels' forward path, the vessel operator must slow down to 4 knots (unless unsafe to do so) and may resume normal vessel operations once the vessel has passed the sea turtle. If a sea turtle is sighted within 164 feet (50 meters) of the forward path of the operating vessel, the vessel operator must shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 328 feet (100 meters) at which time normal vessel operations may be resumed. Between June 1 and November 30, vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation lines or mats. In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.	Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	This mitigation measure would reduce the expected **moderate** impacts on sea turtles, but no population-level impacts are expected.	NMFS BO T&C 5, 5a, 5b, 5c
52.	Vessel observer requirements	Vineyard Wind must ensure that vessel operators and crew maintain a vigilant watch for marine mammals or sea turtles by slowing down, altering course, or stopping the vessel to avoid striking marine mammals or sea turtles. Vessel personnel must be provided an Atlantic reference guide that includes and helps identify marine mammals and sea turtles that may be encountered in the Project area and material regarding NARW SMAs, sightings information, and reporting. When not on active watch duty, members of the monitoring team must consult NMFS' NARW reporting systems for the presence of NARWs in the Project area. A visual observer aboard the vessel must monitor a vessel strike-avoidance zone around the vessel. All vessels transiting to and from the WDA and traveling over 10 knots must have a visual observer on duty at all times. Vineyard Wind must also have a trained lookout on all vessels during all phases of the Project between June 1 and November 30 to observe for sea turtles and communicate with the captain to take required avoidance measures as soon as possible if one is sighted. If a vessel is carrying a visual observer	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The mitigation and monitoring measure would further reduce the expected **moderate** impacts on the large whale species, the expected **negligible** to **minor** impacts on all other marine mammal species, and **minor** impacts on sea turtle species resulting from vessel interactions.	NMFS BO T&C 5a NOAA IHA Section 4

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		for the purposes of maintaining watch for NARWs, an additional lookout is not required and this visual observer must maintain watch for whales and sea turtles. If the trained lookout is a vessel crewmember, this must be their designated role and primary responsibility while the vessel is transiting. Any designated crew observers should be trained in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. The trained lookout must monitor seaturtlesightings.org prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day.					
53.	Vessel speed requirements November 1 through May 14	From November 1 through May 14, all vessels must travel at 10 knots or less when transiting to/from or within the WDA, except within Nantucket Sound (unless an active DMA is in place) and except crew transfer vessels as described below. From November 1 through May 14, crew transfer vessels may travel at more than 10 knots if there is at least one visual observer on duty at all times aboard the vessel to visually monitor for large whales and real-time PAM is conducted. If a NARW is detected via visual observation or PAM within or approaching the transit route, all crew transfer vessels must travel at 10 knots or less for the remainder of that day.	Marine Mammals (3.4)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The mitigation and monitoring measure would further reduce the expected **moderate** impacts on the large whale species, and the expected **negligible** to **minor** impacts on all other marine mammal species resulting from vessel interactions.	BOEM NOAA IHA Section 4
54.	Vessel speed requirements in DMAs	All vessels, regardless of length, must travel at 10 knots or less within any NMFS-designated DMA, with the exception of crew transfer vessels as described above. Crew transfer vessels traveling within any designated DMA must travel at 10 knots or less, unless NARWs are confirmed to be clear of the transit route and WDA for two consecutive days, as confirmed by either vessel-based surveys conducted during daylight hours and PAM, or by an aerial survey conducted once the lead aerial observer determines adequate visibility. If confirmed clear by one of these measures, vessels transiting within a DMA must employ at least two visual observers on duty to monitor for NARWs. If a NARW is observed within or approaching the transit route, vessels must operate at 10 knots or less until clearance of the transit route for two consecutive days is confirmed by the procedures described above.	Marine Mammals (3.4)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The mitigation and monitoring measure would further reduce the expected **moderate** impacts on the large whale species, and the expected **negligible** to **minor** impacts on all other marine mammal species resulting from vessel interactions.	NOAA IHA Section 4
55.	Vessel speed requirements in SMAs	All vessels greater than or equal to 65 feet (19.8 meter) in overall length must comply with the 10-knot speed restriction in any SMA (see https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-ship-strikes-north-atlantic-right-whales)	Marine Mammals (3.4)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The mitigation and monitoring measure would further reduce the expected moderate impacts on the large whale species and the expected **negligible** to **minor** impacts on all other marine mammal species resulting from vessel interactions.	NOAA IHA Section 4
56.	Reporting of all NARW sightings	If a NARW is observed at any time by PSOs or personnel on any Project vessels, during any Project-related activity or during vessel transit, Vineyard Wind must immediately report the sighting information to NMFS and BOEM (the time, location, and number of animals) to the NOAA Fisheries 24-hour Stranding Hotline number (866-755-6622), the USCG via channel 16, and through the WhaleAlert app (http://www.whalealert.org/).	Marine Mammals (3.4)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	This monitoring measure would not reduce the expected **minor** to **moderate** temporary impacts on marine mammals as a result of pile-driving activities or vessel operations but would ensure that the amount of take that potentially occurs does not exceed the exempted take under the ESA and MMPA.	NMFS BO T&C 8a NOAA IHA Section 4
57.	Vessel communication of threatened and endangered species sightings	Whenever multiple Project vessels are operating, any visual observations of listed species (marine mammals and sea turtles) must be communicated to a PSO and/or vessel captains associated with other Project vessels.	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Communication between project vessels would further reduce the expected **minor** to **moderate** temporary impacts by alerting vessels to the presence of marine mammals in the area, potentially minimizing the vessel interactions.	BOEM

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
58.	Marine mammal and sea turtle geophysical survey exclusion zones	For sparkers and similar sub-bottom profiler equipment operating below 180 kilohertz (kHz) or within the hearing ranges of each hearing group (excluding the Innomar), minimum exclusion zone distances for ESA-listed species of marine mammals and sea turtles must be monitored at all times and be demarcated within the watch zone with effective distance-finding methods (e.g., reticle binoculars, range finding sticks, monitoring system software). A 1,640-foot (500-meter) watch zone will be established in every direction around each survey vessel. All threatened and endangered species within this distance will be monitored by a third-party PSOs. A 656-foot (200-meter) exclusion zone must be established around each survey vessel for endangered and threatened marine mammals and sea turtles. Exclusion zones for non-ESA-listed marine mammals must be followed as required by NMFS through Project-specific mitigation and monitoring requirements of ITAs. If an ITA is not required, Vineyard Wind must monitor default exclusion zones of 328 feet (100 meters) for all non-listed marine mammals. The exclusion zones must be established within the watch zone with accurate distance finding methods (e.g., reticle binoculars, range finding sticks, calibrated video cameras, and software). If the exclusion zones cannot be adequately monitored for animal presence (i.e., a PSO determines conditions are such that ESA listed species cannot be reliably sighted within the exclusion zones), the survey must be stopped until such time that the exclusion zones can be reliably monitored. This monitoring must be carried out by approved PSOs (see specific details on PSO requirements below). For marine mammals, these requirements are for sound sources that are operating within the hearing range of marine mammals (below 180 kHz).	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The use of PSO visual monitoring would further reduce the expected **minor** to **moderate** temporary impacts on marine mammals by establishing exclusion zones that must be free of marine mammals or sea turtles for geophysical surveys to commence, ensuring that no marine mammals or sea turtles are close enough to geophysical surveys to suffer injury.	BOEM
59.	Geophysical survey off-effort PSO monitoring	During good daylight conditions during periods when survey equipment is not operating (e.g., daylight hours; Beaufort sea state 3 or less), to the maximum extent practicable, visual PSOs must conduct observations for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods.	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Monitoring	This monitoring measure would not reduce the expected **minor** to **moderate** impacts on marine mammals and sea turtles, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR § 585.633(b)).	BOEM
60.	Geophysical survey vessel whale strike-avoidance and equipment shutdown protocols	Avoidance measures must occur for listed whales or any other unidentified whale sighted within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard) at a distance of 1,640 feet (500 meters) or less from a survey vessel. PSOs must notify the vessel captain of any whale within 1,640 feet (500 meters) of vessel within this area. The vessel captain must immediately implement strike-avoidance procedures to maintain a separation distance of 1,640 feet [500 meters]) from listed whales including changing vessel direction or reducing vessel speed to allow the animal to travel away from the vessel. Any time a listed species (sea turtles, whales, and manta rays) is within a 656-foot (200-meter) avoidance zone in any direction around a survey vessel, PSOs must notify the vessel captain that a full stop is required if safety permits. The PSO must also notify the resident engineer that a shutdown of all active sparker sources below 180 kHz is immediately required. The vessel operator and crew must comply immediately with any call for a shutdown by the PSO. Any disagreement or discussion must occur only after shutdown.	Marine Mammals (3.4); Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The mitigation and monitoring measure would further reduce the expected moderate impacts on large whale species and the expected **negligible** to **minor** impacts on all other marine mammal species resulting from vessel interactions. The shutdown and power-down protocols would further reduce the expected **negligible** temporary impacts by ensuring that no marine mammals are close enough to pile-driving acoustic impacts to suffer mortal injury.	BOEM

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
61.	Geophysical survey clearance of exclusion zone and restart protocols following shutdowns	At the beginning of each survey, active sparker and other sub-bottom profiling acoustic sound sources less than 180 kHz requiring exclusion zones (excludes the Innomar), must not be activated until a PSO has verified the 656-foot (200-meter) exclusion zone to be clear of all whales, humpback whales, Kogia, and beaked whales for a full 30 minutes and a 328-foot (100-meter) exclusion zone to be clear for other marine mammals for a full 15 minutes. Any time a marine mammal is sighted within the exclusion zone, the PSO will require the resident engineer or other authorized individual to cause a shutdown of the survey equipment. Geophysical survey equipment may be allowed to continue operating if marine mammals voluntarily approach the vessel (e.g., to bow ride) when the sound sources are at full operating power. The vessel operator must comply immediately with any call for a shutdown by the PSO. Any disagreement or discussion must occur only after shutdown. Following a shutdown, ramp up of the equipment may begin immediately only if visual monitoring of the exclusion zone continues throughout the shutdown, the animals causing the shutdown were visually followed and confirmed by PSOs to be outside of the exclusion zone and heading away from the vessel, and the exclusion zone remains clear of all protected species All shutdowns of geophysical survey equipment due to protected species sightings that are not re-sighted require the following monitoring periods before ramp-up procedures: 15 minutes for small cetaceans and seals, and 30 minutes for ESA-listed whales, humpback whales, Kogia, and beaked whales. Geophysical exclusion, survey power-up, and post-shutdown exclusion protocols must be followed for all ESA-listed species, in addition to any future ITA requirements under the MMPA for marine mammals. For non-ESA-listed marine mammals, requirements must be followed as required by the NMFS through Project-specific mitigation and monitoring requirements of ITAs. If an ITA is not obtained, Vineyard Wind must follow the measures above for non-listed species.	Marine Mammals (3.4)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The use of PSO visual monitoring would further reduce the expected **minor** to **moderate** temporary impacts on marine mammals by establishing exclusion zones that must be free of marine mammals or sea turtles for geophysical surveys to commence, ensuring that no marine mammals or sea turtles are close enough to geophysical surveys to suffer injury.	BOEM
62.	Sea turtle avoidance and exclusion zones during geophysical surveys	Vessel operators and crews must maintain a vigilant watch for all marine protected species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any ESA-listed species. The presence of a single species at the surface may indicate the presence of submerged animals in the vicinity; therefore, precautionary measures should always be exercised. A visual observer aboard the vessel must monitor a vessel strike-avoidance zone (species-specific distances detailed below) around the vessel according to the parameters stated below, to ensure the potential for strike is minimized. Minimum exclusion zone distances for ESA-listed sea turtles must be monitored at all times and be demarcated within the watch zone with effective distance finding methods (e.g., reticle binoculars, range finding sticks, monitoring system software). A 1,640-foot (500-meter) watch zone will be established in every direction around each survey vessel. All threatened and endangered species within this distance will be monitored by third-party PSOs and survey operations and listed species data recorded. A 656-foot (200-meter) exclusion zone must be established around each survey vessel for endangered and threatened sea turtles. The exclusion zone is the distance within which vessel avoidance measures to maintain a distance of 656-feet (200 meters) or greater is not possible, and a sparker or boomer source must be shut down. Exclusion zone requirement applies when a sound source is used within the hearing range of sea turtles. Survey vessel crewmembers responsible for navigation duties must	Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The use of PSO visual monitoring would further reduce the expected temporary impacts on sea turtles by establishing exclusion zones that must be free of sea turtles for HRG survey activities to commence.	BOEM

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		receive site-specific training on ESA-listed species sighting/reporting and vessel strike-avoidance measures. Visual observers monitoring the vessel strike-avoidance zone can be either third-party PSOs or crewmembers, but crewmembers responsible for these duties must be provided sufficient training to distinguish ESA-listed species to broad taxonomic groups and have no other responsibilities during the time of observation. If the exclusion zones cannot be adequately monitored for animal presence (i.e., a PSO determines conditions are such that ESA-listed species cannot be reliably sighted within the exclusion zones), the survey must be stopped until such time that the exclusion zones can be reliably monitored. This monitoring must be carried out by NMFS-approved PSOs.					
63.	Geophysical survey exclusion zone, power-up, and re-start procedures	At the beginning of each survey, active acoustic sound sources operating at less than 200 kHz must not activated until a PSO has verified the 656-foot (200-meter) pre-survey exclusion zones to be clear of all sea turtles for a full 30 minutes. Any time a sea turtle is sighted within the exclusion zone, the PSO will require the resident engineer or other authorized individual to shut down the survey equipment if power-up procedures have started. The vessel operator must comply immediately with any call for a shutdown by the PSO. Any disagreement should be discussed only after shutdown. At full power, a shutdown of sparker equipment must occur any time a sea turtle is sighted within 50 meters of the vessel. Following a shutdown for any reason or when sea turtles are sighted within 50 meters of the survey vessel, ramp up of the equipment may begin immediately only if visual monitoring of the exclusion zone continues throughout the shutdown and all animals are confirmed by PSOs to be outside of the exclusion zone throughout the shutdown. All shutdowns of geophysical survey equipment due to protected species sightings that are not re-sighted require the 30-minute clearance period before ramp-up procedures.	Sea Turtles (3.5)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The use of PSO visual monitoring would further reduce the expected temporary impacts on sea turtles by establishing exclusion zones that must be free of sea turtles for HRG survey activities to commence or resume.	BOEM
64.	Local hiring plan	Require preparation and implementation of a local hiring plan to maximize Vineyard Wind's direct hiring of southeastern Massachusetts residents. Components of the plan shall include coordination with unions, training facilities, and schools.	Demographics, Employment, and Economics (3.6); Environmental Justice (3.7)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The requirement of a local hiring plan would further increase the expected **minor beneficial** impact on demographics, employment, and economics due to the direct hiring of southeastern Massachusetts residents.	Voluntary by Vineyard Wind
65.	Remove six northeastern turbine placement locations	Require Vineyard Wind to not place turbines within the area defined by the six northeasternmost turbine locations in the proposed layout to reduce visual impacts on the Nantucket NHL. Vineyard Wind has already committed to not place three of the six turbines as part of the NHPA Section 106 process.	Cultural Resources (3.8); Commercial Fisheries and For-Hire Recreational Fishing (3.10); Navigation and Vessel Traffic (3.11); Other Uses (3.12)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Although the impact significance level would not be changed, not using these turbine placement options would marginally reduce the proposed Project's overall visual impacts, including the impacts on the Nantucket NHL; would slightly increase the area of open ocean available for navigation in the northern portion of the WDA and marginally reduce the proposed Project's overall visual impacts on non-Project vessels; and would slightly increase the area of open ocean available for navigation by military, national security, or scientific vessels, and would slightly increase unobstructed airspace within the northern portion of the WDA.	BOEM NHPA Section 106
66.	Apply no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey Paint Color to the turbines	Require Vineyard Wind to paint the WTGs off-white/light grey (no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey) to reduce visual impacts during daylight hours on historic properties. Vineyard Wind has already committed to this measure as part of the NHPA Section 106 process.	Cultural Resources (3.8); Recreation and Tourism (3.9)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Although the impact significance level would not be changed, painting the WTGs light grey would reduce the proposed Project's overall visual impacts during daylight hours, including the impacts on historic and scenic properties.	Voluntary by Vineyard Wind NHPA Section 106

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
67.	Fund a restoration and stabilization project at Gay Head Light	Vineyard Wind will contribute $137,500 to fund a mitigation plan to resolve impacts on the Gay Head Lighthouse, pursuant to a NHPA Section 106 MOA. The Gay Head Light Advisory Board has requested that to mitigate the adverse visual effect to the Lighthouse, Vineyard Wind provide funding to address the advanced state of corrosion of the lantern curtain wall. The mitigation plan will investigate the degree of deterioration, at least temporarily stabilize the lantern curtain wall so that further damage is prevented, and fully (permanently) restore as much as possible of the curtain wall within the budget requested. The investigation will be used to allow for future permanent restoration work on the Gay Head Light.	Cultural Resources (3.8)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Even with the implementation of a mitigation plan to resolve adverse effects, an uninterrupted sea view free of modern visual elements is a contributing element to NRHP eligibility of the Gay Head Light. As a result, the presence of visible WTGs from the Proposed Action structures would have long-term, continuous, widespread, **moderate** impacts on this resource.	NHPA Section 106
68.	Fund an ethnographic study and prepare a NRHP nomination package for the Chappaquiddick Island TCP	Require Vineyard Wind to fund a mitigation plan to resolve impacts on the Chappaquiddick TCP, pursuant to a NHPA Section 106 MOA. To mitigate the adverse visual effect to the TCP, Vineyard Wind will perform a limited ethnographic study to document the TCP and prepare a documentation package to nominate the TCP for the NRHP. Such a study will be limited to ethnographic and historical information only, and will not include any archaeological fieldwork.	Cultural Resources (3.8)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Even with the implementation of a mitigation plan to resolve adverse effects, an uninterrupted sea view free of modern visual elements is a contributing element to NRHP eligibility of the Chappaquiddick TCP. As a result, the presence of visible WTGs from the Proposed Action structures would have long-term, continuous, widespread, **moderate** impacts on this resource.	NHPA Section 106
69. .	Fund an ethnographic study and prepare an NRHP nomination package for the Vineyard Sound and Moshup’s Bridge TCP	Require Vineyard Wind to fund a mitigation plan to resolve impacts on the Vineyard Sound and Moshup’s Bridge TCP, pursuant to a NHPA Section 106 MOA. To mitigate the adverse visual effect to the TCP, Vineyard Wind will prepare an ethnographic study to document the TCP and prepare a documentation package to nominate the TCP for the NRHP. Such a study will be limited to ethnographic and historical information only and will not include any archaeological fieldwork.	Cultural Resources (3.8)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Even with the implementation of a mitigation plan to resolve adverse effects, an uninterrupted sea view free of modern visual elements is a contributing element to NRHP eligibility of the Vineyard Sound and Moshup’s Bridge TCP. As a result, the presence of visible WTGs from the Proposed Action structures would have long-term, continuous, widespread, **moderate** impacts on this resource.	NHPA Section 106
70.	Avoid identified shipwrecks, debris fields, and submerged landform features that can be avoided	Require Vineyard Wind to avoid the shipwrecks, potentially significant debris fields, and as many as possible of the submerged, landform features identified during marine archaeological surveys of the WDA and OECC. While avoidance of shipwrecks and debris fields is typically simple, avoidance of all submerged landform features is typically not possible due to their size and orientation.	Cultural Resources (3.8)	Construction	Mitigation	Avoiding these specific resources will result in **negligible** impacts on the two shipwrecks, five potentially significant debris fields, and 12 submerged landform features identified during marine archaeological surveys.	Voluntary by Vineyard Wind NHPA Section 106
71.	Conduct additional investigations of any previously identified submerged landform features that cannot be avoided	Require Vineyard Wind to fund a mitigation plan to resolve impacts on the unavoidable submerged landform features identified during marine archaeological surveys of the WDA and OECC that remain in the APE. The mitigation plan will include collection of up to two additional vibracores in each of the unavoidable submerged landform features; laboratory analyses of subsamples collected from the cores where terrestrial soils were identified (Carbon 14 dating, bulk geochemical analysis of nitrogen, pollen analysis, and microdebitage analysis); and a professional report of results suitable for technical audiences. Tribal representatives will have the opportunity to be present for all stages of work, including core collection, core opening, and core sub-sampling. The mitigation plan will also include the development of educational and documentary materials, including PowerPoint presentations prepared for a non-technical audience, digital geodatabase in ArcGIS documenting the landform features and the study activities (known boundaries of landforms, core locations), assistance to tribes in configuring their own GIS software on their own computers, and an in-person presentation on the study prepared for non-technical audience.	Cultural Resources (3.8)	Construction	Mitigation	Although impacts on 12 submerged landform features will be avoided (see row above), impacts on the remaining 19 submerged landform features will result in **major** impacts on marine archaeological resources. Development of a specific treatment plan to mitigate impacts on the 19 submerged landform features will reduce the expected impacts from **major** to **moderate**.	NHPA Section 106

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
72.	Avoid or investigate submerged potential historic properties identified as a result of future marine archaeological resources identification surveys	Require Vineyard Wind to avoid or investigate potential submerged archaeological resources identified as a result of future marine archaeological resources identification surveys that will be performed in any portions of the APE not previously surveyed: • Any *potential archaeological resource* (i.e., one or more geophysical survey anomalies or targets with the potential to be an archaeological resource) will be avoided. If avoidance is not possible, the anomaly or target will be assessed to BOEM's satisfaction using industry-standard ground-truthing techniques to determine whether it constitutes an identified archaeological resource. • Any *identified archaeological resource* will then be avoided. If avoidance is not possible, additional investigations will be performed to determine eligibility for listing in the NRHP. • Any *submerged landform features* that may be contributing elements to the Nantucket Sound TCP or are outside the boundaries of the Nantucket Sound TCP and are considered contributing elements to a cultural landscape will be avoided or additional mitigations will be required for resolving adverse effects pursuant to 36 CFR § 800.6. If avoidance is not possible, then each unavoidable landform feature will be subjected to the same mitigation plan as will be used to resolve effects to the known unavoidable submerged landform features, to conduct additional investigations and development of educational and documentary materials, as discussed above. • Any *archaeological resources determined eligible for listing on the NRHP* (i.e., historic properties) will be avoided or subjected to a Phase III data recovery plan, pursuant to 36 CFR § 800.6.	Cultural Resources (3.8)	Construction	Mitigation	Avoidance of archaeological resources would reduce any impacts on these resources to **negligible** by not impacting the resource. If resources cannot be avoided additional investigations of submerged archaeological resources and submerged landform features would reduce the expected **major** impacts on **moderate** impacts by applying additional mitigation measures developed during the course of NHPA Section 106 consultation.	NHPA Section 106
73.	Daily two-way communication during construction	Vineyard Wind shall establish clear daily two-way communication channels between fishermen and the Project during construction. Vineyard Wind is responsible for ensuring this applies to contractors and sub-contractors.	Commercial Fisheries and For-Hire Recreational Fishing (3.10)	Construction	Monitoring	The required daily communication between Vineyard Wind and fishermen and fishery representatives would further reduce the expected **minor** to **moderate** impacts on commercial fisheries by allowing fishermen to know where construction activities are occurring and Vineyard Wind contractors to know where fishing is occurring.	Voluntary by Vineyard Wind
74.	Providing electronic charting information for Project infrastructure	Make available to the fishing community electronic chart information showing the as-built location of Project infrastructure including buried cable, cable protection measures, turbine foundations (including scour protection extent), and ESPs.	Commercial Fisheries and For-Hire Recreational Fishing (3.10)	Operations	Mitigation	The as-built location information of proposed-Project infrastructure would allow the fishing industry to make informed decisions regarding the navigation and fishing within the WDA and OECC.	Voluntary by Vineyard Wind
75.	Rhode Island compensation fund[2]	A $4.2 million direct compensation fund to be held in escrow to compensate for any claims of direct impacts on Rhode Island vessels or Rhode Island fisheries interests[3] in the Project area.	Commercial Fisheries and For-Hire Recreational Fishing (3.10); Other Uses (3.12)	Construction, Operations and Maintenance, and Decommissioning	Mitigation	The establishment of a direct compensation fund could potentially decrease the expected **moderate** to **major** impacts on commercial fisheries to **minor** to **moderate** by allowing for financial compensation for direct impacts on Rhode Island vessels and fishing interests. However, the overall **moderate** impact rating would not change. Further details regarding the beneficial effects of this mitigation measure on commercial fisheries is provided in FEIS Section 3.10.	Voluntary by Vineyard Wind Rhode Island CZM

[2] The $25.4 million is calculated as follows: Rhode Island economic exposure was valued at $6,190,281 over 30 years using a 2.5 percent annual escalator to the initial 1-year exposure value. When the Rhode Island Fisheries Advisory Board asked to front-load the initial payment, the amount in nominal dollars was reduced to $4.2 million (but the value in real terms is still $6.1 million). For Massachusetts, the economic exposure plus upstream and downstream multipliers is $19,185,016. The Rhode Island $6,190,281 plus the Massachusetts $19,185,016 equals $25,375,297. The $25.4 million compensation funds are calculated from Fishing Vessel Trip Reports, Dealer Reports, and Vessel Monitoring System data (King and Associates 2019 and the MOA between Vineyard Wind and the Massachusetts Executive Office of Energy and Environmental Affairs, for detailed methodology [CZM 2020]).

[3] Fishing interests are broadly defined to include owners and operators of vessels, vessel crews, shoreside processors, vessel supplier and support services, and other entities that can demonstrate losses directly related to the Vineyard Wind Project.

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76.	Massachusetts compensation fund[2]	A $19,185,016 million direct compensation fund to be held in escrow to compensate for any claims of direct, downstream, and cumulative (upstream) impacts on Massachusetts vessels or Massachusetts fisheries interests[3] in the Project area.	Commercial Fisheries and For-Hire Recreational Fishing (3.10); Other Uses (3.12)	Construction, Operations and Maintenance, and Decommissioning	Mitigation	The establishment of a direct compensation fund could potentially decrease the expected **moderate** to **major** impacts on commercial fisheries to **minor** to **moderate** by allowing for financial compensation for direct impacts on Massachusetts vessels and fishing interests. However, the overall **moderate** impact rating would not change. Further details regarding the beneficial effects of this mitigation measure on commercial fisheries is provided in FEIS Section 3.10.	Voluntary by Vineyard Wind Massachusetts CZM
77.	Other states' compensation fund	A $3.3 million direct compensation fund to be held in escrow to compensate for any claims of direct, downstream, and cumulative (upstream) impacts from others affected states including Connecticut, New Jersey, and New York vessels or fisheries interests[3] in the Project area for the 30-year life of the Project[4].	Commercial Fisheries and For-Hire Recreational Fishing (3.10); Other Uses (3.12)	Construction, Operations and Maintenance, and Decommissioning	Mitigation	The establishment of a direct compensation fund could potentially decrease the expected **moderate** to **major** impacts on commercial fisheries to **minor** to **moderate** by allowing for financial compensation for direct impacts on Other States' vessels and fishing interests. However, the overall **moderate** impact rating would not change. Further details regarding the beneficial effects of this mitigation measure on commercial fisheries is provided in FEIS Section 3.10.	Voluntary by Vineyard Wind
78.	Rhode Island Fisherman's Future Viability Trust	Vineyard Wind entered into an agreement with the Rhode Island Coastal Resources Management Council regarding the establishment and funding of the Rhode Island Fishermen's Future Viability Trust (the "Trust"). The purpose of the $12.5 million Trust is to further the policies of the Ocean Special Area Management Plan with respect to the continued viability and success of Rhode Island's fishing industry and to support and promote the compatibility of offshore wind and commercial fishing interests within Rhode Island's Geographic Location Description. The Trust will provide funds to address concerns about safety and effective fishing in and around the Project area and wind energy facilities generally. Examples of how the funds may be used include improvements in fishing vessels, fishing methods, and gear, supporting widespread deployment of navigational equipment, financial support of individual fisherman, purchase of updated safety equipment (e.g., radar, GPS, survival suits, life rafts, etc.), and payment for increased insurance costs related to fishing around wind farms.	Commercial Fisheries and For-Hire Recreational Fishing (3.10)	Construction, Operations and Maintenance, and Decommissioning	Mitigation	The establishment of the Rhode Island Fisherman's Future Viability Trust could potentially decrease the expected **moderate** to **major** impacts on commercial fisheries to **minor** to **moderate** by providing funds to allow for improving fishing vessels, gear, and other equipment as well as to fund to address concerns about safety and effective fishing around the Project area specifically and wind energy facilities in general. However, the overall **moderate** impact rating would not change. Further details regarding the beneficial effects of this mitigation measure on commercial fisheries is provided in FEIS Section 3.10.	Voluntary by Vineyard Wind Rhode Island CZM
79.	Massachusetts Fisheries Innovation Fund	On May 21, 2020, the Massachusetts Executive Office of Energy and Environmental Affairs and Vineyard Wind entered into MOA for a $1.75 million Fisheries Innovation Fund (CZM 2020). The purpose of the fund is to support programs and projects that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. The fund will provide support to programs and projects through grants to conduct studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries as well as provide grants for technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area. These programs and projects may include, but are not limited to, studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries, improvements in fishing vessels and gear, development of new technology to improve navigation in and around the wind farm area, the development of alternative gear and fishing methods, optimization of vessel systems, technology and innovation upgrades	Commercial Fisheries and For-Hire Recreational Fishing (3.10)	Construction, Operations and Maintenance, and Decommissioning	Mitigation	The establishment of the Massachusetts Fisheries Innovation Fund could potentially decrease the expected **moderate** to **major** impacts on commercial fisheries to **minor** to **moderate** by providing funds to allow for technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area. It would also fund studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries. However, the overall **moderate** impact rating would not change. Further details regarding the beneficial effects of this mitigation measure on commercial fisheries is provided in FEIS Section 3.10.	Voluntary by Vineyard Wind Massachusetts CZM

[4] The value is based on communication from Vineyard Wind (Geri Edens, Pers. Comm., October 11, 2020) and includes Connecticut, New Jersey, and New York. Payment structure and frequency obtainment would be similar to other established funds.

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		for fishery participants (and vessels) actively fishing within a wind energy area, and general fishing vessel safety improvements.					
80.	Submarine cable system burial plan	A copy of the submarine cable system burial plan shall be submitted by Vineyard Wind as part of their FDR and Fabrication and Installation Report that depicts precise planned locations and burial depths of the entire cable system. This plan shall be reviewed by the USCG and BOEM.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	USCG's review and BOEM's approval of the submarine cable system burial plan would provide an added layer of coordination to aid in reducing impacts on navigation and vessel traffic. Although BOEM does not anticipate impacts on traffic separation schemes as a result of the proposed-Project, review and approval of the plan would aid in confirming this determination.	USCG Recommended Mitigation 1c
81.	Boulder relocation reporting	The locations of any boulder (which will protrude >2 meters or more on the sea floor) relocated during cable installation activities must be reported to BOEM, MassDEP, Massachusetts CZM, USCG, NOAA, and the local harbormaster within 30 days of relocation. These locations must be reported in latitude and longitude degrees to the nearest 10 thousandth of a decimal degree (roughly the nearest meter), or as precise as practicable.	Navigation and Vessel Traffic (3.11)	Construction	Mitigation and Monitoring	Documenting the locations of relocated boulders would allow for an understanding of the seafloor elements potentially affected and the potential implications for navigation and vessel traffic.	BOEM
82.	Vessel safety practices	All Project vessels involved in construction, operations, maintenance, and decommissioning activities will comply with U.S. or SOLAS standards, as applicable, with regards to vessel construction, vessel safety equipment, and crewing practices.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Compliance with USCG and SOLAS standards would further reduce the expected **minor** to **moderate** impacts on navigation by requiring that all vessels are manned sufficiently to operate safely and are equipped with proper safety equipment.	USCG (additional mitigation measure developed during course of FEIS)
83.	WTG and ESP marking	Each WTG and ESP will be marked with PATONs, subject to the approval of the Commander (dpw-1), First Coast Guard District. Vineyard Wind will: • Provide BOEM and USCG with a proposed lighting, marking, and signaling plan, which must be approved by BOEM after consultation with the USCG. The plan should conform to the International Association of Marine Aids to Navigation and Lighthouse Authorities Recommendation O-139, The Marking of Man-Made Offshore Structures. Should any part of the recommendation conflict with federal law or regulation, or if Vineyard Wind seeks an alternative to the recommendation, Vineyard Wind must consult with the USCG. • Mark each individual WTG and ESP with clearly visible, unique, alphanumeric identification characters. • Light each WTG and ESP in a manner that is visible by mariners in a 360-degree arc around the WTG and ESP. • Apply to the First Coast Guard District to establish PATONs for the facility. Approval for all PATONs must be obtained before installation of the Vineyard Wind structures begins. • Ensure each WTG is lighted with red obstruction lighting consistent with the FAA Advisory Circular 70/7460-1L Change 2 (FAA 2018), so long as this requirement does not preclude the use of an ADLS. • Provide signage that covers 360-degrees of the wind turbine structures warning vessels of the air draft of the turbine blades as determined at highest astronomical tide. • Cooperate with USCG and NOAA to ensure that cable routes and wind turbines are depicted on appropriate government produced and commercially available nautical charts. • Provide mariner information sheets on Vineyard Wind's website with details on the location of the turbines and specifics such as blade clearance above sea level.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The added elements to Vineyard Wind's self-imposed plans would further mitigate potential impacts on navigation and vessel traffic by ensuring additional coordination with USCG and making proposed-Project elements more clearly identifiable to mariners.	USCG Recommended Mitigation 1a

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
84.	WTG shutdown mechanism	Equip all WTG rotors (blade assemblies) with control mechanisms operable from the Vineyard Wind control centers available 24 hours a day, 7 days a week. The control mechanisms shall enable control room operators to shut down the requested WTGs within an agreed upon time of notification between the USCG and Vineyard Wind. A formal shutdown procedure will be part of the standard operating procedures and periodically tested. Normally, USCG-ordered shutdowns will be limited to those WTGs in the immediate vicinity of an emergency and for as short a period as is safely practicable under the circumstances, as determined by the USCG.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Requiring WTG shutdown mechanisms would aid in USCG's ability to respond if an emergency situation were to occur at any time, day or night.	USCG Recommended Mitigation 1b
85.	USCG Training and Exercises	Vineyard Wind will participate in periodic USCG-coordinated training and exercises to test and refine notification and shutdown procedures and to provide SAR training opportunities for USCG vessels and aircraft.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Refinement of procedures may aid in USCG's ability to respond if an emergency situation were to occur.	USCG Recommended Mitigation 5a
86.	Web-based cameras	Installation of up to 10 strategically placed web-based cameras that the USCG could potentially access to support a SAR event.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The addition of web-based cameras may aid in USCG's ability to respond if an emergency situation were to occur.	Voluntary by Vineyard Wind
87.	Mooring attachments, and access ladders	Mooring attachments (for securing vessels) and access ladders for use in emergencies shall be placed on each WTG. Plans for the design and placement of access ladders shall be submitted for USCG review and BOEM approval.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Mooring attachments and access ladders may aid in USCG's ability to respond if an emergency situation were to occur.	USCG (additional mitigation measure developed during course of FEIS)
88.	Marine communications analysis and coordination	Vineyard Wind will conduct a marine radar study to evaluate potential radar impacts and identify potential future mitigation measures, the results of which will be discussed with BOEM and USCG. BOEM and USCG may later work with Vineyard Wind to implement any identified mitigations.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Although the COP and FEIS address some elements of potential marine communications interference associated with the proposed Project, requiring a standalone marine communications analysis and coordination with USCG would allow for the development of site-specific mitigation plans to be implemented under the direction of USCG and BOEM.	USCG (additional mitigation measure developed during course of FEIS)
89.	Operations and maintenance plan	Prior to operation of the Project, Vineyard Wind shall submit a written plan for operations and maintenance, which includes control center(s), for review by BOEM and the USCG. The plan must demonstrate that the control center(s) will be adequately staffed to perform standard operating procedures, communications capabilities, and monitoring capabilities. The plan shall include, but not be limited to, the following topics, which may be modified through ongoing discussions with the USCG: • Standard Operating Procedures: Methods for establishing and testing WTG rotor shutdown; methods of lighting control; method(s) for notifying the USCG of mariners in distress or potential/actual SAR incidents; method(s) for notifying the USCG of any events or incidents that may impact maritime safety or security; and methods for providing the USCG with environmental data, imagery, communications and other information pertinent to SAR or marine pollution response. • Staffing: Number of personnel intended to staff the control center(s) to ensure continuous monitoring of WTG operations, communications, and surveillance systems. • Communications: Capabilities to be maintained by the control center(s) to communicate with the USCG and mariners within and in the vicinity of the Project area. Communications capability shall at a minimum include VHF marine radio and landline and wireless for voice and data.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation and Monitoring	Development and implementation of the control center plan would establish a mechanism to ensure clear lines of communication with USCG, which would help reduce impacts on navigation and vessel traffic in the event of an emergency.	USCG Recommended Mitigation 2b

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
		• Monitoring: The control center(s) should maintain the capability to monitor the Vineyard Wind installation and operations in real time (including night and periods of poor visibility) for determining the status of all PATONs; searching for and locating mariners in distress upon notification of a maritime distress incident; and detection of a survivor who has climbed to the survivor's platform, if installed, on any WTG or ESP.					
90.	WTG/ESP installation	No WTG/ESP installation work shall commence at the Project site (i.e., on or under the water) without prior review by BOEM and USCG of a plan to be submitted by Vineyard Wind that describes the schedule and process for erecting each WTG, including all planned mitigations to be implemented to minimize any adverse impacts on navigation while installation is ongoing. Appropriate Notice to Mariners submissions will accompany the plan.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Allows BOEM and USCG to provide feedback throughout the construction process to help ensure that all required measures are carried out to reduce impacts.	USCG Recommended Mitigation 2a
91.	USCG reporting	**Complaints**: On a monthly basis during installation, Vineyard Wind shall provide USCG with a description of any complaints received (either written or oral) by boaters, fishermen, commercial vessel operators, or other mariners regarding impacts on navigation safety allegedly caused by construction vessels, crew transfer vessels, barges, or other equipment. Describe any remedial action taken in response to complaints received. **Correspondence**: Vineyard Wind shall provide to USCG copies of any correspondence received by Vineyard Wind from other federal, state, or local agencies that mention or address navigation safety issues. **Maintenance Schedule**: Vineyard Wind will provide the USCG with its planned WTG maintenance schedule, forecasted out to at least one quarter. Appropriate Notice to Mariners submissions will accompany each maintenance schedule.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The USCG reporting requirement would allow for continued correspondence between Vineyard Wind and USCG to aid in conflict resolution to reduce potential effects to navigation and vessel traffic.	USCG Recommended Mitigation 3a, 3b, 3c
92.	Public participation	To ensure sufficient opportunity for the public to receive information directly from the owners/operators of the wind energy facility, Vineyard Wind will attend periodic meetings of the Southeastern Massachusetts and Rhode Island Port Safety Forums to provide briefs on the status of construction and operations and on any problems or issues encountered with respect to navigation safety.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Vineyard Wind's participation in public events would provide another forum to communicating updates on the status of construction and operations, which would help further reduce potential impacts on navigation and vessel traffic.	USCG Recommended Mitigation 4
93.	Helicopter landing platforms	If Vineyard Wind's ESPs include helicopter-landing platforms, those platforms will be designed and built to accommodate USCG HH60 rescue helicopters.	Navigation and Vessel Traffic (3.11)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Allowing for USCG helicopters to land on ESPs could allow for more efficient response to potential emergency situations, whether they occur within the WDA or not.	USCG
94.	Add conditions of COP approval	Require the following conditions of COP approval to de-conflict potential impacts on warning area W-105A, Nantucket ASR-9, and Falmouth ASR-8 radar systems, and to address potential impacts of DAS: • Acknowledge that structures can withstand the daily sonic overpressures (sonic booms) and potential falling debris from dispensing chaff and flare; • Confirm that the USAF will not be held liable for any damage to property or personnel (Hold and Save Harmless clause); • Notify NORAD prior to Project completion for RAM scheduling; • Contribute funding for RAM execution; • Curtailment of operations for national security or defense purposes as described in the leasing agreement; and • Coordinate with the Department of Defense and the Navy on any proposal to use DAS as part of the Project or associated transmission cables.	Other Uses (3.12)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The Military Aviation and Installation Assurance Siting Clearinghouse (2020) identified these conditions of COP approval as necessary to de-conflict concerns raised by the USAF about warning area W-105A, and impacts on radar systems used by NORAD.	Department of Defense

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
95.	Scientific survey mitigation	Requirement to implement a proponent-funded mitigation program to address adverse impacts from the Project on recurring scientific surveys including: • **Evaluation of survey designs**: Evaluate and quantify effects and impacts of proposed Project-related wind development activities on scientific survey operations and on provision of scientific advice to management. • **Identification and development of new survey approaches**: Evaluate or develop appropriate statistical designs, sampling protocols, and methods, while determining if scientific data quality standards for the provision of management advice are maintained. • **Calibration of new survey approaches**: Design and carry out necessary calibrations and required monitoring standardization to ensure continuity, interoperability, precision, and accuracy of data collections. • **Development of interim provisional survey indices**: Develop interim ad hoc indices from existing non-standard data sets to partially bridge the gap in data quality and availability between pre-construction and operational periods while new approaches are being identified, tested, or calibrated. • **Wind energy monitoring to fill regional scientific survey data needs**: Apply new statistical designs and carryout sampling methods to effectively mitigate survey impacts due to offshore wind activities from Vineyard Wind operations for the operational life span of the Project. • **Development and communication of new regional data streams**: New data collections will require new data collection, analysis, management, dissemination, and reporting systems. Changes to surveys and new approaches will require substantial collaboration with fishery management, fishing industry, scientific institutions, and other partners.	Other Uses (3.12)	Construction, Operations, Maintenance, and Decommissioning	Mitigation and Monitoring	This mitigation program may not significantly reduce the expected major impacts on NOAA scientific surveys from the proposed Project in the short term, but should lessen long-term impacts. The mitigation program could be applied to future wind energy facility projects to minimize or avoid similar impacts.	NOAA
99.	Environmental data sharing with federally recognized Native American tribes	Require that Vineyard Wind share the results and/or reports generated as a result of the Benthic Monitoring Plan; optical surveys of benthic invertebrates and habitat; evaluation of additional benthic habitat data in Muskeget Channel prior to cable lay operations; PAM; trawl survey for finfish and squid; reporting of all NARW sightings; injured/protected species reporting; NARW PAM monitoring; reporting of marine mammals and sea turtles in the pile-driving exclusion zone; PSO elements of weekly and monthly pile-driving reports; monthly construction summaries, including pile-driving reports; PSO and reporting requirements for pile driving; monthly reporting for protected species; vessel strike reporting for sea turtles; and other injured/dead protected species reporting with federally recognized Native American tribes, unless a tribe specifically requests not to receive a report(s). The reports and/or data will be shared with the federally recognized tribes currently participating in government-to-government consultations with BOEM for the Project: the Mashpee Wampanoag Tribe, the Wampanoag of Gay Head (Aquinnah); the Mashantucket Pequot Indian Tribe; the Mohegan Tribe of Indians of Connecticut; the Shinnecock Indian Nation; the Narraganset Indian Tribe; and the Delaware Tribe of Indians.	Environmental Justice (3.7)	Construction, Operations, Maintenance, and Decommissioning	Monitoring	This mitigation measure would not reduce the expected **negligible** to **minor** impacts on the subsistence fishing, cultural practices of, and values held by Native American tribes related to fish, shellfish, and marine mammal populations. However, sharing the information generated as a result of efforts to reduce impacts on fish, shellfish, and marine mammal populations will increase engagement on these topics with federally recognized Native American tribes and possibly address the tribes' concerns about impacts by providing documentation and the results of efforts to avoid, minimize, and/or mitigate impacts on fish, shellfish, and marine mammal populations.	Federally recognized Native American tribes
100.	Coordination with federally recognized Native American tribes in local hiring plan	Require Vineyard Wind to include coordination with federally recognized Native American tribes in the local hiring plan to facilitate Vineyard Wind's direct hiring of members of federally recognized Native American tribes, when possible and appropriate. Vineyard Wind will be required to coordinate with the two federally recognized tribes in southeastern Massachusetts, the Mashpee Wampanoag Tribe, and the Wampanoag of Gay Head (Aquinnah).	Demographics, Employment, and Economics (3.6); Environmental Justice (3.7)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	The requirement of a local hiring plan would further increase the expected **minor beneficial** impact on demographics, employment, and economics due to the potential direct hiring of members of federally recognized Native American tribes in southeastern Massachusetts.	Federally recognized Native American tribes

Measure Number	Measure	Description	Resource Area Mitigated and FEIS Section Number	Project Phase	Measure Type	Expected Effect on Impacts from Action Alternatives	Measure Related to Consultation
101.	Engagement with federally recognized Native American tribes regarding fishing compensation, trust, and innovation funds	Require Vineyard Wind to develop and implement an engagement plan to increase awareness of and potential participation in the proposed Rhode Island Compensation Fund, Massachusetts Compensation Fund, Rhode Island Fisherman’s Future Viability Trust, Massachusetts Fisheries Innovation Fund, and Other States Compensation Fund among federally recognized Native American tribes. Vineyard Wind will be required to host at least one outreach event, held virtually online or in person, with each of the federally recognized Native American tribes that are interested and eligible, based on geographic location, to participate in the listed programs: the Mashpee Wampanoag Tribe, the Wampanoag of Gay Head (Aquinnah); the Mashantucket Pequot Indian Tribe; the Mohegan Tribe of Indians of Connecticut; the Shinnecock Indian Nation; and the Narraganset Indian Tribe.	Environmental Justice (3.7)	Construction, Operations, Maintenance, and Decommissioning	Mitigation	Increasing the awareness of and participation in these compensation, trust, and innovation funds among federally recognized Native American tribes would reduce the expected **negligible** to **minor** impacts on tribe members involved in commercial, recreational, or subsistence fishing to **negligible** impacts by allowing for financial compensation for direct impacts on vessels and fishing interests; providing funds to allow for improving fishing vessels, gear, and other equipment; to address concerns about safety and effective fishing around the Project area specifically and wind energy facilities in general; and fund studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries.	Federally recognized Native American tribes

µPa = micropascal; ADLS = Aircraft Detection Lighting System; AIS = Automatic Identification System; APE = area of potential effect; BACI = Before After Control Impact; BO = Biological Opinion; BOEM = Bureau of Ocean Energy Management; BSEE = Bureau of Safety and Environmental Enforcement; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; CZM = Office of Coastal Zone Management; dB = decibel; dB re 1 µPa = decibels relative to one micropascal; DMA = Dynamic Management Area; DTS = Distributed Temperature Sensing System; EFH = Essential Fish Habitat; ESA = Endangered Species Act; ESP = electrical service platform; FAA = Federal Aviation Administration; FDR = Facility Design Report; FEIS = Final Environmental Impact Statement; GPS = global positioning system; HAPC = Habitat Area of Particular Concern; HDD = horizontal directional drilling; HH:MM = hour:minute; HRG = high-resolution geophysical; IHA = Incidental Harassment Authorization; IR = infrared; ITA = Incidental Take Authorization; kHz = kilohertz; km = kilometer; MassDEP = Massachusetts Department of Environmental Protection; MMPA = Marine Mammal Protection Act; MOA = Memorandum of Agreement; NA = not applicable; NARW = North Atlantic right whale; NHESP = Natural Heritage and Endangered Species Program; NHL = National Historic Landmark; NHPA = National Historic Preservation Act; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; NORAD = North American Aerospace Defense Command; NRHP = National Register of Historic Places; OECC = Offshore Export Cable Corridor(s); PAM = passive acoustic monitoring; PATON = private aid to navigation; PPPP = Piping Plover Project Plan; PSO = protected species observer; RAM = Radar Adverse Impact Management; RMS = root mean squared; SAR = search and rescue; SMA = seasonal management area; SOLAS = International Convention for the Safety of Life at Sea; T&C = terms and conditions; TCP = Traditional Cultural Property; USACE = U.S. Army Corps of Engineers; USAF = U.S. Air Force; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service; UTC = Universal Time Coordinated; VHF = very high frequency; WDA = Wind Development Area; WTG = wind turbine generator; Y/N = yes/no; YY-MM-DDT = Year-Month-Day Time Zone; YYYY-MM-DD = Year-Month-Day

[a] While these mitigation measures apply specifically to NARWs, additional benefits to non-target species of marine mammals, sea turtles, and fish are expected to occur.

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APPENDIX E

Environmental and Physical Settings

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APPENDIX E. ENVIRONMENTAL AND PHYSICAL SETTINGS

This appendix discusses the physical, geological, and biological settings in the vicinity of the proposed Project. In addition, it addresses potential impacts on these settings as determined from field and laboratory studies within the United States (mainly from the Block Island Wind Farm) and from outside the United States. Although projects in the United States may utilize larger monopile foundations and larger turbines than those used in the well-studied projects of the North Sea, the basic science behind how monopile size, water depth, currents, and waves interact to affect local hydrodynamics and create seabed scour and other effects are well understood and applicable to projects in the United States (U.S.) Bureau of Ocean Energy Management (BOEM) recently compared the long-term monitoring results from Europe to monitoring results from the first project in U.S. waters (the Block Island Wind Farm) and found that benthic scour at the Block Island Wind Farm was minor. BOEM has gathered the information in this document through direct outreach and dialogue with European regulatory agencies and private industry partners, as well as by reviewing both peer-reviewed and gray literature.

E.1. GENERAL REGIONAL SETTING

The proposed Project is located in southern New England and includes land areas in the Commonwealth of Massachusetts and adjacent nearshore and offshore waters. Figure E.1-1 shows the region surrounding the proposed Project.

The geologic history of the Atlantic coast of the United States is that of a passive margin, where the coastal mountains and continental sediments have been eroded over the millennia and deposited as thick layers of unconsolidated sediments in the Outer Continental Shelf (OCS). More recently in geologic time, periods of glaciation reworked, eroded, and deposited sediments along the northeastern Atlantic, leaving behind glacial formations offshore that include deep infilled channels, glacial moraine deposits, boulder fields, areas of highly consolidated sediments, and highly variable, heterogeneous conditions. Glacial moraines identified on the islands of Long Island (New York), Block Island (Rhode Island), Martha’s Vineyard (Massachusetts), and Nantucket Island (Massachusetts) roughly connect through a series of offshore moraine deposits. Glacial deposits are found in and around BOEM lease areas off the coast of Rhode Island and Massachusetts and call areas offshore New York. In areas in and around the glacial moraines, sediments are expected to be generally coarser grained, highly variable, and consolidated with erratics such as boulders deposited both on the seabed and in the subsurface.

The proposed Project’s offshore cables would make landfall in south-central Cape Cod in Barnstable County. The Covell’s Beach landfall site would be located within the Town of Barnstable, the largest community on Cape Cod; the Town of Barnstable includes forests, wetlands, ponds, protected open space, public use areas, low- to medium-density residential development, and some commercial and industrial uses along major roads. The Town of Barnstable management plan prioritizes preserving the historic character of the area and preserving natural resources (Town of Barnstable 2010). The proposed Project would also include office, storage, and port facilities on Martha’s Vineyard. About 2 percent of Martha’s Vineyard is zoned for commercial or industrial use, 40 percent is preserved from development, and nearly all of the remaining land area is developed for residential uses (Martha’s Vineyard Commission 2010).

From the Cape Cod coast, the proposed Project would extend south-southwest through Nantucket Sound, pass between Martha’s Vineyard and Nantucket via Muskeget Channel, and continue south offshore. Offshore waters in the proposed Project area would be located within the greater Georges Bank area (though not part of the bank itself) of the Northeast U.S. Continental Shelf Ecosystem. This ecosystem extends from the Gulf of Maine to Cape Hatteras, North Carolina (BOEM 2014). The Wind Development Area (WDA) and Offshore Export Cable Corridor (OECC) would be located within the Southern New England sub-region of the Northeast U.S. Continental Shelf Ecosystem, which is distinct from other regions based on differences in productivity, species assemblages and structure, and habitat features (Cook and Auster 2007).

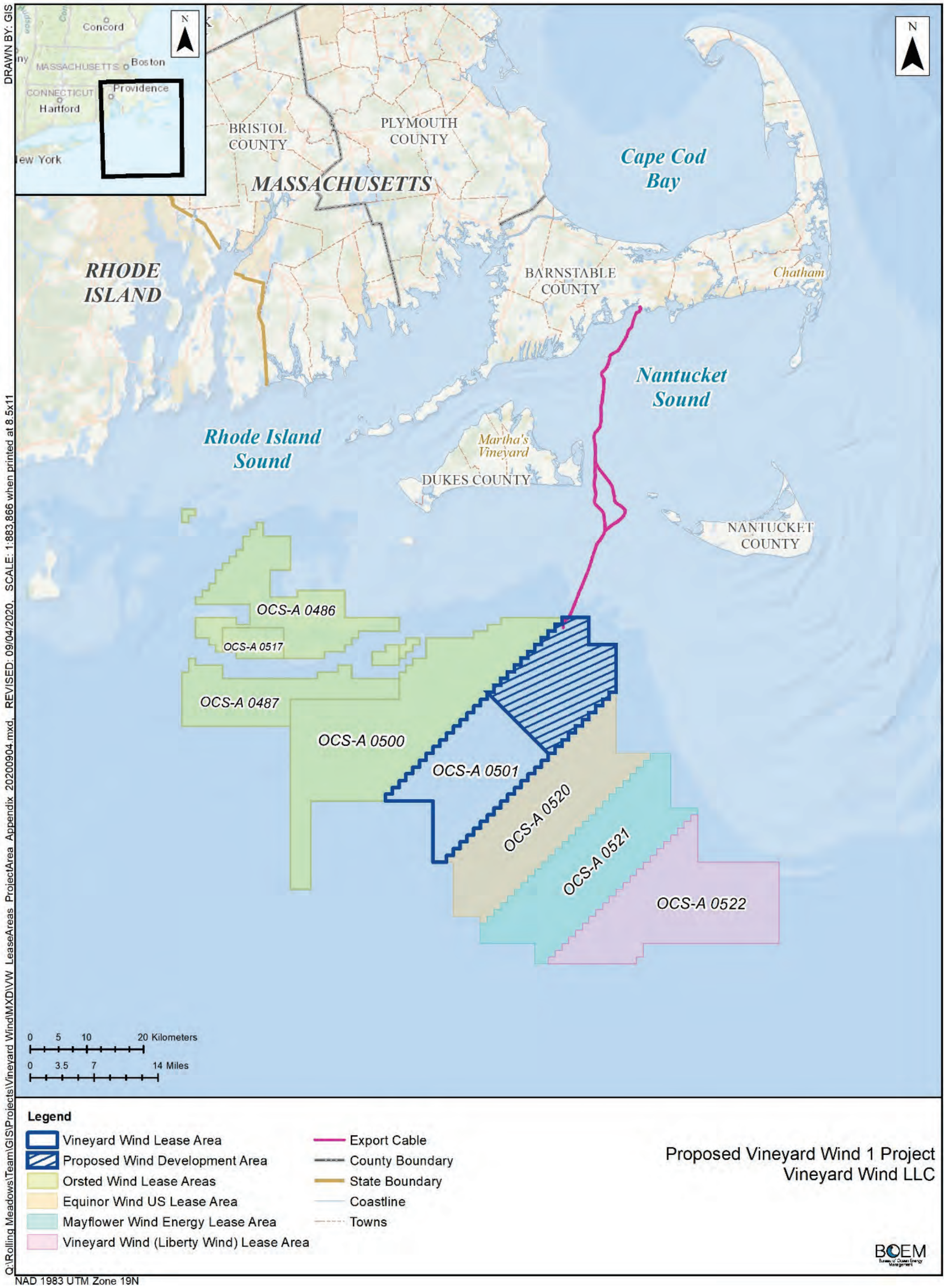


Figure E.1-1: Overall View of the Region Surrounding the Proposed Project

E.2. CLIMATE AND METEOROLOGY

Understanding atmospheric physical processes are vital to offshore wind energy development. National Oceanic and Atmospheric Administration (NOAA) buoys collect site-specific information on air and water temperature, wind speeds and direction, and air pressure via the National Data Buoy Center. Current and historical data is available to the public. NOAA satellites collect a wide variety of atmospheric data over much larger regions. Several lessees are already collecting site-specific data within their lease area(s) using specialized buoy systems to inform their Project engineering designs. This data may also provide a baseline for comparison in the future.

The Atlantic seaboard is classified as a mid-latitude climate zone based upon the Köppen Climate Classification System. The region is characterized by mostly moist subtropical conditions, generally warm and humid in the summer with mild winters. During the winter, the main weather feature is the nor'easter in the northeastern United States. During the summer, convective thunderstorms occur frequently. The Atlantic hurricane season runs from June 1 to November 30.

The Massachusetts climate is characterized by frequent and rapid changes in weather, large daily and annual temperature ranges, large variations from year to year, and geographic diversity. The National Climatic Data Center (NCDC) defines distinct climatological divisions to represent areas that are nearly climatically homogeneous. Locations within the same climatic division are considered to share the same overall climatic features and influences. The site of the Proposed Action is located within the Massachusetts coastal division.

E.2.1. Ambient Temperature

According to NCDC data for the Massachusetts coastal division, the average annual temperature is 50.5 degrees Fahrenheit (°F) (10.3 degrees Celsius [°C]), the average winter (December–February) temperature is 31.7°F (-0.2°C) and the average summer (June–August) temperature is 69.6°F (20.9°C), based on data collected from 1987 through 2019. Table E.2-1 summarizes average temperatures at the individual recording stations within the general area of the proposed Project site. Data for some stations as seen in the table are reflective of different years of weather observations; however, the general pattern shows little difference across the listed locations.

Table E.2-1: Representative Temperature Data

Station	Annual Average °F/°C	Annual Maximum °F/°C	Annual Minimum °F/°C
Coastal Division	50.5/10.3	59.2/15.1	41.8/5.4
Nantucket	50.7/10.4	57.6/14.2	43.9/6.6
Martha's Vineyard	51.2/10.7	59.1/15.1	43.2/6.2
Hyannis	51.1/10.6	58.8/14.9	43.4/6.3
Buzzards Bay Buoy	50.4/10.2	NA	NA
Nantucket Sound Buoy	52.4/11.3	NA	NA

Sources: NOAA 2019a (Coastal Division 2019 data; Nantucket 2019 data; Martha's Vineyard 2019 data; Hyannis 2019 data) and NOAA 2019b (Buzzards Bay Buoy 2009-2019 data; Nantucket Sound Buoy 2009-2019 data).

°C = degrees Celsius; °F = degrees Fahrenheit; NA = not applicable

E.2.2. Wind Conditions

Table E.2-2 summarizes wind conditions in the Massachusetts coastal division. This table shows the monthly average wind speeds, monthly average peak wind gusts, and the hourly peak wind gusts for each individual month. Data from 2009 through 2019 show that monthly wind speeds range from a low of 11.97 miles per hour (mph) (19.27 kilometers per hour [km/hr]) in July to a high of 17.02 mph (27.38 km/hr) in January. The monthly wind peak gusts reach a maximum during November at 21.23 mph (34.17 km/hr). The one-hour average wind gusts reach a maximum during October at 64.65 mph (104.04 km/hr).

Table E.2-2: Representative Wind Speed Data

Month	Monthly Average Windspeed		Monthly Average Peak Gust		Peak One-Hour Average Gust	
	mph	km/hr	mph	km/hr	mph	km/hr
January	17.02	27.38	20.97	33.75	61.29	98.64
February	15.77	25.38	19.35	31.15	63.53	102.24
March	15.91	25.61	19.44	31.29	64.42	103.68
April	14.90	23.97	18.12	29.16	49.21	79.20
May	13.14	21.14	15.89	25.58	58.16	93.60
June	12.31	19.81	14.93	24.03	44.52	71.64
July	11.97	19.27	14.49	23.32	57.04	91.80
August	12.48	20.08	15.14	24.37	59.95	96.48
September	13.92	22.40	17.08	27.48	51.90	83.52
October	16.45	26.48	20.40	32.82	64.65	104.04
November	17.01	27.38	21.23	34.17	57.71	92.88
December	15.99	25.73	19.84	31.93	59.50	95.76

Source: NOAA 2019b, (National Data Buoy Center, Nantucket Sound Station 44020, 2009 through 2019)

km/hr = kilometer per hour; mph = mile per hour

Throughout the year, wind direction is variable. However, seasonal wind directions are primarily focused from the west/northwest during the winter months (December–February) and from the south/southwest during the summer months (June–August). Figure E.2-1 shows a 5-year wind rose for Buoy Station 44020 (Nantucket Sound). Wind speeds are in meters per second. Percentages indicate how frequently the wind blows from that direction.

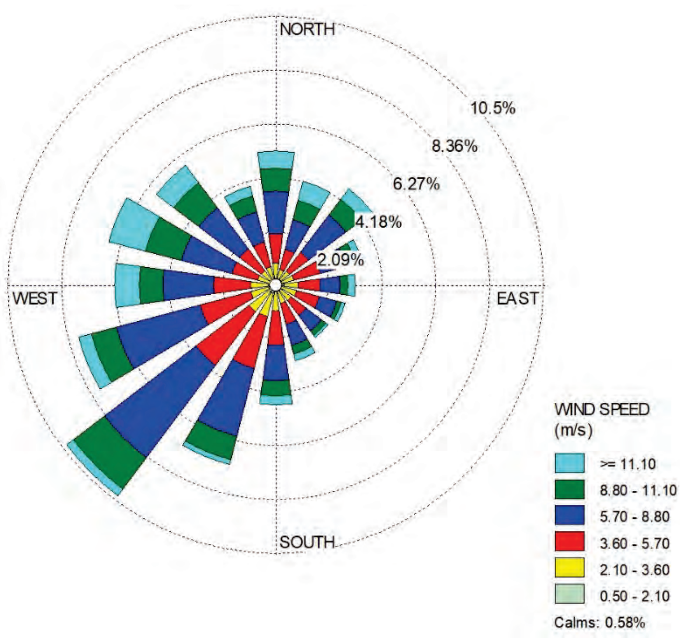


Figure E.2-1: 5-year (2015-2019) Wind Rose for Buoy 44020

E.2.3. Precipitation and Fog

Data from NCDC show that the annual average precipitation is 49.75 inches (126.37 centimeters) in the Massachusetts coastal division. Table E.2-3 shows monthly variations in average precipitation, which range from a high of 5.59 inches (14.20 centimeters) for October to a low of 3.30 inches (8.38 centimeters) in May.

Table E.2-3: Representative Monthly Precipitation Data (2009-2019) [a]

Month	Average Precipitation	
	inches	centimeters
January	4.04	10.26
February	3.86	9.80
March	4.67	11.85
April	4.14	10.51
May	3.30	8.38
June	4.20	10.67
July	3.72	9.44
August	3.67	9.33
September	3.56	9.03
October	5.59	14.20
November	4.15	10.53
December	4.87	12.36
Annual Average	49.75	126.37

Source: NOAA 2019a

[a] Precipitation is recorded in melted inches (snow and ice are melted to determine monthly equivalent). Data are representative of the Massachusetts coastal division.

Snowfall amounts can vary quite drastically within small distances. Data from the Martha's Vineyard Station (KMVY) shows that the annual snowfall average is approximately 23 inches (58.4 centimeters), and the month with the highest snowfall is February, averaging around 8 inches (20.3 centimeters).

Fog is a common occurrence along coastal Massachusetts. Fog is especially dense across the water south of Cape Cod towards the islands of Martha's Vineyard and Nantucket. Fog data were collected from 1997 to 2009 at the BUZM3 meteorological station located in Buzzard's Bay, approximately 25 miles (40 kilometers) from the project site; and from 2007 to 2009 at the Martha's Vineyard Coastal Observatory (MVCO) meteorological station located 2 miles (3 kilometers) south of Martha's Vineyard (Merrill 2010). The data show that fog is most common in the Project area during the months of June, July, and August, with a typical range of 6 to 11 days per month with at least 1 hour of fog. In the winter, fog is much less frequent, with 3 or fewer days with at least 1 hour of fog.

The potential for icing conditions, i.e., atmospheric conditions that can lead to the deposition of ice from the atmosphere onto a structure, was also predicted based on data collected at the BUZM3 tower (Merrill 2010). Icing is rare when the water temperature is greater than 43°F (6°C), so in most months of the year, and for many days during the winter months, there is no potential for icing to occur. The data show that moderate icing (defined by the Federal Aviation Administration as a rate of accumulation such that short encounters become potentially hazardous) is unlikely to occur more than 1 day per month, while the potential for light icing is above 5 days per month in December, January, and February. Icing would be unlikely to occur at any time from April through October.

E.2.4. Hurricanes

During the 160 years for which weather records have been kept, ten hurricanes have made landfall in Massachusetts and five others have passed through the WDA without making landfall. The latest hurricane that made a direct landfall was Hurricane Bob in 1991. Out of those ten hurricanes, five ranked as Category 1 on the Saffir-Sampson Scale, two were Category 2 hurricanes, and three were Category 3 hurricanes. Since records have been kept, no Category 4 or 5 hurricanes have made landfall in Massachusetts. Of the hurricanes that passed through the WDA without making landfall in Massachusetts, one was Category 2, one was Category 1, and three were tropical storms when they passed through the WDA. The most recent of these storms was Beryl in 2006. NOAA 2019c defines the winds speeds and typical damage associated with each category of hurricane.

In addition to hurricanes, Nor'easters (cold-core extratropical cyclones) may occur several times per year in the fall and winter months. Wind gusts during the strongest Nor'easters can cause similar damage to a Category 1 hurricane, although Nor'easters typically are larger and last longer than hurricanes.

E.2.5. Mixing Height

Table E.2-4 presents atmospheric mixing height data from two nearby stations. As shown in the table, the minimum average mixing height is 389 meters (1,276 feet), while the maximum average mixing height is 1,421 meters (4,662 feet). The minimum average mixing height is much higher than the height of the top of the proposed rotors (255 meters [837 feet]).

Table E.2-4: Representative Seasonal Mixing Height Data

Season [a]	Data Hours Included [b]	Nantucket Average Mixing Height (meters) [c]	Chatham Average Mixing Height (meters) [c]
Winter	Morning – No Precipitation Hours	780	668
	Morning – All Hours	905	655
	Afternoon – No Precipitation Hours	791	774
	Afternoon – All Hours	890	747
Spring	Morning – No Precipitation Hours	588	681
	Morning – All Hours	734	664
	Afternoon – No Precipitation Hours	746	1,218
	Afternoon – All Hours	827	1,110
Summer	Morning – No Precipitation Hours	389	569
	Morning – All Hours	448	568
	Afternoon – No Precipitation Hours	609	1,421
	Afternoon – All Hours	667	1,295
Fall	Morning – No Precipitation Hours	625	566
	Morning – All Hours	739	583
	Afternoon – No Precipitation Hours	765	1,036
	Afternoon – All Hours	831	945
Annual Average	Morning – No Precipitation Hours	595	620
	Morning – All Hours	707	618
	Afternoon – No Precipitation Hours	727	1,121
	Afternoon – All Hours	804	1,028

Source: Data drawn from Cape Wind Energy Project Final Environmental Impact Statement (MMS 2009).

[a] Winter = December, January, February; Spring = March, April, May; Summer = June, July, August; Fall = September, October, November

[b] Missing values not included

[c] Data from MMS 2009

E.2.6. Potential General Impacts of Offshore Wind Facilities

A known impact to the atmospheric environment as a result of offshore wind facilities is the wake effect. The presence of a wind facility extracts energy from the free flow of wind, creating a "wake" downstream of the facility. The resulting "wake effect" is the aggregated influence of the wake on the available wind resource and the energy production potential of any facility located downstream. Christiansen and Hasager (2005) observed offshore wake effects from existing facilities via satellite with synthetic aperture radar to last anywhere from 2 to 20 kilometers (1.2 to 12.4 miles) depending on ambient wind speed, direction, degree of atmospheric stability and the number of turbines within a facility. During stable atmospheric conditions, these offshore wakes can be longer than 70 kilometers (43.5 miles).

A less understood impact is the formation of a microclimate. Past modeling studies suggest a change in temperature and moisture downwind of offshore wind energy facilities. From September 2016 to October 2017, a study using aircraft observations accompanied with mesoscale simulations provided a look into the spatial dimensions of micrometeorological impacts from a wind energy facility in the North Sea (Siedersleben et al. 2018). Large offshore wind facilities can potentially have an impact on the local microclimate. However, this potential is fairly low because very specific conditions must be met in order for the impact to occur. The local redistribution of moisture and heat due to rotor-induced vertical mixing has no influence on the local climate outside of the immediate vicinity of a wind facility. Only a permanent change in the air–sea interactions could change the local climate. For example, warmer air over a cold ocean would result in an increased heat transfer to the ocean, thereby causing more water vapor transport into the atmosphere because of the dryer air within the wake of a turbine/facility. Such events are rare because they can only occur when there is a strong increase in temperature with altitude at or below hub height in order to create the warming and drying within the wake of large offshore wind energy facilities. The increase of temperature with height is an inversion, better explained as a reversal of the normal decrease of air temperature with altitude. These specific conditions are not likely to occur off the south coast of Massachusetts.

E.3. GEOLOGY AND SEAFLOOR CONDITIONS

The proposed Project would be located south of Cape Cod in the Atlantic Ocean and Nantucket Sound, where the physiographic regions known as the Seaboard Lowland section of the New England Province and the Atlantic Coastal Plain Province meet. The proposed Project would straddle these two physiographic regions. The Lowland, which includes part of the continental shelf, is a broad belt that extends from south of Rhode Island northeast to central Maine. Erosion and deposition related to glacial processes produced numerous changes in drainage patterns and observed topography over geologic time. The land formations in the Coastal Plain are low relief and are composed of a wedge of unconsolidated sediments that overlay much older consolidated rock. The north bounds of the Coastal Plain run from the north side of Long Island through Rhode Island Sound to Martha’s Vineyard. Offshore water depths generally range from approximately 131 to 262 feet (40 to 80 meters), with some areas as shallow as 65 feet (20 meters). North of Martha’s Vineyard, Nantucket Sound exhibits water depths mostly around 40 to 50 feet (12 to 15 meters), with several shallower shoals, and it generally becomes shallower as one approaches Cape Cod. The sea has also influenced landforms in this region, creating barrier spits and longshore accretions of sandy beaches with the prevailing currents (Fenneman 1938; Denny 1982; Oldale 1992).

Geology and seafloor conditions are a fundamental factor determining whether a potential site could support wind turbine foundations. The major possible factors relating to a seafloor failing to support a pile-driven wind turbine generator (WTG) or other marine structure are: liquefaction due to earthquakes or wave action, seafloor suitable for foundation type (monopile), soil cohesion and soil strength, repeat loading (structural), inadequate damping (structural), sediment transport and sand waves, and scour.

Liquefaction is a process in which solid material behaves as a liquid. Earthquakes can produce vibrations that interact with soil particles in such a way that they become suspended while agitated by that energy. While the soil particles are suspended, they behave like a liquid, allowing structures attached or imbedded into the seafloor to sink or tip over. The frequency at which this phenomenon can occur is related to the frequency and intensity of earthquake activity within an area, the composition and depth of the soil, and the underlying stratigraphy of the area. To a lesser degree, wave action can also create shallow liquefaction effects depending on wave and sediment characteristics.

Foundation types for particular offshore wind projects are selected based on the seafloor’s characteristics. Seafloor conditions that may be challenging for one foundation type may be well suited for another. Structures that are pile driven into the seafloor are designed to be sited in locations where there is ample loose sediment to allow for it. For these foundation types, some amount of rocks or boulders intermixed within the sediment can be tolerated through avoidance, micro-routing, or drilling, and the depth a pile is driven can be increased to accommodate for looser sediments. For other types of foundations and engineering strategies, rocky seafloor conditions are preferable.

Soil cohesion is how strongly bound together soil particles are, and soil strength is the amount of shear stress a soil can sustain. The underlying layers, types, and depths of soils of a seafloor affect how much strength and stiffness are exhibited by the soil. The particles that make up soil vary in compactness, size, and abundance. Material with different proportions of particle sizes will have different properties. If a seafloor is composed of material that lacks cohesion and soil strength, it may deform or displace around the structure under the forces of pile installation.

Repeat loading refers to repeated, externally applied forces on a structure. Changes in environmental conditions created by wind and wave forces can vary in direction, intensity, and duration. This repeat loading can have a cumulative impact on a structure's ability to stand, and must be accounted for within the design of the structure.

Damping is the suppressing of energy or decrease in swaying or swinging. Inadequate damping is when forces are able to create enough movement that can affect the function or integrity of a structure. Structures sway from receiving energy from dynamic wind and wave forces. These oscillations can become amplified over time if they are not mitigated through damping, and can potentially compromise the structure. Damping can be done by increasing the size and depth of the foundation, and by adding components to the structure that act to mitigate or negate loading by absorbing and counter-acting the oscillation.

Sediment transport is the movement of sediment, typically due to a combination of gravity acting on the sediment and/or movement of the water with sediment particles in it. Sand waves are ridge-like structures that are formed by waves or currents of the water. Typically, sand waves are not static. They are migrating bedforms and evidence of active sediment transport.

Scour is the removal of sediment, such as silt, sand, and gravel, from around the base of obstructions due to a current's flow in the sea. An obstruction in a water body that is moving may cause flow changes, including higher or lower velocities around the obstructions. Foundations installed in the seabed are subject to scour around the base of the structure where it contacts the seabed.

To determine whether the seafloor can support WTGs, geologic surveys are performed. Geologic surveys can be broadly divided as either physiographic or geotechnical. Physiographic, also known as geophysical, surveys involve passive or remote techniques that provide information about the surface and near-surface of the seafloor, without physically contacting it. Examples of these physiographic surveying techniques include hydrographic, bathymetric, sonar, and magnetometer surveying. Geotechnical surveys physically sample and penetrate the seafloor. These are the surveys that provide the information most pertinent to the ability of the seafloor to support a given type of foundation design. Two types of geotechnical surveys, borings and vibracores, are techniques that extract material from below the seafloor that can have their composition and characteristics analyzed in a laboratory. Cone penetration tests provide information about the layers of material under the seafloor surface, including bearing capacity and soil strength of the sediment, by measuring the pressure and resistance as the instrument is driven into the seafloor. Benthic grabs directly pick up sediment samples at the surface of the seafloor. All of these direct samplings and measurements provide input to computer modeling that engineers use to assess the ability of the seafloor to support WTGs.

When selecting the foundation type and design for a wind energy project, water depth and the underlying material of the seafloor are some of the most important considerations. Structural problems can be avoided by matching foundation design to site characteristics. The most widely used foundation type is a monopile that is driven into the seafloor in locations with sufficiently thick sediment above the bedrock, few boulders, and less than 100 feet (30 meters) water depth.

Foundations and towers are among the least likely WTG components to require repair or replacement. An analysis of several European offshore wind facilities during the first 10 years of operation was conducted, which included hundreds of WTGs between 2 to 4 megawatts (MW) in size of varying ages (Carroll et al. 2016). At the time the study was published, approximately 80 percent of all offshore wind foundations in European waters were monopiles (EWEA 2016). Failure rates of component groups in the study were examined as a combination of replacements, minor repairs, and major repairs per turbine each year. The study found that the replacement rate of a single foundation and tower was 0.0, indicating there was no occurrence of a foundation and tower failing to stand during this time frame. Foundations and towers had a combined repair rate of 0.181 per year. Repairs to the foundation and tower are among the quickest and cheapest relative to the other WTG component categories (Carroll et al. 2016). A review of cable failures found an average failure rate for offshore AC cables of approximately 0.003 failure per kilometer per year (Warnock et al. 2019).

Physiographic and geotechnical surveys have explored the subsurface geological conditions in the proposed WDA and OECC (COP Volume II-A, Section 2.1.2.2, Epsilon 2018a; COP Addendum Section 2.2, Epsilon 2019a). BOEM’s Engineering and Technical Review Branch (ETRB) has reviewed all of the geophysical and geotechnical information provided in the Construction and Operations Plan (COP) and other data submissions from Vineyard Wind. ETRB concurs with Vineyard Wind’s conclusion that fixed bottom foundations as described in their COP are technically feasible and safe for wind turbine installations to a depth below the seafloor of 131.2 feet (40 meters) and electrical service platform (ESP) foundations to a depth below the seafloor of 246 feet (75 meters). If the COP is approved and Vineyard Wind intends to install foundations beyond these depths, then further information from Vineyard Wind would be required with the Facility Design Report/Fabrication and Installation Report. This information would then be evaluated by ETRB prior to allowing the installation of components beyond the above stated depths.

If the COP is approved, Vineyard Wind must then submit a Facility Design Report and a Fabrication and Installation Report. The Facility Design Report provides specific engineering details of the design of all facilities, including structural drawings, environmental and engineering data, a complete set of calculations used for design, Project-specific geotechnical studies, and a description of loads imposed on the facility. The Facility Design Report must demonstrate that the design conforms to the responsibilities under the lease. The Fabrication and Installation Report describes how the facilities would be fabricated and installed in accordance with the design criteria identified in the Facility Design Report, the COP, and generally accepted industry standards and practices. Both of these reports must be reviewed and certified by a BOEM-approved third-party Certified Verification Agent prior to submittal. BOEM has 60 days to review these reports and provide objections to Vineyard Wind. If BOEM has no objections to the reports—or once any BOEM objections have been resolved—Vineyard Wind may commence construction of the Project.

E.3.1. Historical Formation

Today, the continental shelf off the United States eastern seaboard resides on a passive continental margin with minimal tectonic and seismic activity (COP Volume II-A, Section 2.1; Epsilon 2018a). Hundreds of millions of years ago, prior to this relatively quiescent period, numerous continental plate collisions produced the multiple mountain chains that are prominent on the present landscape, including the Appalachian and Adirondack systems (Denny 1982). Subsequently, weathering and erosion have supplied sediment from the bedrock-based piedmont to the coastal plain regions sloping down toward the Atlantic Ocean. The sediment forms a wedge that thickens toward the sea and is modified by fluvial, estuarine, and coastal processes. Starting approximately 2.6 million years ago, a series of glaciations modified the landscape in the northern latitudes, scouring, transporting, and depositing materials along their path. Glacial periods within the last 500,000 years are believed to be responsible for the geomorphology present on today’s landscape (Denny 1982).

E.3.2. Current Seafloor Conditions

The current range of seabed conditions is a result of historical geologic events. Little to no terrigenous sediment supply exists in the region, so the surficial sediment layer comes mostly from glacial deposits (Baldwin et al. 2016). A direct correlation between grain size and bottom current velocities is evident from the strong tidal currents in and around Nantucket Sound to the open water, general shelf circulation south of the islands (COP Volume II-A, Section 2.1; Epsilon 2018a). Where high current conditions exist, the coarsest material persists (gravel, cobbles, boulders), often with large ripples and waves in the sandy surficial layer (Poppe et al. 2012; Baldwin et al. 2016).

Very homogenous seafloor conditions exist in offshore areas, dominated by fine sand and silt. Water depths range from 114.8 to 170.6 feet (35 to 52 meters) over a gently sloping seafloor that dips toward the south-southwest. There is a distribution of localized patches of ripples and sand waves throughout the area. These features represent the only vertical relief in an otherwise relatively flat, featureless seafloor that slopes gradually offshore. These features range from 32 to 656 feet (10 to 200 meters) wide by 328 to 1,640 feet (100 to 500 meters) long, but may exceed 3,280 feet (1,000 meters) in length. These features are typically less than 3.3 feet (1 meter) in height, but can reach up to 22.9 feet (7 meters).

Seafloor features that are stable and exhibit vertical relief provide a significant rare habitat amidst the broad sand flats. Such habitats include gravel or pebble-cobble beds, sand waves, biogenic structures (e.g., burrows, depressions, sessile soft-bodied invertebrates), shell aggregates, boulders, hard bottom patches, sulfur sponge (*Cliona celata*) beds, and cobble beds with and without sponge cover. These coarser substrates provide complex interstitial spaces for shelter and generally exhibit greater faunal diversity. Other special, sensitive, and unique habitats (living bottom, hard/complex bottom, eelgrass [*Zostera marina*] beds, and marine mammal habitats) occur in places in and near the proposed Project (COP Volume II-A, Section 5.2; Epsilon 2018a).

The seafloor near Muskeget Channel is particularly complex, being composed mostly of sand, but with a variety of slopes, contours, and sand wave dimensions (COP Volume II-A, Section 2.1; Epsilon 2018a). This area also includes a significant amount of hard/complex bottom habitat, as well as boulders that are buried shallowly and could be exposed by shifting sands. Water depths in the Muskeget Channel area range from 0 to 100 feet (0 to 30 meters), with the main part of the channel lying mostly between 23 and 65 feet (7 to 20 meters). The seafloor in the proposed OECC is primarily a flat bed of sand and silt, but it includes sparse small patches of minor vertical relief, as well as several eelgrass beds nearby. Water depths in the proposed OECC, which Vineyard Wind has routed to avoid shoals and eelgrass beds, are around 40 to 50 feet (12 to 15 meters) for most of the route, becoming gradually shallower over the final 2 miles (3.2 kilometers) approaching the land.

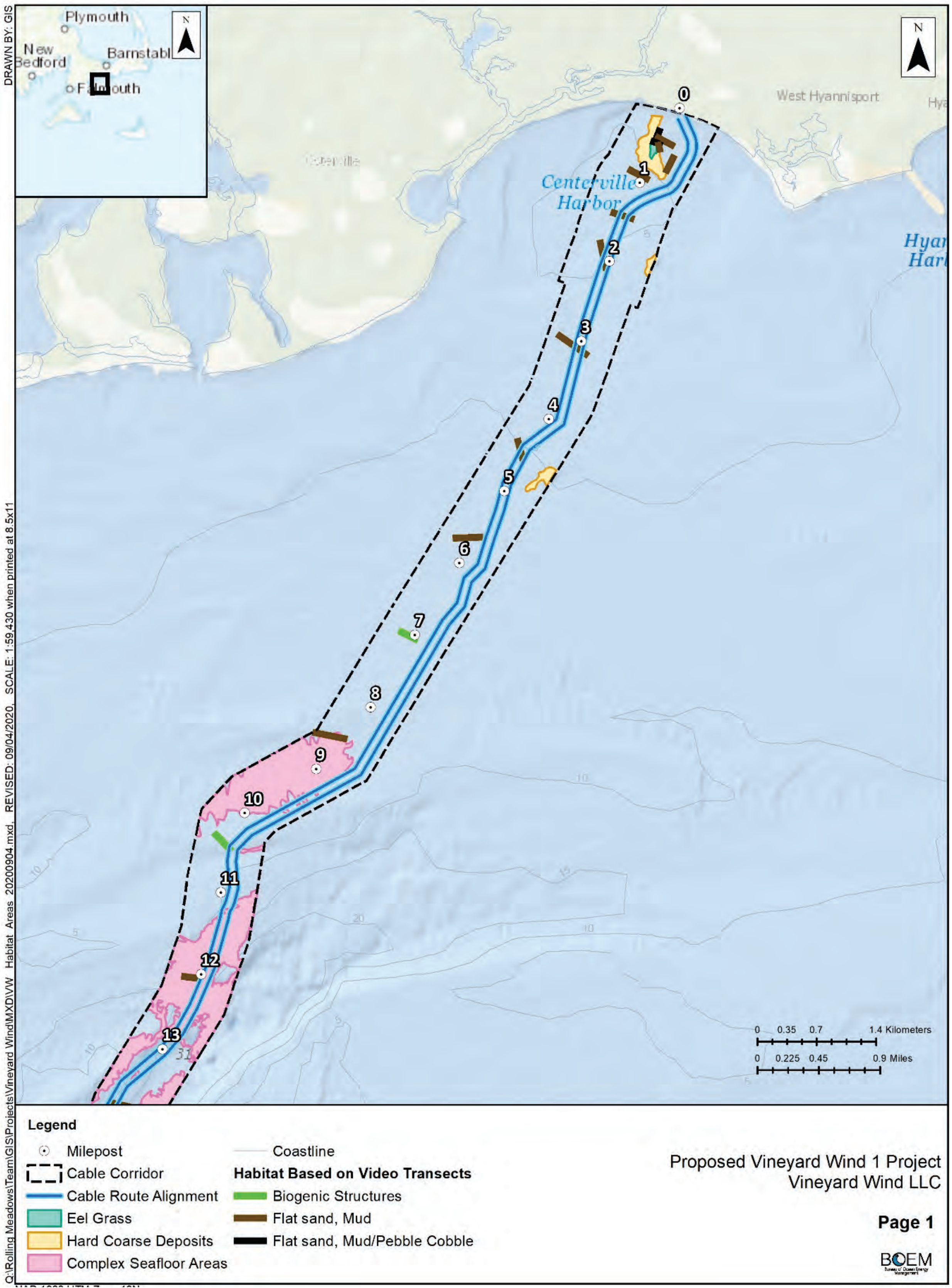
Seafloor habitats can also be classified more broadly as biogenic structures, hard bottom, complex seafloor, and other, which would include the majority of flat sand and mud habitat in the WDA and OECC (Attachment E in Epsilon 2018b). Hard bottom in the OECC typically consists of a combination of coarse deposits such as gravel, cobble, and boulders in a sand matrix. These coarse deposits form a stable surface over which sand waves forced by tidal currents periodically migrate. Certain hard-bottom areas also include piles of exposed boulders, but no bedrock outcrops are present in the OECC or WDA. Complex seafloor in the OECC and WDA consists of bedforms such as rugged fields of sand waves; although these mobile features are less amenable to benthic macroinvertebrates, they may be attractive to finfish. Maps delineating these seafloor areas, based on the results of a 2018 survey reported in Attachment E of Epsilon 2018b, are shown on Figures E.3-1a through E.3-1e.

Seafloor conditions can also be described according to the Coastal and Marine Ecological Classification Standard (CMECS) substrate component, which classifies seafloor types based on the composition and particle size of the surface layers of the substrate (FGDC 2012). Maps delineating seafloor conditions according to CMECS substrate classifications, based on the results of a 2018 survey reported in Attachment E of Epsilon 2018b, are shown on Figures E.3-2a and E.3-2b.

E.3.3. Potential General Impacts of Offshore Wind Facilities

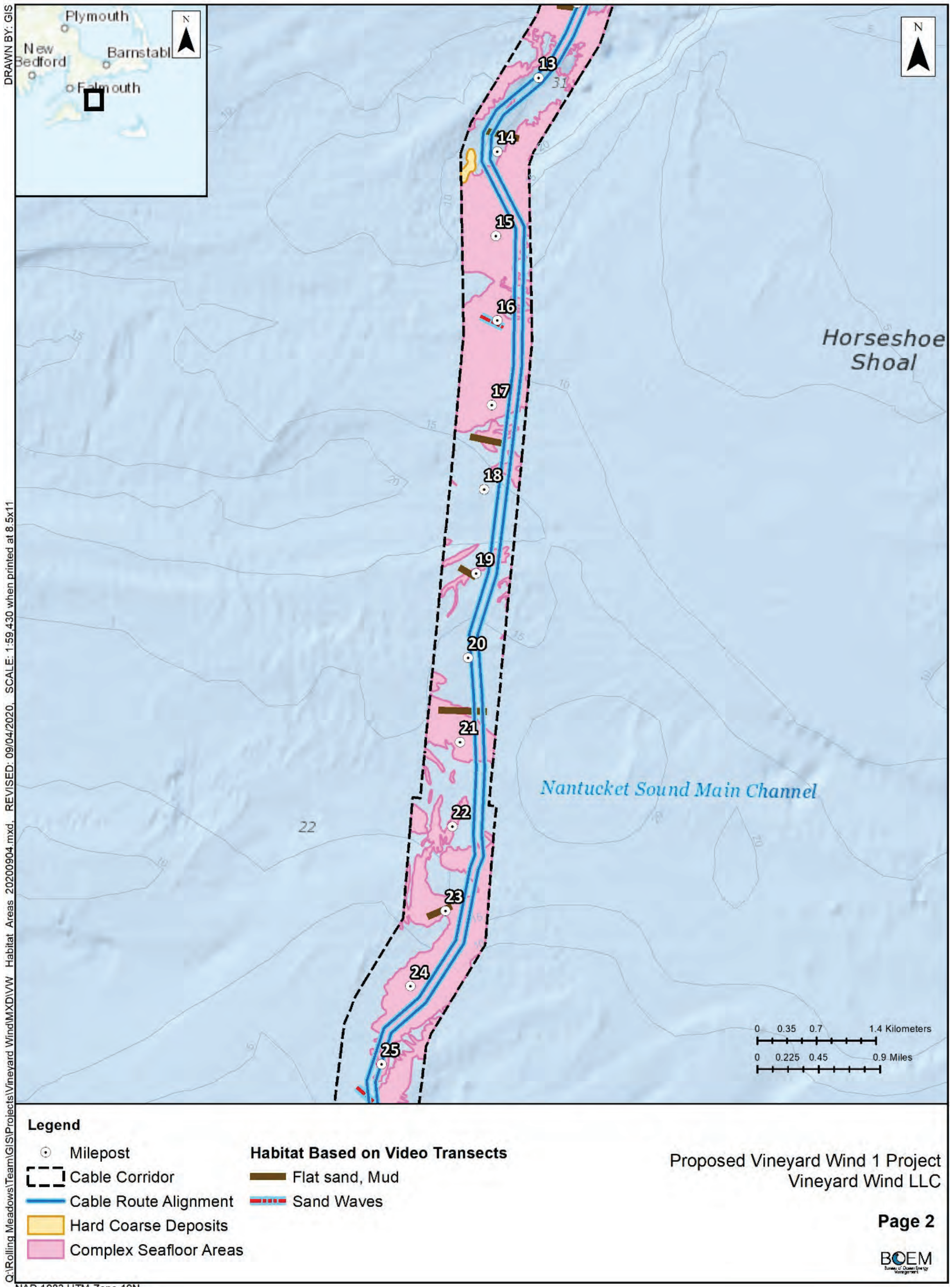
Scour, turbidity, and sedimentation are all conditions related to the strength of oceanographic forces, geologic conditions, and sediment processes. Scour occurs when the oceanographic forces are strong enough to mobilize the local sediments away from their current location, without additional sediments being added to the system to replace the mobilized sediments. Turbidity occurs when either sufficient force is present to mobilize sediments from the seabed into the water column, or additional sediments are being put into the system in such a way that they remain suspended for a period of time. Turbid conditions would remain as long as the particles are suspended in the water column. Lastly, sedimentation occurs when the oceanographic conditions are not strong enough to mobilize sediments and additional sediments are actively being deposited.

Geologic conditions heavily influence the feasibility and technical complexity of installing and operating offshore wind facilities. Geologic conditions such as sediment uniformity, density, and grain size can contribute to the potential for an installation or facility to have occurrences of scour, turbidity, and/or sedimentation. The presence of bedforms, such as ripples and sand waves, indicate local oceanographic forces are mobilizing surficial sediments and a lack of fine sediment indicates current and tidal forcing can be strong enough to remove smaller sized particles.



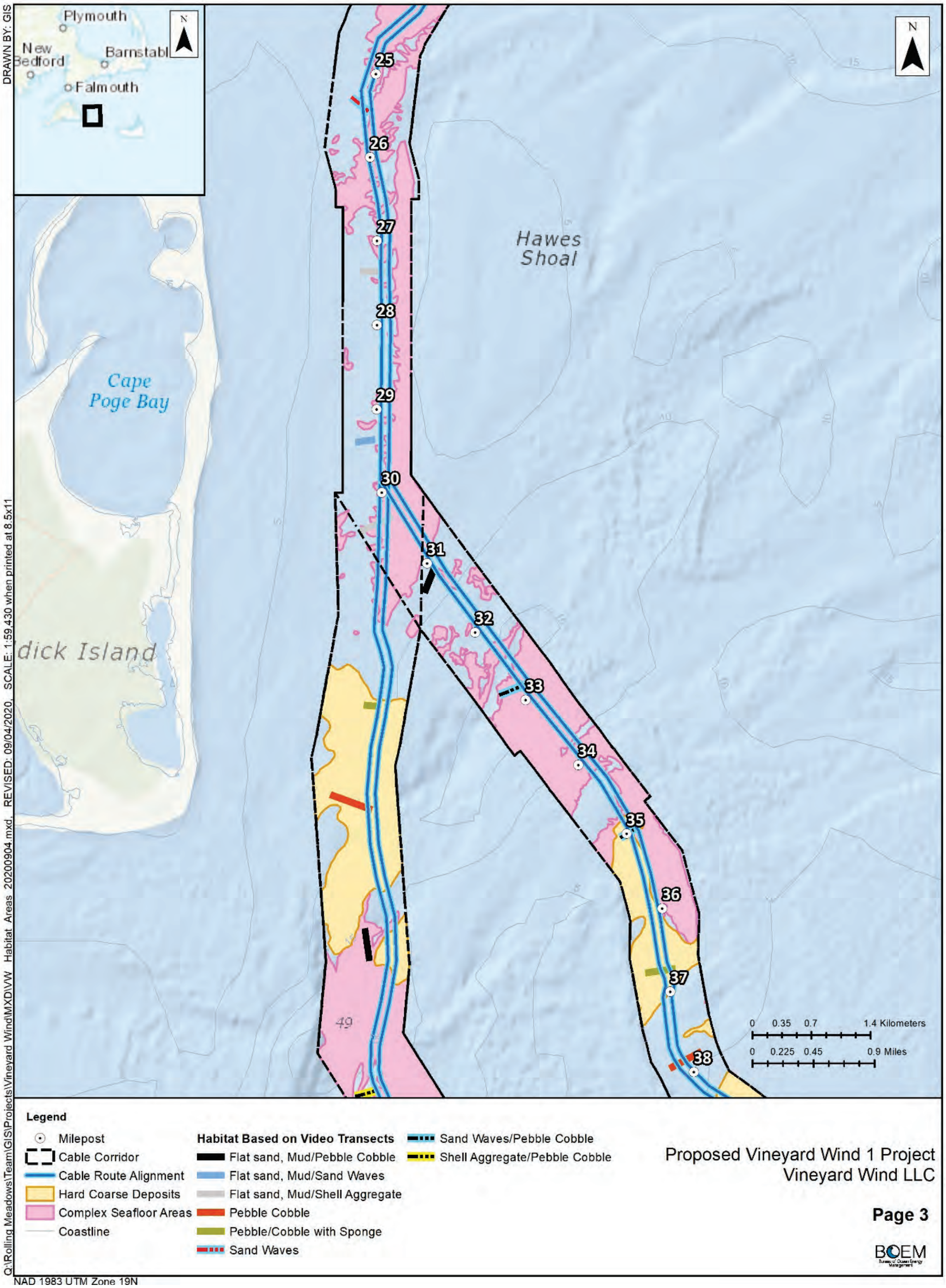
Source: Attachment E in Epsilon 2018b

Figure E.3-1a: Seafloor Habitats within the Offshore Export Cable Corridor



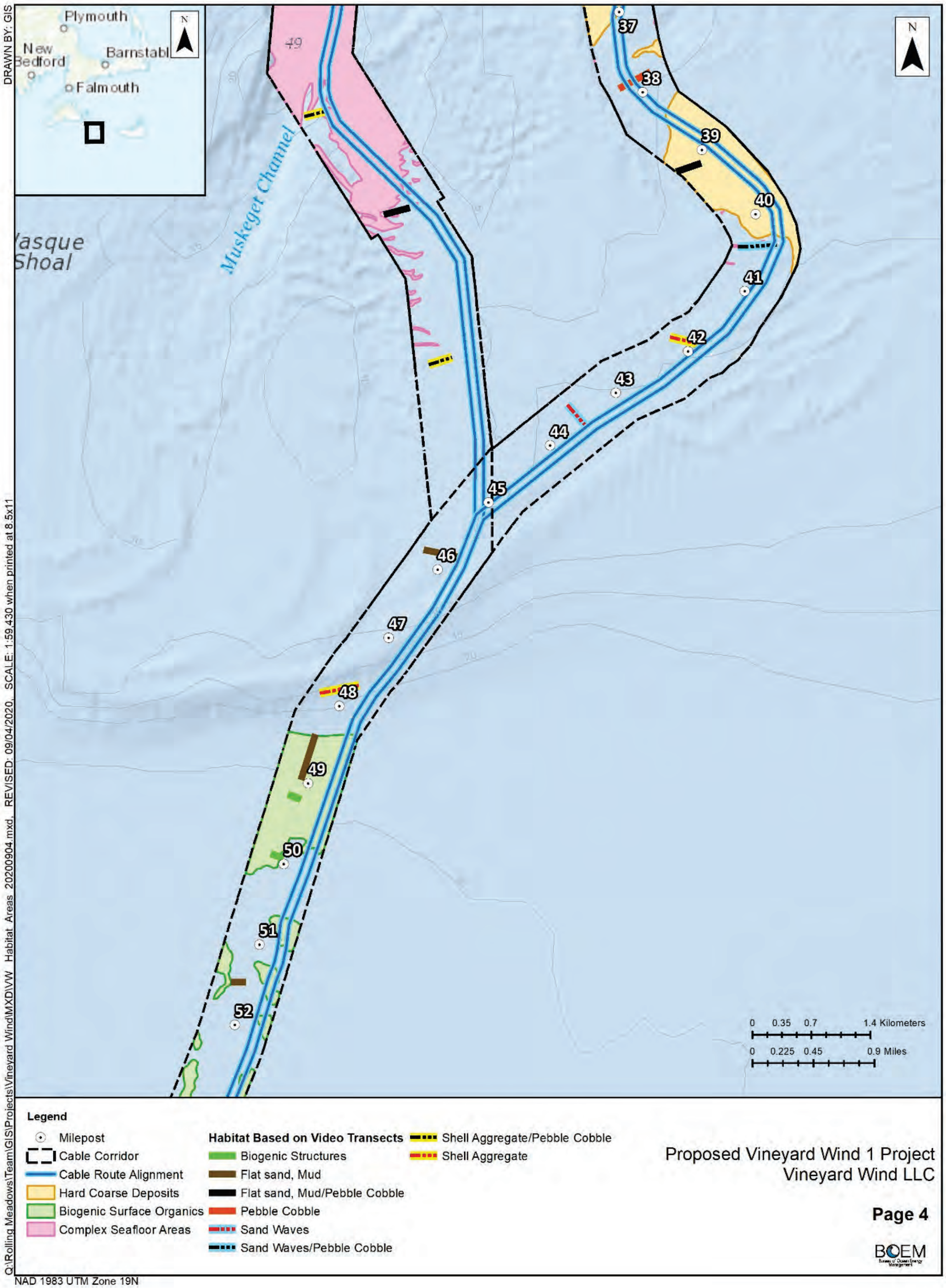
Source: Attachment E in Epsilon 2018b

Figure E.3-1b: Seafloor Habitats within the Offshore Export Cable Corridor



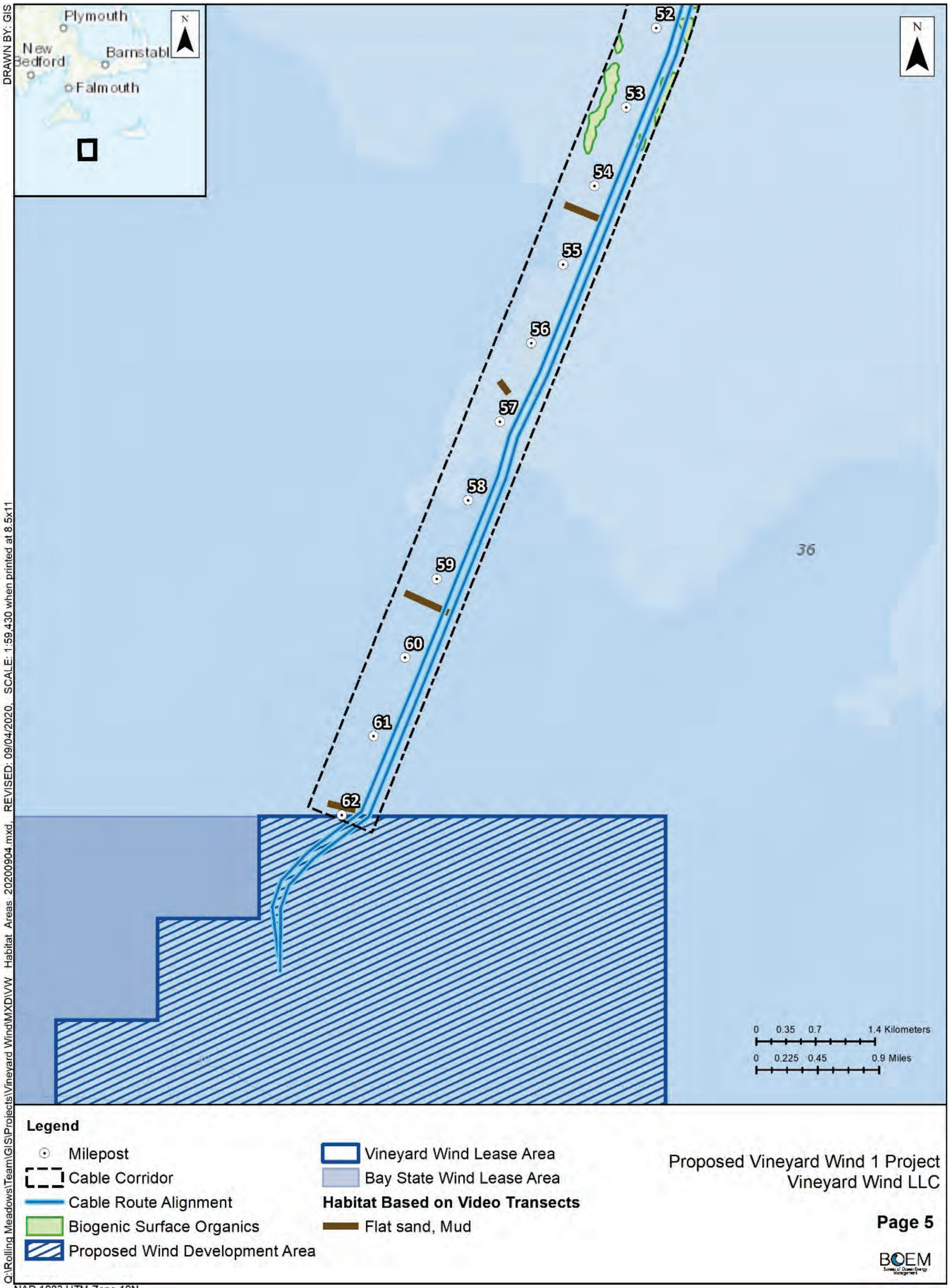
Source: Attachment E in Epsilon 2018b

Figure E.3-1c: Seafloor Habitats within the Offshore Export Cable Corridor



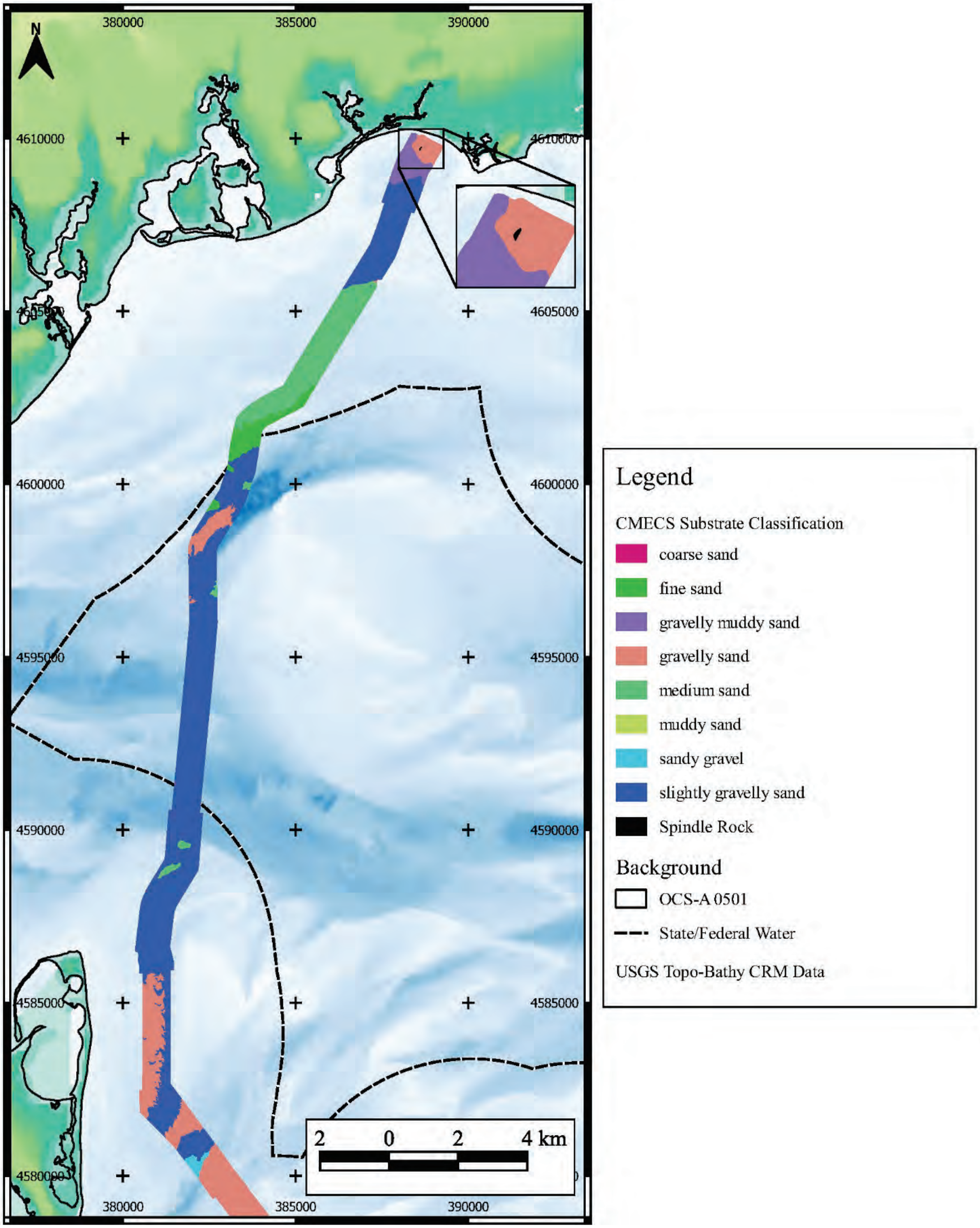
Source: Attachment E in Epsilon 2018b

Figure E.3-1d: Seafloor Habitats within the Offshore Export Cable Corridor



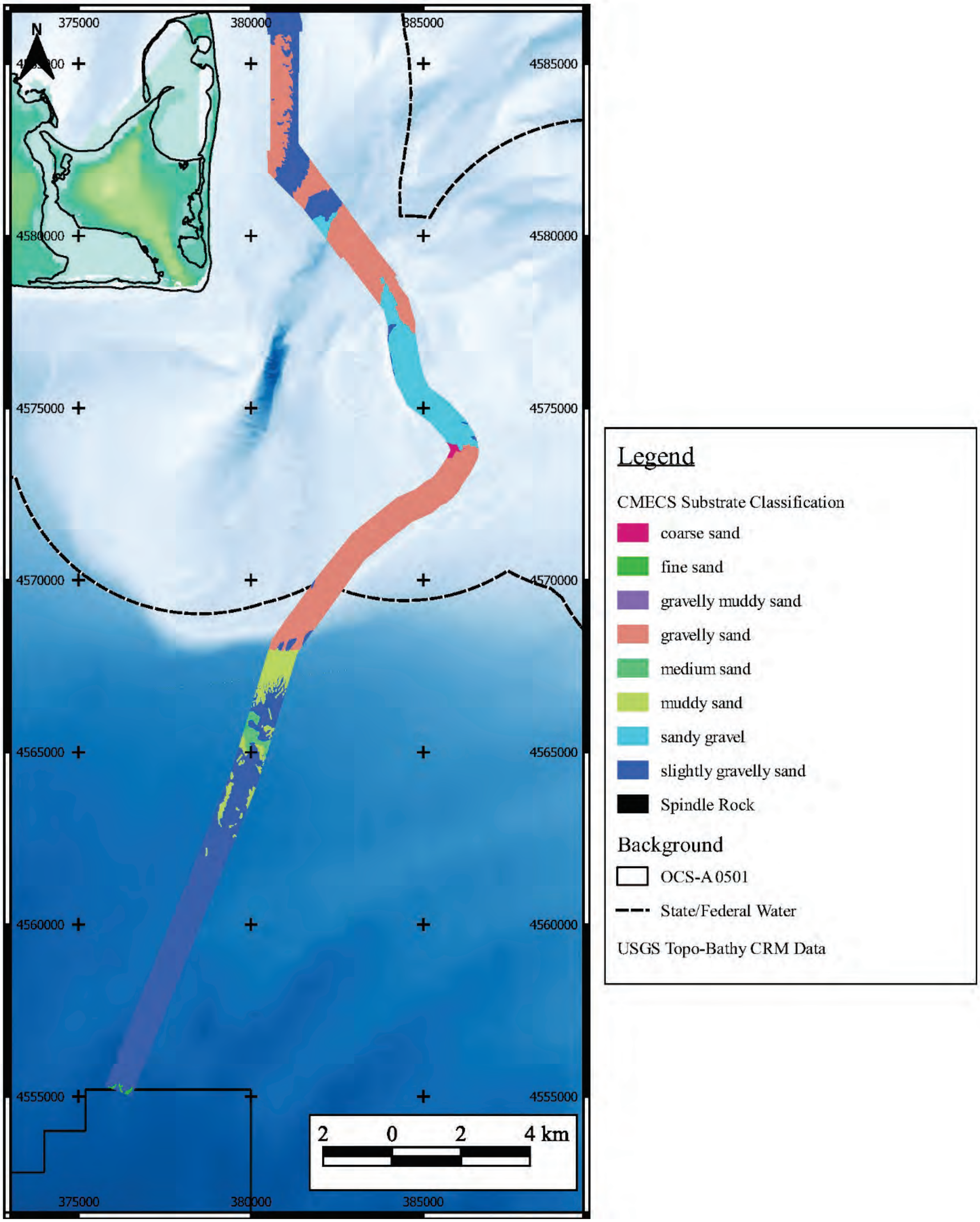
Source: Attachment E in Epsilon 2018b

Figure E.3-1e: Seafloor Habitats within the Offshore Export Cable Corridor



Source: Modified from Vineyard Wind 2020

Figure E.3-2a: Coastal and Marine Ecological Classification Standard Substrates within the Offshore Export Cable Corridor



Source: Modified from Vineyard Wind 2020

Figure E.3-2b: Coastal and Marine Ecological Classification Standard Substrates within the Offshore Export Cable Corridor

BOEM Atlantic lease areas are described as sediment-starved due to continental geology and the distance from shore, meaning there are no additional sediment inputs to the OCS. Thus, surficial sediments are continually reworked by oceanographic forces such as tides, currents, and storms, and sedimentation is not expected at lease areas. As documented at the Thanet and London Array offshore wind facilities in the United Kingdom, the potential exists for the formation of surficial sediment plumes at WTG monopiles (Vanhellemont and Ruddick 2014, as summarized in Swanson 2019). Sediment plumes tend to form when the following conditions are present: (1) shallow water, (2) significant speed of tidal currents, and (3) mobile sediments. The Thanet and London Array offshore wind facilities, which are both located in the Thames River Estuary, are composed of 100 and 175 WTGs, respectively, located in 0 to 82 feet (0 to 25 meters) water depths with tidal velocities that vary up to 0.8 to greater than 1 meter per second (m/s) (Vanhellemont and Ruddick 2014; COP Volume III, Appendix III-K; Epsilon 2020b). In contrast, the proposed Vineyard Wind Project WTGs would be sited in water depths from 121 to 162 feet (37 to 49.5 meters) with tidal velocities at 0.3 m/s (COP Volume II-A, Section 2.2.4; Epsilon 2018a). As described in the COP (Volume III, Appendix III-K; Epsilon 2020b) sediment transport and mobility is low within the proposed WDA given the slow tidal current velocity. The lack of conditions required for the formation of sediment plumes are expected to greatly reduce, if not eliminate, the potential for surficial sediment plumes to form. Additionally, the proposed use of scour protection around each of the WTG monopile foundations would be expected to further reduce the already low likelihood of sediment plume formation (Swanson 2019).

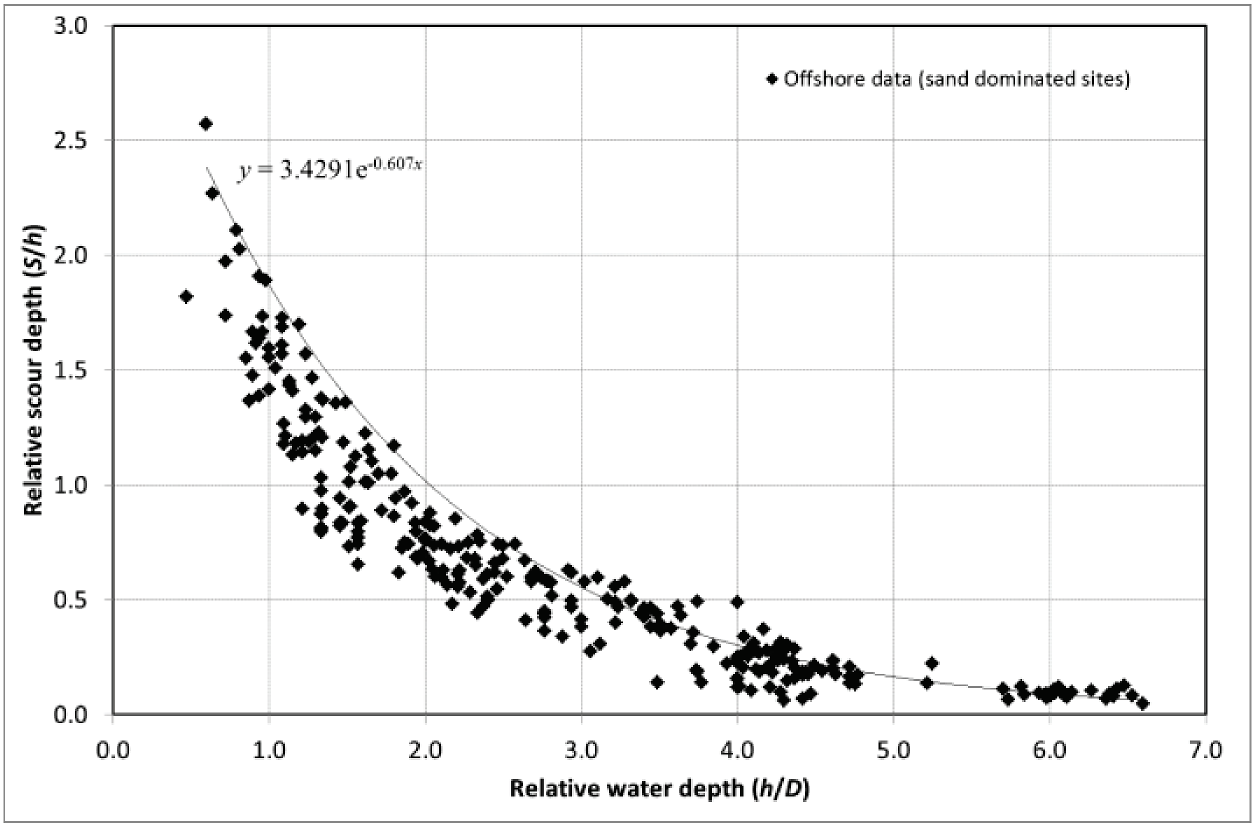
Turbidity is most closely associated with activities such as cable installation and pile driving, which occur primarily during installation where seabed sediments are actively being disturbed. The sediments are temporarily suspended and then resettle within a short time period of minutes to hours depending on site-specific conditions such as sediment grain size.

Scour is a highly complex response to a multidimensional set of local conditions that include oceanographic forces, sediment properties, and anthropogenic inputs. Current understanding includes strong associations between scour, structure diameter, water depth, and sediment conditions. In general, the larger the diameter of the structure, the shallower the water depths, the more uniform and sandier the sediment conditions, and the stronger the oceanographic forces, the more likely an area is to experience scour (Harris and Whitehouse 2014). Scour in uniform sandy soils is expected to increase over time until reaching an equilibrium, while the scour in non-uniform soils is more variable (Harris and Whitehouse 2014).

Site conditions and foundation diameter tend to dominate scour potential analysis. Sand-dominated seabeds are more susceptible to severe scour than finer grained or mixed sediments; as the foundation diameters increase, the potential depth (severity) of scour also increases. Based on field measurements at offshore wind energy facilities installed in uniform sand conditions, the relationship between scour and foundation diameter is described as scour(S)/diameter(D) = 1.8 (Harris and Whitehouse 2014). Non-uniform marine soils—a combination of gravel, sand, silt and clay—respond differently than uniform sandy soils, and scour predictions are more complex. Offshore wind energy facilities with non-uniform soils typically experience scour more slowly.

Scour became a significant issue in early offshore wind development during the 2000s as turbine sizes began to increase and facilities were often located close to shore in shallow waters. The most commonly referenced examples of offshore wind energy facility scour often include observations from North Sea sites Scroby Sands and Arklow Bank (Whitehouse et al. 2011). These two sites were located in water depths ranging from about 6.56 to 39.37 feet (2 to 12 meters) with pile diameters of 13.78 and 17.06 feet (4.2 and 5.2 meters), respectively. As described above, sandy dominated seabeds, such as those found at Scroby Sands and Arklow Bank, are more susceptible to severe scour than finer grained or mixed sediments. In addition, subsequent research has shown the ratio of the water depth to foundation diameter can be a significant indicator for severe scour and was a major contributing factor to the scour experienced as the Scroby Sands and Arklow Bank offshore wind energy facility sites (Figure E.3-3).

Other case studies on scour at offshore wind energy facilities include field data from three offshore wind energy facilities located in non-uniform marine soils.



Source: Harris and Whitehouse 2014

S/h = scour depth divided by water depth; h/D = water depth divided by pile diameter

Figure E.3-3: Measured Data from European Wind Energy Facilities Showing a Decrease in Relative Scour Depth with an Increase in Relative Water Depth

The Barrow Offshore Wind Farm scour survey undertaken in a glacial till area showed modest local scour (S/D = 0.04) (Harris and Whitehouse 2014). Values of S/D = 0.4 were found at the Kentish Flats Offshore Wind Farm, located on a coarse sandy seabed with shell gravel and clay outcrops overlying soft to firm clay deposits. North Hoyle Offshore Wind Farm, located in a strongly heterogeneous region with poorly sorted sediments and a sandy gravel or gravelly sand seabed where larger patches of gravel are found offshore, showed limited scour just after installation; however, within a year, no scour was recorded at any foundation. In general, current industry research indicates scour predictions have vastly improved since large scour pits were identified as a significant issue for offshore wind development, and scour protection has been shown to be effective (Harris et al. 2011).

E.4. PHYSICAL OCEANOGRAPHY

Oceanographic forces such as waves, currents, and tides vary along the Atlantic OCS, depending on bathymetry, winds, and other factors. The Atlantic OCS is generally wide and shallow, with water depths reaching 492 feet (150 meters). Although there is some data available, BOEM recognizes that in-situ oceanographic data is limited along the Atlantic Coast of the United States. To fill these data gaps, extensive worldwide effort has been invested in developing and refining ocean models capable of providing detailed oceanographic information not only along the U.S. coast, but on a global scale. Several ocean models are run in real-time on a continual basis, receiving data from buoys, gliders, ships, and satellites, updating results accordingly. These models provide daily and long-term oceanographic data sets that span decades, grounded by in-situ measurements.

Offshore wind developers also contribute to the oceanographic knowledge base through the deployment of data collection buoys during their site assessment phase. Buoys collect data for 1 to 5 years, measuring meteorological and oceanographic (metocean) conditions such as winds, waves, currents, and temperature. Knowing the site-specific metocean conditions is key to facility design and safe navigation, and therefore a necessity for developers to collect. Some developers have proposed to continue data collection throughout the construction and operation phases.

Key physical factors nearshore include the daily modification of the seabed by tidal currents, and episodic extreme storm events that are capable of extensive erosion and redistribution of coastal materials. Offshore, an area immediately to the west of the proposed Project has been extensively studied, the Rhode Island Ocean Special Area, and the results can be informative for the offshore portions of the proposed Project (Rhode Island Coastal Resources Management Council 2010).

E.4.1. Water Temperatures

Water temperature is seasonally variable and at the surface ranges from approximately 37°F (3°C) in winter to 75°F (24°C) in summer. Offshore temperatures also vary with depth and season due to seasonal stratification and thermoclines; for details, see Appendix A, Section A.8.2. Although waters in the OCS experience considerable vertical mixing in fall, winter, and spring, an important seasonal feature influencing finfish and invertebrates is the cold pool, a mass of cold bottom water in the Middle Atlantic Bight overlain and surrounded by warmer water. The cold pool forms in late spring and persists through summer, gradually moving southwest, shrinking, and warming due to vertical mixing and other factors (Chen et al. 2018). During summer, local upwelling and local mixing of the cold pool with surface waters provides a source of nutrients, influencing the ecosystem's primary productivity (Lentz 2017; Matte and Waldhauer 1984). The cold pool is a dynamic feature of the middle to outer portions of the continental shelf, but its nearshore boundary typically lies at depths from 66 to 131 feet (20 to 40 meters) (Brown et al. 2015; Chen et al. 2018; Lentz 2017). Offshore wind lease areas are mostly sited within depths less than 197 feet (60 meters). While offshore wind foundation structures would affect local mixing of cool bottom waters with warm surface waters, the extent to which these local effects may cumulatively affect the cold pool as a whole is not well understood. Given the size of the cold pool, approximately 11,580 square miles, [30,000 km^2] (NOAA 2020), BOEM does not anticipate that future offshore wind structures as described in the expanded planned action scenario would negatively affect the cold pool, although they could affect local conditions.

E.4.2. Regional Ocean Forces

Clockwise movement around Georges Bank and flow towards the equator dominates large-scale regional water circulation, which is strongest in late spring and summer (Gulf of Maine Census 2018). The edge of the continental shelf creates a shelf-break front that encourages upwelling. Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011). Variable temperature-salinity water masses occupying nearshore and offshore regions converge over Nantucket Shoals, creating a persistent frontal zone in the area. Offshore from the islands, shelf currents flow predominantly toward the southwest, beginning as water from the Gulf of Maine heading south veers around and over Nantucket Shoals. Tidal water masses from nearshore transitioning through Nantucket Sound mix with the shelf current generally following depth contours offshore.

Offshore water masses may extend northward onto the shelf toward the islands and through the OCS lease areas offshore Massachusetts at different times of the year (Ullman and Cornillon 1999), while nearshore waters appear to be affected by freshwater runoff in the spring and show increased sea surface temperature gradients extending seaward from Nantucket Sound tidal exit points. A southeasterly flow along the inner shelf depth contours from Nantucket Sound (Limeburner and Beardsley 1982) may be a factor in maintaining the frontal system over Nantucket Shoals. While the dynamics of this system may not be completely understood at this time, the variability observed in shelf water characteristics plays a role in supporting the diverse marine ecology present offshore New England.

E.4.3. Tides and Tidal Currents

Tidal range in the Nantucket Sound area is typically 2 to 3.2 feet (0.6 to 1 meter), and tidal currents can exceed 3.5 knots (6.5 km/hr) in Muskeget Channel. Elsewhere, 1- to 1.5-knot (1.8 to 2.8 km/hr) flows run west to east in the Main Channel of Nantucket Sound (NOAA 2018a) immediately south of Horseshoe Shoal.

In the WDA, previous studies found that currents are tidally dominated (Spaulding and Gordon 1982), with wind and density variations playing a smaller role. Data suggest that the depth-averaged current speed is approximately 0.58 knot (1.0 km/hr) and the surface current speed is approximately 0.66 knot (1.2 km/hr). While there are no WDA-specific observational data available, a three-dimensional tide and wind driven model described in COP Appendix III-A (Volume III; Epsilon 2020b) has been validated to observed currents at the Rhode Island Ocean Special Area Management Plan (Rhode Island Coastal Resources Management Council 2010). In the WDA, the bottom flood current is predicted to move towards the northeast and the ebb current towards the southwest. Peak predicted current speeds are relatively weak (less than 0.39 knot [0.7 km/hr]). At a similar site nearby, Vineyard Wind collected and reported data in COP Volume II-A Table 2.2-5 (Epsilon 2018a). Currents there were usually less than 0.7 knot (1.3 km/hr) at the surface and less than 0.6 knot (1.1 km/hr) at the bottom, and speeds at both surface and bottom were generally less than 0.31 knot (0.6 km/hr).

E.4.4. Waves

In the Rhode Island Ocean Special Area Management Plan, average wave height ranges from 3 to 10 feet (1 to 3 meters) and is likely to have little impact on the bottom at depth. Extreme wave height estimates range from 21 to 23 feet (6.5 to 7 meters) in a 10-year span to 29 to 30 feet (8.8 to 9 meters) in a 100-year span (Rhode Island Coastal Resources Management Council 2010).

Within the proposed WDA, the annual average of the monthly average significant wave height is approximately 5.9 feet (1.8 meters) and the maximum significant wave height occurs in September. The annual average of the monthly average wave period is approximately 5.9 seconds and the maximum wave period occurs in February.

In many portions of Nantucket Sound, wave heights are limited by the short distance over which the wind can generate waves. This effect can be dramatic in places close to shore, such as a west wind off Chappaquiddick Island or a north wind offshore from the Cape. In addition, the presence of shoals (e.g., Muskeget area, Horseshoe Shoal) scattered around the area force the waves to increase in height locally and break, thereby diminishing further wave building.

Tidal currents can similarly play a role in modifying wave action nearshore. Wind-generated waves working against the tidal current quickly build and can develop standing waves under certain conditions. Conversely, a strong tidal current flowing in the same direction as the waves can actually diminish wave height as a result of the reduced opposing force. These effects come into play where large volumes of water are moving in and out of the Sound, such as through Muskeget Channel and surrounding passages, as well as the channels north and south of Horseshoe Shoal.

As summarized in Swanson (2019), the presence of offshore WTGs has the potential to alter wind-driven waves as they pass through the offshore facility. Generally, such changes are expected to reduce wave energy and thus would not be expected to result in increased shoreline erosion. Using computer modeling, Christensen et al. (2014) showed that an offshore wind facility located 2, 3, and 6 miles (5, 10, and 20 kilometers) offshore would have a positive effect on shoreline accretion that decreased as the offshore wind facility distance from shore increased. While the general model estimated some parameters that may not be directly comparable to the Vineyard Wind 1 Project, the model shows that an offshore wind energy facility at any distance will decrease wave energy, with effects similar to a breakwater. As such, shoreline erosion is not expected to be increased as a result of the Vineyard Wind Project (Swanson 2019).

E.4.5. Potential General Impacts of Offshore Wind Facilities

There have been relatively few studies to analyze the impact of offshore wind facilities on oceanographic processes, primarily due to the fact that changes to these processes are often highly localized and difficult to measure relative to the natural variability of the environment. Further, the studies that do exist tend to focus on direct structural impacts. Even less readily available are analyses on wind-wave interaction impacts due to the fact that the physics behind this interaction are difficult to quantify, model, and validate. Studies conducted thus far rely heavily on small scale tank testing and ocean modeling rather than actual site measurements. These studies have shown, however, that the magnitude of the impact foundations have on oceanographic conditions depends on pile diameter, turbine density, and facility layout; for example, larger diameter piles have a greater impact than the smaller piles used for jacket foundations.

Tank and modeling tests, such as those conducted by Miles et al. (2017) and Cazenave et al. (2016), conclude that mean flows are reduced/disrupted immediately downstream of a monopile foundation, but return to background levels within a distance proportional to the pile diameter (D). These results indicate disruptions for a horizontal distance anywhere from 3.5 D to 50 D, depending on whether it is a current-only regime or a wave and current regime, and a width of 65.6 to 164 feet (20 to 50 meters). Thus, for foundations like those proposed by Vineyard Wind, background conditions would be expected from 164 to 1,148 feet (50 to 350 meters) downstream from each monopile foundation. Cazenave et al. (2016) also conducted a shelf-scale modeling exercise on the Irish Sea, home to Walney (+extensions) and West of Duddon Sands, contiguous offshore wind facilities that together contain 297 turbines (with 1.4 gigawatts total power generation capacity). The shelf-scale model of the eastern Irish Sea indicated a 5 percent reduction in peak water velocities, and found that this reduction may extend up to approximately 0.5 nautical mile (1 kilometer) downstream of a monopile foundation; impacts varied based on array geometry. In general, modeling studies indicate that water flow typically returns to within 5 percent of background levels within a relatively short distance from the structure. Modeling studies, such as the one conducted by Broström (2008), indicate that the combined effect of wind and oceanographic changes anticipated at offshore wind facilities may have the potential to alter upwelling patterns localized to the wind facility. This model experiment was modeled assuming a shallow water depth of 65.62 feet (20 meters) and included additional boundary assumptions. Further modeling studies, such as Carpenter et al. (2016), indicate that offshore wind facilities could impact large-scale stratification in the German Bight, but only when they occupy extensive shelf regions, not at current capacity. Nearly all tank and modeling studies indicate that further studies using more realistic systems are required.

As evaluated in Swanson (2019), export cable laying operations are not expected to have a measurable impact on tidal flows that would result in increased shoreline erosion. The export cable would be buried using a vertical injector tool approximately 1.2 miles (1.9 kilometers) east of Chappaquiddick Island. As described in the COP (Volume II-A, Section 2.3.3; Epsilon 2018a), the maximum ambient tidal flow in the Muskeget Channel south of Chappaquiddick Island is 2.4 m/s. Given the slow speed of the installation tool (maximum of 0.08 m/s) relative to the maximum ambient tidal flow, the tool can be assumed to be stationary in the tidal flow moving around it. As the tidal flow moves around the tool, flow velocity will increase near the tool, but will then diminish back to ambient tidal flow, dependent upon velocity of the ambient tidal flow and the size of the tool (Swanson 2019). As the ambient tidal flow in the area is north/south, as is the proposed cable route, approximately 3.3 feet (1 meter) of the tool would be facing the ambient tidal flow. As shown by Koo et al. (2014), increased velocity resulting from a cable installation tool would be expected to return to ambient levels within three times the width of the tool, or 9.8 feet (3 meters). As the cable laying operations would occur 1.2 miles (1.9 kilometers) off the shoreline of Chappaquiddick Island, no change in ambient tidal flow velocities would occur, and as such, no increased potential for shoreline erosion is expected (Swanson 2019).

Vessel traffic may lead to shoreline erosion from vessel wakes, but this would be limited to approach channels and locations near ports and bays; given the amount and nature of vessel traffic, vessels associated with offshore wind energy would cause a negligible increase, if any, to wake-induced erosion of associated channels (BOEM 2019a).

E.5. Biological Resources

This section discusses the biological resources present in the general vicinity of the proposed Project. Potential impacts on biological resources are assessed in detail in Section 3.2 of the Final Environmental Impact Statement (FEIS).

E.5.1. Sea Life

Moderate productivity and a mostly sand bottom, which has a large effect in shaping the biological resources of the area, characterize the marine areas near the proposed Project.

E.5.1.1. Marine Mammals

Marine mammals use the coastal waters of the northwest Atlantic OCS and the proposed Project area for feeding, breeding, nursery grounds, socializing, and migration (Stone et al. 2017; Leiter et al. 2017). Around 15 species of marine mammals, many of which are migratory, are likely to occur within the proposed Project area (Table E.5-1). In particular, the federally endangered North Atlantic right whale (*Eubalaena glacialis*) frequents the area. Accordingly, several marine zones near the proposed Project are managed using seasonal or year-round restrictions to protect right whales and their habitats. The COP (Epsilon 2018a, 2019b, 2020a, 2020b) and BOEM 2014 present a list of all marine mammals that may occur in the area and corresponding detailed descriptions.

Table E.5-1: Marine Mammals Regularly or Commonly Occurring in the Proposed Region

Common Name	Scientific Name	ESA (MMPA) Status [a]	Relative Occurrence in Region [b]	Seasonal Occurrence in Region
Order Cetacea, Suborder Mysticeti (baleen whales), Family Balaenopteridae				
North Atlantic right whale [c]	*Eubalaena glacialis*	E(D)	Common	Year-round, peak winter-spring
Fin whale [c]	*Balaenoptera physalus*	E(D)	Common	Year-round, peak spring-summer
Sei whale [c]	*Balaenoptera borealis*	E(D)	Regular	Spring-summer
Minke whale [c]	*Balaenoptera acutorostrata acutorostrata*	(N)	Common	Year-round, peak spring-fall
Humpback whale [c]	*Megaptera novaeangliae*	(N)	Common	Year-round, peak spring-summer
Suborder Odontoceti (toothed whales and dolphins)				
Family Physeteridae				
Sperm whale [c]	*Physeter macrocephalus*	E(D)	Common	Year-round, peak summer-fall
Family Delphinidae				
Risso's dolphin	*Grampus griseus*	(N)	Common Offshore	Year-round, peak spring-fall
Long-finned pilot whale	*Globicephala melas*	(S)	Common	Year-round, peak spring-summer
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	(N)	Common	Year-round, peak spring-fall
Short-beaked common dolphin	*Delphinus delphis*	(N)	Common	Year-round, peak summer-fall
Bottlenose dolphin (Western North Atlantic offshore stock)	*Tursiops truncatus*	(D)	Common	Year-round
Family Phocoenidae				
Harbor porpoise	*Phocoena phocoena*	(N)	Common	Year-round, peak fall-spring
Order Carnivora, Suborder Caniformia, Family Phocidae (earless seals)				
Harbor seal	*Phoca vitulina concolor*	(N)	Common	Year-round [e]
Gray seal	*Halichoerus grypus*	(N)	Common	Year-round [e]
Harp seal	*Pagophilus groenlandicus*	(N)	Common	Year-round [e]

[a] ESA (Endangered Species Act) status: E = endangered; MMPA (Marine Mammal Protection Act) status: D = Depleted, S = Strategic; N = Not Strategic. See Section 3.4 for details regarding MMPA status

[b] Based on occurrence within Rhode Island Ocean Special Area Management Plan Study Area (which includes the WDA and surrounding areas): Common = greater than 100 records; Regular = 10–100 records; Rare = less than 10 records; Hypothetical = the remote possibility to occur in the region at some time (Kenney and Vigness-Raposa 2010).

[c] NEFSC and SEFSC 2011

[d] Based on Kraus et al. 2016; BOEM 2014. Region defined as the waters south of Martha's Vineyard and Nantucket and Nantucket Shoals.

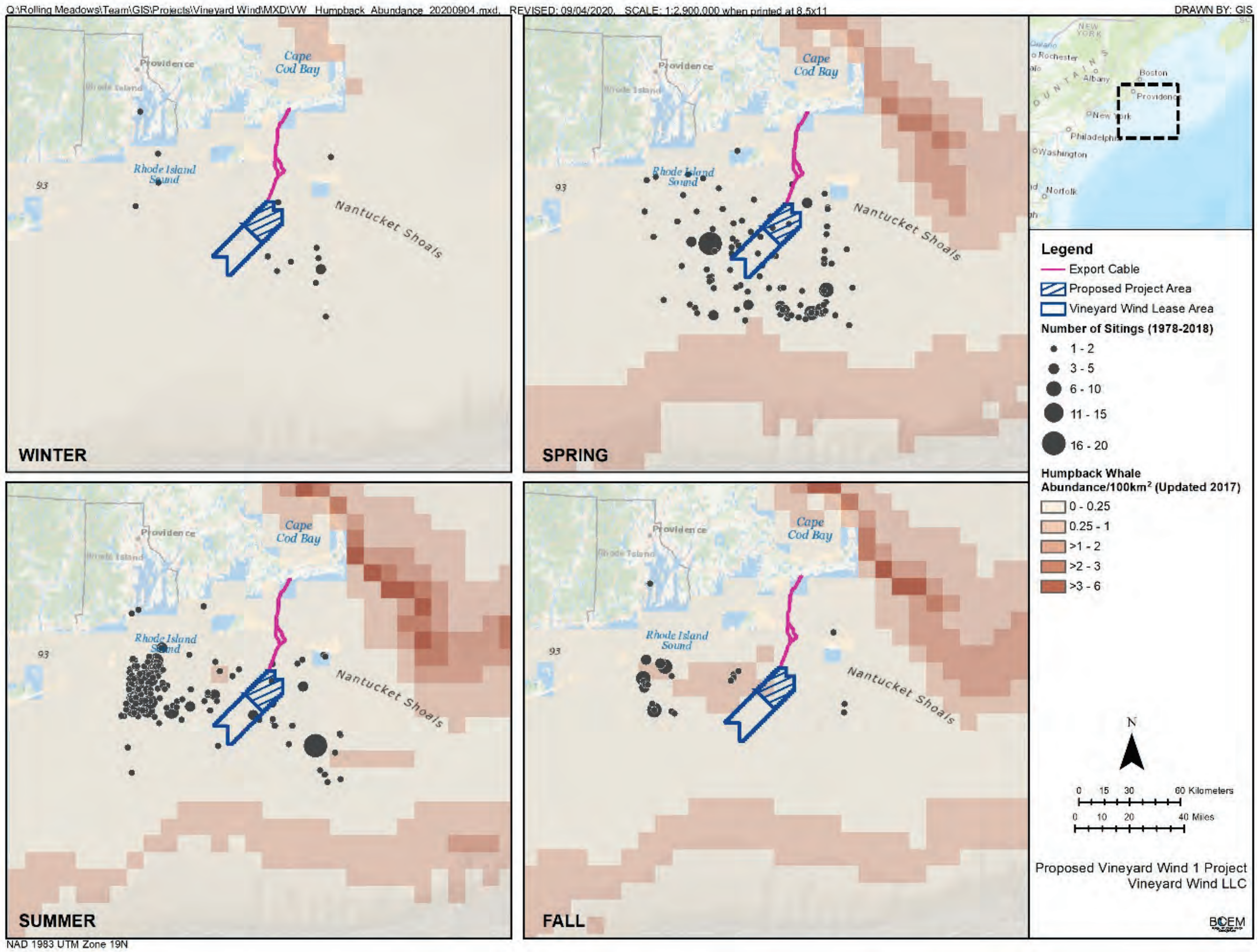
[e] Based on Kenney and Vigness-Raposa 2010.

Marine mammals are highly migratory, and seasonal occurrences near the proposed Project vary for each species. The Biological Assessment (BA) includes distribution maps of the listed species near the proposed Project and details regarding their seasonal occurrence (BOEM 2018a, 2020a). Seasonal distributions for humpback whales, minke whales, harbor porpoise, and three dolphin species in the proposed Project area are shown on Figures E.5-1 through E.5-4).

Vineyard Wind submitted comprehensive acoustic modeling of underwater sound propagation and potential effects on marine species during piling installation for the Proposed Action (Pyć et al. 2018) that provided detailed information for the pile-driving analysis. This information is summarized in FEIS Appendix F.

E.5.1.2. Finfish and other Species of Commercial Importance

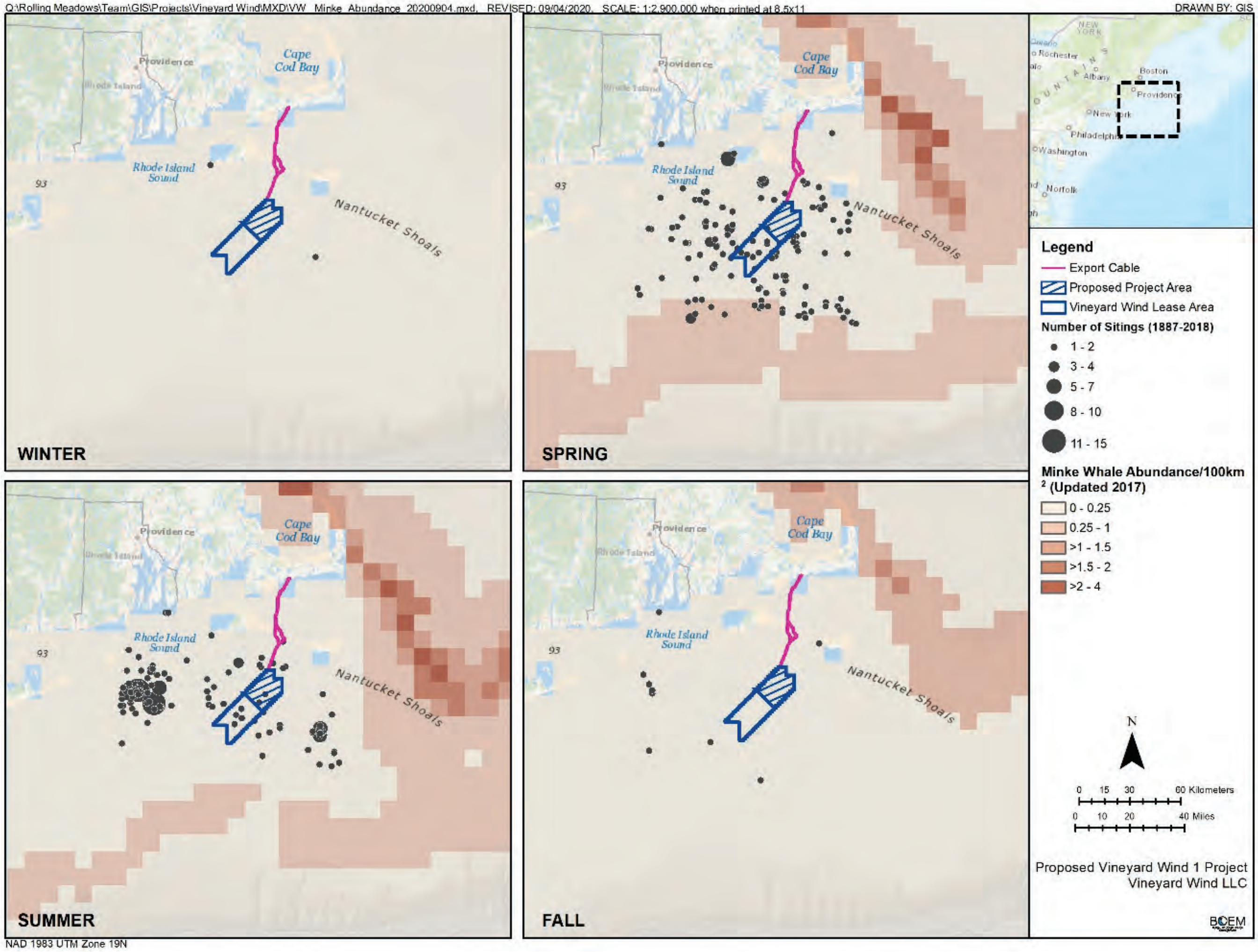
Resident and migratory finfish species as well as demersal (bottom feeders) and pelagic (inhabiting the water column) types occur in portions of the OCS lease areas offshore Massachusetts and within the WDA. Many of these species have designated Essential Fish Habitat, a delineation of important marine and diadromous (migratory between salt and fresh waters) fish habitat for all federally managed species (finfish and invertebrates) mandated through the Magnuson-Stevens Fishery Conservation and Management Act (Title 50 Code of Federal Regulations [CFR] Part 600) (BOEM 2019b, 2020b). A complete list of species with Essential Fish Habitat near the proposed Project can be found in BOEM 2020b. Table E.5-2 shows some of the most significant species occurring in this area, and indicates those species of commercial/recreational importance. For more information on commercial and for-hire recreational fishing activities and species, see FEIS Section 3.10 and BOEM 2020b.



Source: Roberts et al. 2016a; Right Whale Consortium 2018

km^2 = square kilometers

Figure E.5-1: Humpback Whale Abundance Estimates (Number of Whales per 100 km^2) with Sightings Data from 1978 to 2018 Overlaid in the Vineyard Wind Project Area

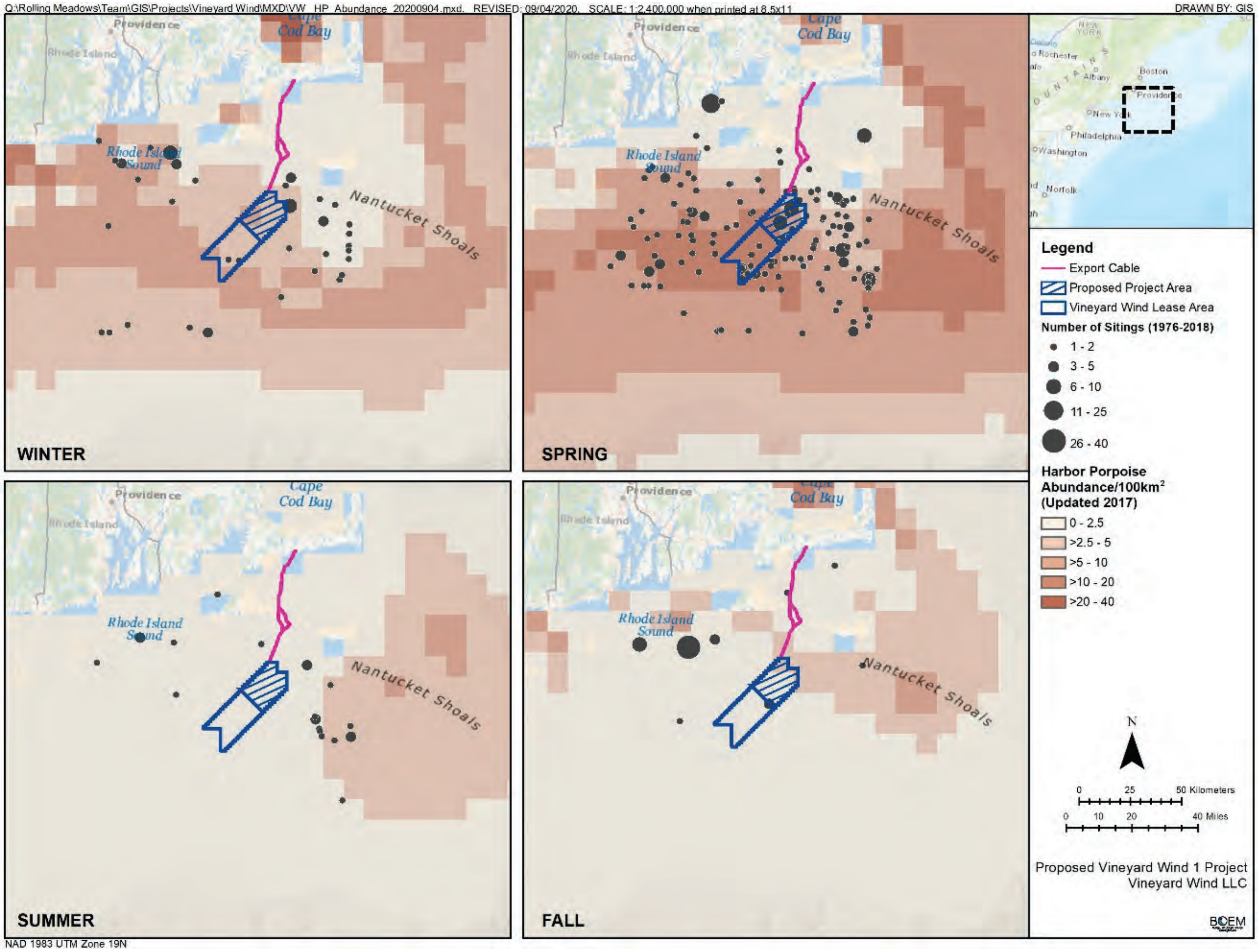


Source: Roberts et al. 2016ab; Right Whale Consortium 2018

km^2 = square kilometers

Note: Three sightings of single whales prior to 1962; all others from 1997–2018 in the Vineyard Wind Project area

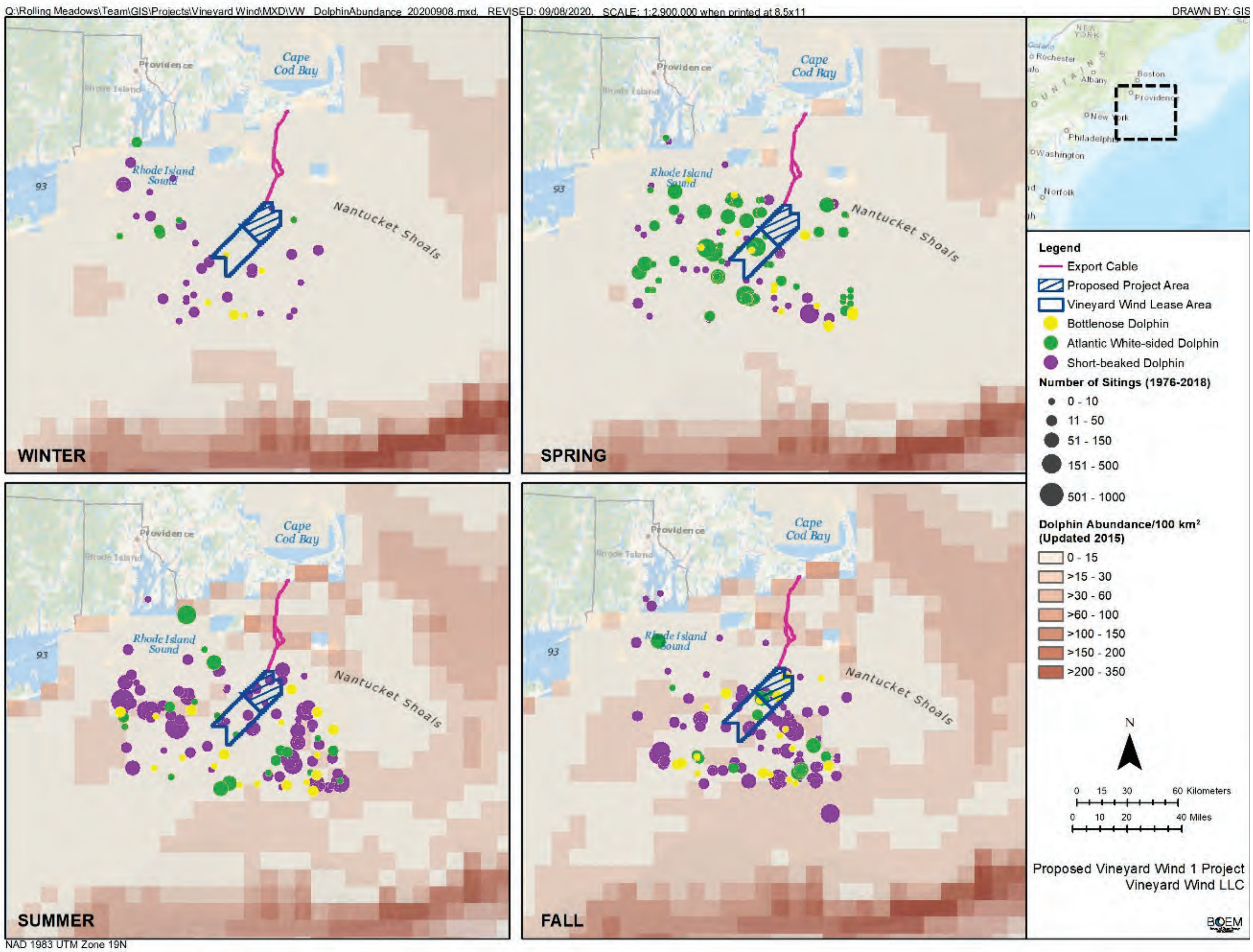
Figure E.5-2: Minke Whale Abundance Estimates (Number of Whales per 100 km^2) with Sightings Data from 1978 to 2018 Overlaid in the Vineyard Wind Project Area



Source: Roberts et al. 2016a; Right Whale Consortium 2018

km^2 = square kilometers

Figure E.5-3: Harbor Porpoise Abundance Estimates (Number of Porpoise per 100 km^2) with Sightings Data from 1976 to 2018 Overlaid in the Vineyard Wind Project Area



Source: Roberts et al. 2016b; Right Whale Consortium 2018

km^2 = square kilometers

Figure E.5-4: Bottlenose Dolphin, Atlantic White-Sided Dolphin, and Short-Beaked Common Dolphin Abundance Estimates (Number of Dolphins per 100 km^2) with Sightings Data from 1976 to 2018 Overlaid in the Vineyard Wind Project Area

Table E.5-2: Major Finfish and Invertebrate Species in Southern New England

Common Name	Scientific Name	Regional Species	Project Area Species	Listing Status	Federally Managed, EFH in WDA	Federally Managed, EFH in OECC	Resident [a]	Migratory [a]	Benthic [b]	Demersal [b]	Pelagic [b]	Commercial/ Recreational Importance	Current Condition (Source)
alewife	*Alosa pseudoharengus*	X	X					X			J A	X	Depleted (NMFS 2019)
albacore tuna	*Thunnus albacares*	X	X		X	X		X			J A	X	Above target population levels (NOAA undated a)
American eel	*Anguilla rostrata*	X	X					X			A	X	Depleted (ASMFC 2017)
American lobster	*Homarus americanus*	X	X					X	E J A		L	X	Declining (ASMFC 2015)
American oyster	*Crassostrea virginica*	X	X				X		A		L	X	Stable (CBP undated a)
American sand lance	*Ammodytes americanus*	X	X				X			E J A		X	Common (Staudinger et al. 2020)
American shad	*Alosa sapidissima*	X	X					X			J A	X	Depleted (ASMFC 2020)
Atlantic butterfish	*Peprilus triacanthus*	X	X		X	X		X			E L J A	X	Common (Guida et al. 2017)
Atlantic cod	*Gadus morhua*	X	X		X	X		X		J A	E L	X	Significantly below target population levels (NOAA, undated b), overfished (NEFSC 2017)
Atlantic croaker	*Micropogonias undulatus*	X					X			J A	E L	X	Stable (CBP, undated b)
Atlantic herring	*Clupea harengus*	X	X		X	X		X			L J A	X	Common (Guida et al. 2017)
Atlantic mackerel	*Scomber scombrus*	X	X		X	X		X			E L J	X	Significantly below target population levels (NOAA undated c), overfished, undergoing overfishing (NEFSC 2018a)
Atlantic menhaden	*Brevoortia tyrannus*	X	X					X			E L J A	X	Stable (SEDAR 2020)
Atlantic salmon	*Salmo salar*	X		X				X			J A		Endangered (BOEM 2019b, 2020b)
Atlantic sea scallop	*Placopecten magellanicus*	X	X		X	X	X		E L J A		L	X	Common (NEFSC 2018b)
Atlantic skipjack tuna	*Katuwonus pelamis*	X	X		X	X		X			J A	X	Above target population levels (NOAA, undated d)
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	X	X	X				X			A		Endangered (BOEM 2019b, 2020b)
Atlantic surfclam	*Spisula solidissima*	X	X		X	X	X		J A			X	Above target population levels (NOAA undated e)
Atlantic wolffish	*Anarhichas lupus*	X	X		X	X	X			E J A	L		Overfished, not undergoing overfishing (NEFSC 2017)
Atlantic yellowfin tuna	*Thunnus albacares*	X	X		X	X		X			J A	X	Above target population levels (NOAA undated f)
barndoor skate	*Dipturus laevis*	X	X		X		X			J A			Depleted (Oceana undated)
basking shark	*Cetorhinus maximus*	X	X		X			X			J A		Declining (Rigby et al. 2019a)
bay scallops	*Argopecten irradians*	X	X				X		A	L		X	Depleted (MBA 2017)
black drum	*Pogonias cromis*	X					X			J A		X	Stable (CBP undated c)
black sea bass	*Centropristis striata*	X	X		X	X		X		J A		X	Not overfished, not undergoing overfishing (SEDAR 2018)
blue mussel	*Mytilus edulis*	X	X				X		A	L		X	Abundance levels of moderate concern (Safina Center and MBA 2017)
blue shark	*Prionace glauca*	X	X		X	X		X			J A		Declining (Rigby et al. 2019b)
blueback herring	*Alosa aestivalis*	X	X					X			J A	X	Depleted (NMFS 2019)

Common Name	Scientific Name	Regional Species	Project Area Species	Listing Status	Federally Managed, EFH in WDA	Federally Managed, EFH in OECC	Resident [a]	Migratory [a]	Benthic [b]	Demersal [b]	Pelagic [b]	Commercial/ Recreational Importance	Current Condition (Source)
bluefin tuna	*Thunnus thynnus*	X	X		X	X		X			J A	X	Unknown overfished status, not undergoing overfishing (ICCAT 2017)
bluefish	*Pomatomus salatrix*	X	X		X	X		X			J A	X	Depleted (ASMFC 2019a)
cobia	*Rachycentron canadum*	X	X		X	X		X			E L J A	X	Above target population levels (NOAA undated g)
common thresher shark	*Alopias vulpinus*	X	X		X	X		X			J A		Unknown (NOAA undated h)
dusky shark	*Carcharhinus obscurus*	X	X		X	X		X			J A		Declining (Rigby et al. 2019c), overfished (SEDAR 2016)
giant manta ray	*Manta birostris*	X		X				X			J A		Endangered (BOEM 2018a)
haddock	*Melanogrammus aeglefinus*	X	X		X	X		X			E L	X	Above target population levels (NOAA undated i)
horseshoe crab	*Limulus polyphemus*	X	X				X		E J A		L	X	Neutral (ASMFC 2019b)
Jonah crab	*Cancer borealis*	X	X					X	E J A		L	X	Unknown (NOAA undated j)
king mackerel	*Scomberomorus cavalla*	X	X		X	X		X			E L J A	X	Above target population levels (NOAA undated k)
little skate	*Leucoraja erinacea*	X	X		X	X	X			J A		X	Common(Guida et al. 2017)
longfin squid	*Doryteuthis pealeii*	X	X		X	X		X	E		J A	X	Common (Guida et al. 2017)
monkfish	*Lophius americanus*	X	X		X	X	X			J A	E L	X	Above target population levels (NOAA undated l)
northern sea robin	*Prionotus carolinus*	X	X					X		J A	E L		Stable (CBP undated d)
ocean pout	*Zoarces americanus*	X	X		X	X		X		E J A		X	Overfished, not undergoing overfishing (NEFSC 2017)
ocean quahog	*Arctica islandica*	X	X		X		X		J A			X	Above target population levels, declining (NOAA undated m)
Pollock	*Pollachius virens*	X	X		X			X		J	E L	X	Above target population levels (NOAA undated n)
porbeagle shark	*Lamna nasus*	X	X		X			X			J A		Stable, overfished but not undergoing overfishing (Curtis et al. 2016)
red hake	*Urophycis chuss*	X	X		X	X		X		J A	E L	X	Common (Guida et al. 2017)
sandbar shark	*Carcharhinus plumbeus*	X	X		X	X		X			J A		Declining (Musick et al. 2009)
sand tiger shark	*Carcharias taurus*	X	X		X	X		X			J A		Species of concern, declining (NOAA 2010)
scup	*Stenotomus chrysops*	X	X		X	X		X		J A		X	Common (Guida et al. 2017)
shortfin mako shark	*Isurus oxyrinchus*	X	X		X			X			J A		Significantly below target population levels (NOAA undated o), overfished and undergoing overfishing (ICCAT 2017)
shortfin squid	*Illex illecebrosus*	X	X			X		X			A	X	Unknown (NOAA undated p)
shortnose sturgeon	*Acipenser brevirostrum*	X		X				X		A			Endangered (BOEM 2018a)
silver hake	*Merluccius bilinearis*	X	X		X	X		X			E L J	X	Common (Guida et al. 2017)
smooth dogfish	*Mustelus canis*	X	X		X	X		X			J A		Not overfished, not undergoing overfishing (SEDAR 2015)
Spanish mackerel	*Scomberomorus maculatus*	X	X		X	X		X			E L J A	X	Above target population levels (NOAA undated q)

Common Name	Scientific Name	Regional Species	Project Area Species	Listing Status	Federally Managed, EFH in WDA	Federally Managed, EFH in OECC	Resident [a]	Migratory [a]	Benthic [b]	Demersal [b]	Pelagic [b]	Commercial/ Recreational Importance	Current Condition (Source)
spiny dogfish	*Squalus acanthias*	X	X		X	X		X		A	A	X	Common (Guida et al. 2017)
spot	*Leiostomus xanthurus*	X						X		J A	E L J A		Stable (CBP undated e)
spotted sea trout	*Cynoscion nebulosus*	X					X			E L J A		X	Overfished, undergoing overfishing (ASMFC 2011)
striped bass	*Morone saxatilis*	X	X					X		J A	J A	X	Significantly below target population levels (NOAA undated r), overfished, undergoing overfishing (NEFSC 2019)
summer flounder	*Paralichthys dentatus*	X	X		X	X		X		J A	E L	X	Below target population levels (NOAA undated s)
tautog	*Tautoga onitis*	X	X					X		E L J A	E	X	Overfished, undergoing overfishing (ASMFC 2016)
tiger shark	*Galeocerdo cuvier*	X	X		X			X			J A	X	Declining (Ferreira et al. 2019)
weakfish	*Cynoscion regalis*	X						X			E L J A	X	Depleted (ASMFC 2019c)
whelks	*Busycotypus canaliculatus* and *Busycon carica*	X	X				X		E J A			X	Depleted and declining (MA DMF 2020)
white hake	*Urophycis tenuis*	X	X		X	X		X		J	E L J	X	Not overfished, not undergoing overfishing (NEFSC 2017)
white shark	*Carcharadon carcharias*	X	X		X	X		X			J A	X	Declining (Rigby et al. 2019d)
windowpane flounder	*Scophthalmus aquosus*	X	X		X	X		X		J A	E L	X	Not overfished, not undergoing overfishing (NOAA 2018b)
winter flounder	*Pseudopleuronectes americanus*	X	X		X	X		X		L	E J A	X	Significantly below target population levels (NOAA undated t), overfished, not undergoing overfishing (NEFSC 2015)
winter skate	*Leucoraja ocellata*	X	X		X	X		X		J A		X	Common (Guida et al. 2017)
witch flounder	*Glyptocephalus cynoglossus*	X	X		X	X		X			E L	X	Overfished (NEFSC 2017)
yellowtail flounder	*Limanda ferruginea*	X	X		X	X		X		J A	E L	X	Significantly below target population levels (NOAA undated u), overfished, undergoing overfishing (NEFSC 2015)

A = adult; E = egg; EFH = Essential Fish Habitat; L = larvae; J = juvenile; OECC = Offshore Export Cable Corridor; WDA = Wind Development Area

[a] Migration encompasses movements potentially affecting the presence of a species in the Project area. It includes short inshore/offshore seasonal movements (e.g., flatfish, skates) as well as long-distance migrations (e.g., tuna).

[b] Habitat use was separated by life stage based on information from several sources (ASMFC 1998; ASMFC 2018; BOEM 2018b; Collette and Klein-MacPhee 2002; Miller and Klimovich 2017; Nelson et al. 2018; Roberts 1978). Some species with EFH in the Project area did not have EFH designation for all life stages, while for other species, some life stages may not occur near the proposed Project.

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E.5.1.3. Benthic Invertebrates

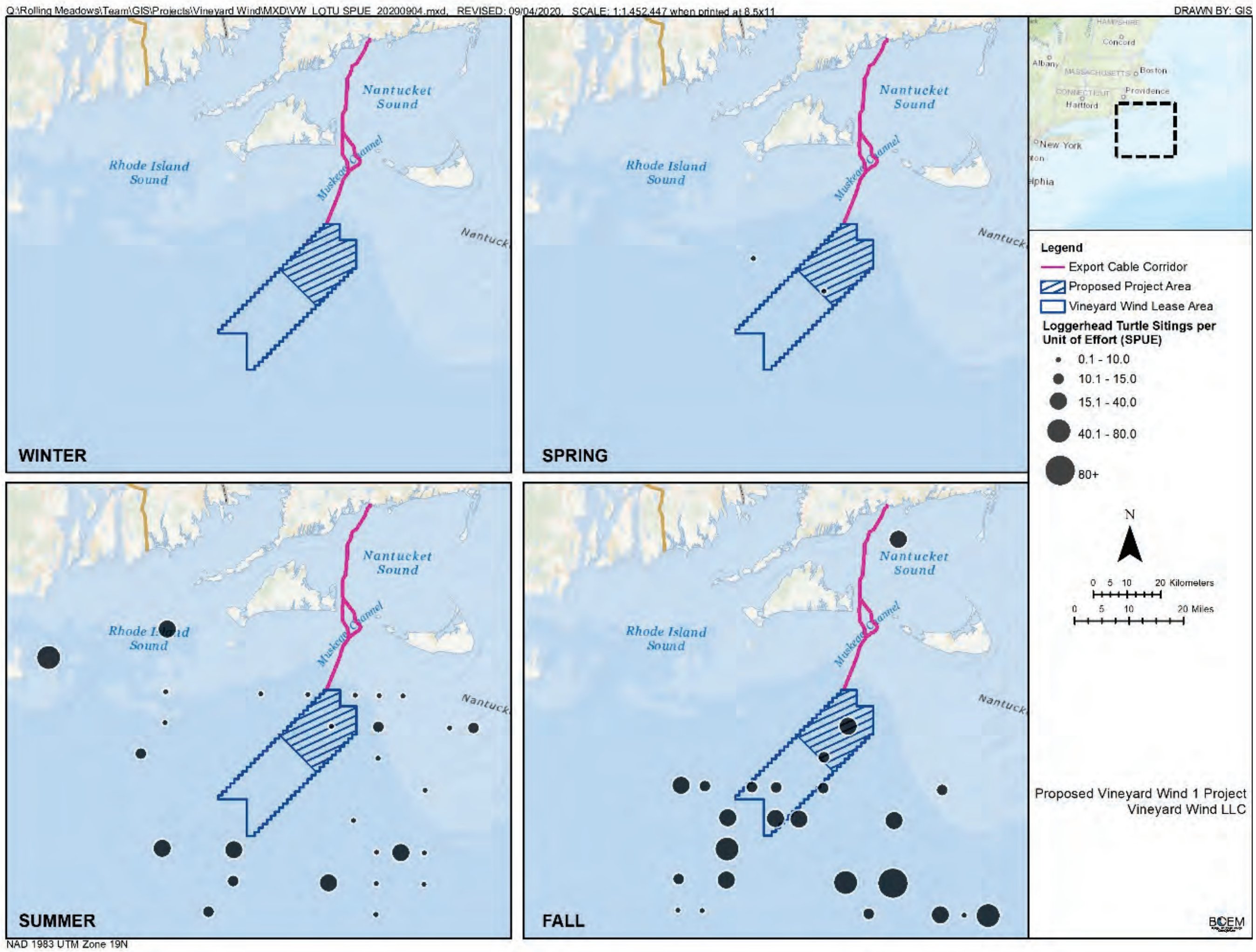
Typical invertebrates in the region include polychaetes (bristle worms), crustaceans (particularly amphipods), mollusks (gastropods and bivalves), echinoderms (e.g., sand dollars, brittle stars, and sea cucumbers), and various others (e.g., sea squirts and burrowing anemones) (BOEM 2014). Overall, the region experiences strong seasonality in water temperature and phytoplankton concentrations, with corresponding seasonal changes in the densities of benthic organisms (COP Volume III, Section 6.5; Epsilon 2020b).

The WDA is part of the Southern New England Shelf as described by Theroux and Wigley (1998), which has a higher biomass and density of benthic fauna than neighboring geographic areas such as the Gulf of Maine and Georges Bank. Common sand dollars (*Echinarachnius parma*) are abundant in the WDA, as are hydrozoans, bryozoans, hermit crabs, euphausiids, sea stars, anemones, sand shrimp (*Crangon septemspinosa*), nematode worms, pandalid shrimp, and monkey dung sponge (*Suberites ficus*) (COP Volume III, Section 6.5; Epsilon 2020b). Polychaete worms and amphipod crustaceans dominate infaunal assemblages. These are all common in the Nantucket Shelf region. Similar communities exist near Cape Cod along the proposed OECCs landfall sites, with abundant nut clams, polychaetes, and amphipods, as well as oligochaetes and nemertean ribbon worms (COP Volume III, Section 6.5; Epsilon 2020b). As mentioned in Table E.5-2, the region is also home to commercially important benthic invertebrates, including American lobster (*Homarus americanus*), Atlantic sea scallop (*Placopecten magellanicus*), Atlantic surfclam (*Spisula solidissima*), and ocean quahog (*Arctica islandica*), among others.

E.5.1.4. Sea Turtles

Four species of sea turtles may occur near the proposed Project area: leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), Kemp’s ridley (*Lepidochelys kempii*), and green (*Chelonia mydas*). Each of these is protected under the Endangered Species Act (Section 3.5). All of these sea turtles are migratory and enter New England waters primarily in the summer and fall. However, hawksbill sea turtles are rarely sighted in Massachusetts and are unlikely to occur near the proposed Project area. The other species may use the proposed Project area for travel, foraging, diving at depth for extended periods, and possibly for extended rest periods on the seafloor (COP Volume III, Section 6.8; Epsilon 2020b). Targeted surveys have been conducted for sea turtles near the proposed Project area, and the results can be found in Kraus et al. 2016. A more detailed discussion regarding aspects of sea turtles potentially affected is available in the Vineyard Wind BA (BOEM 2018a, 2020a).

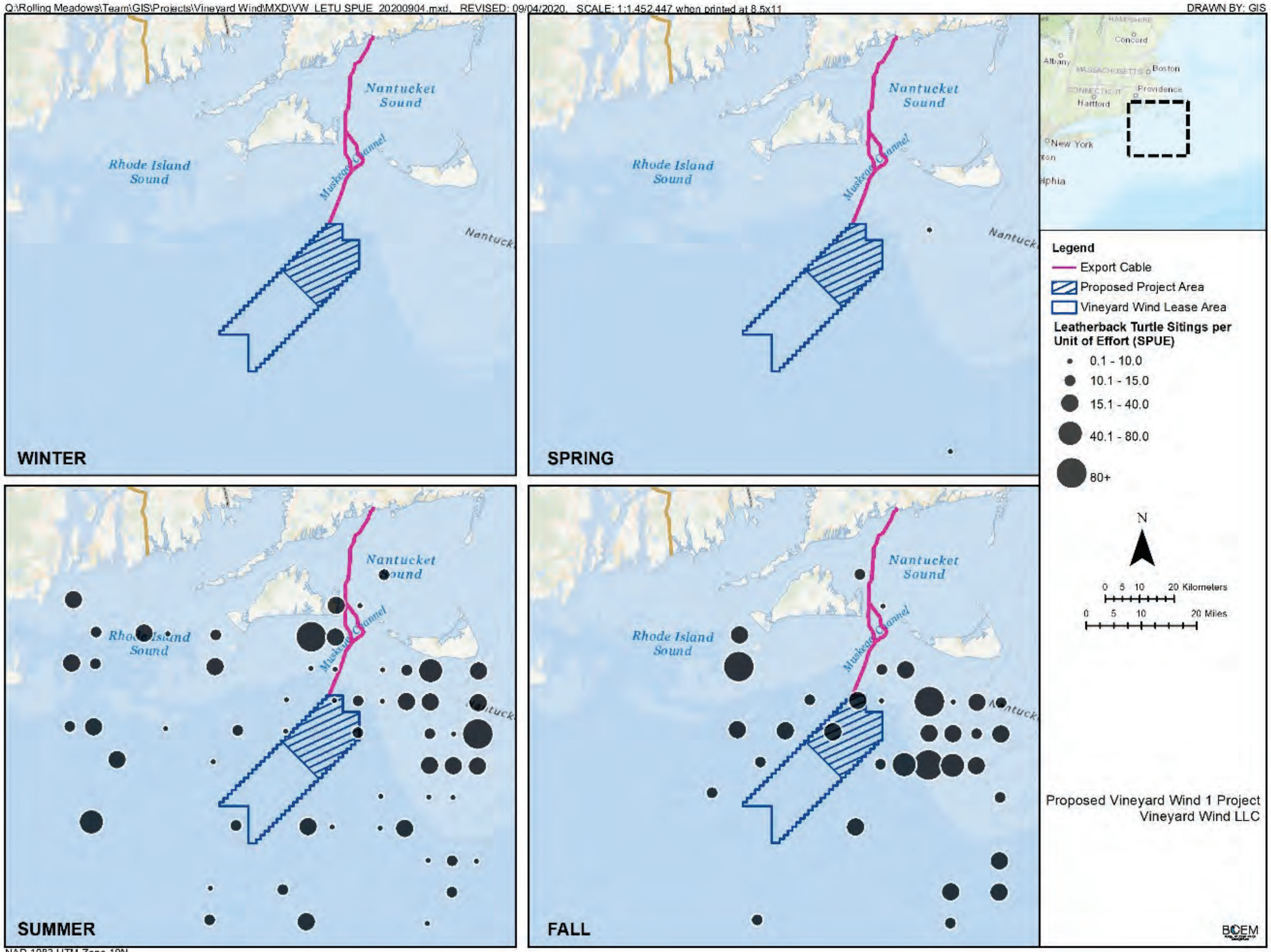
Strandings data for sea turtles from 1998 to 2017, sightings per unit effort (SPUE), indicate similar trends in the seasonal occurrence for loggerhead, leatherback, Kemp’s ridley, and unidentified sea turtles in the Project area (Figures E.5-5 through E.5-8). These SPUE maps do not depict the full level of distribution of a species in an area, but rather show the number of animal SPUE where surveys occurred. Additional information on sea turtle occurrence in the proposed Project area is available in the Vineyard Wind BA (BOEM 2018a, 2020a).



Source: Right Whale Consortium 2018

Note: Number of turtles per 621.4 miles (1,000 kilometers) in the proposed Project area during winter (December–February), spring (March–May), summer (June–August), and fall (September–November)

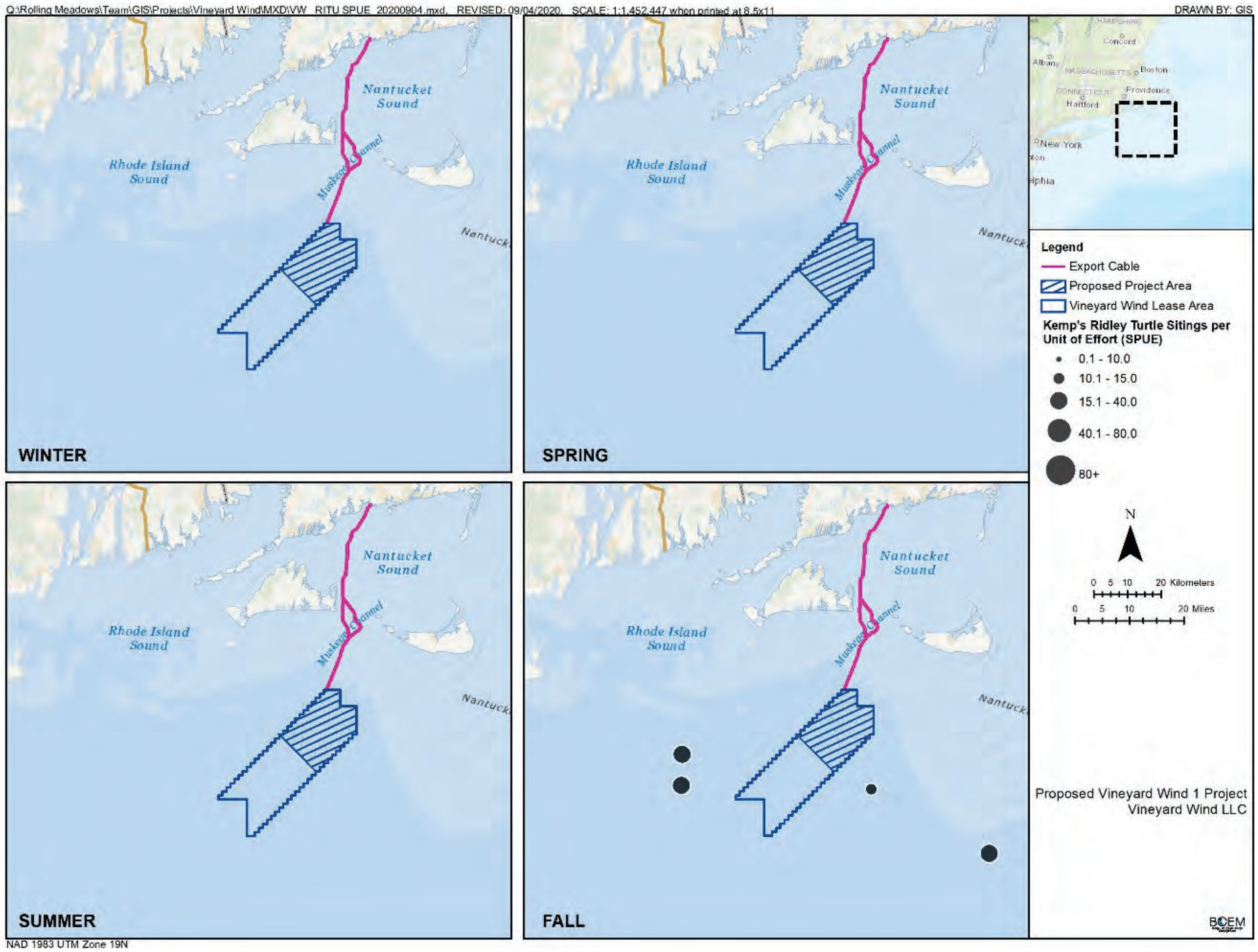
Figure E.5-5: Loggerhead Sea Turtle SPUE



Source: Right Whale Consortium 2018

Note: Number of turtles per 621.4 miles (1,000 kilometers) in the proposed Project area during winter (December–February), spring (March–May), summer (June–August), and fall (September–November)

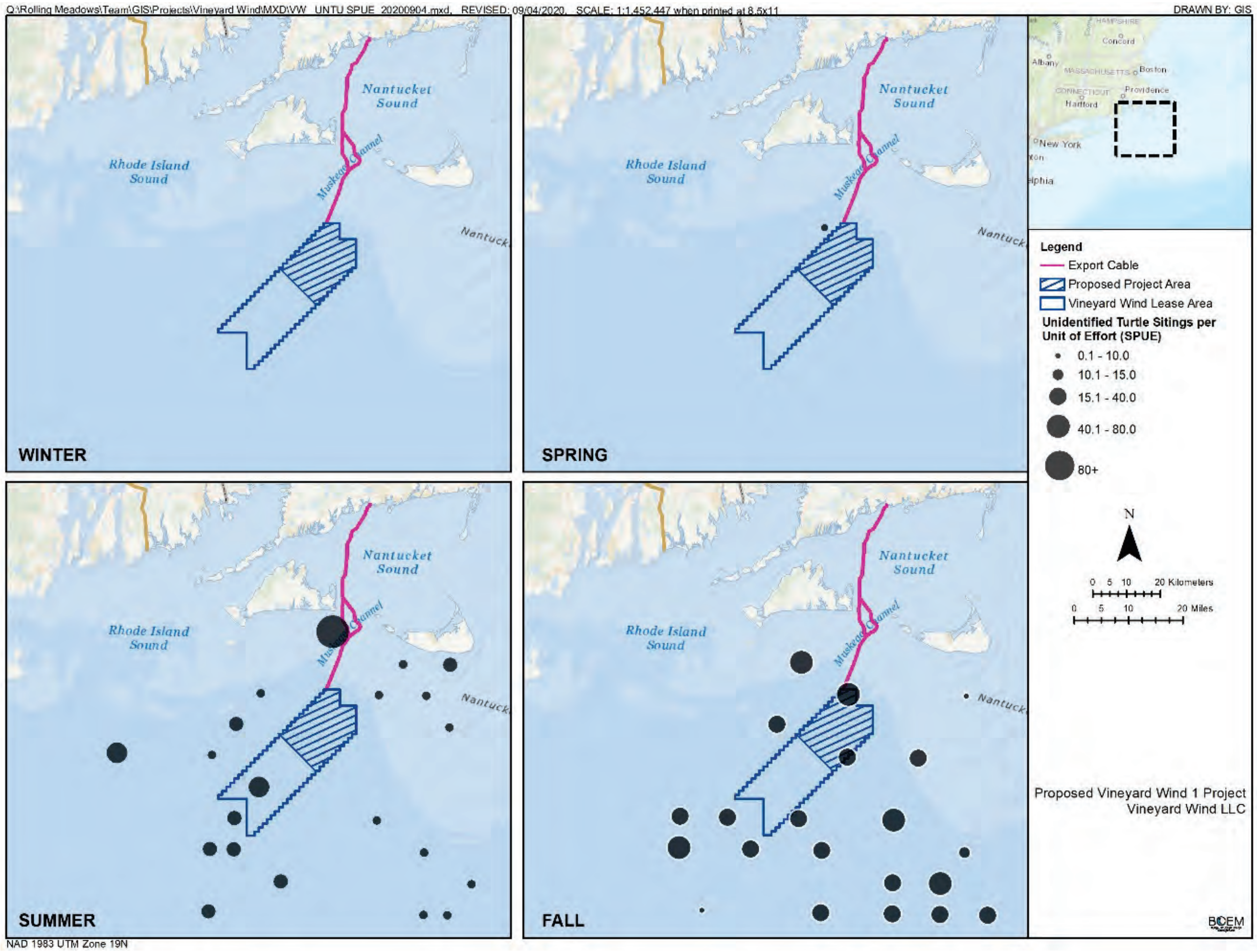
Figure E.5-6: Leatherback Sea Turtle SPUE



Source: Right Whale Consortium 2018

Note: Number of turtles per 621.4 miles (1,000 kilometers) in the proposed Project area during winter (December–February), spring (March–May), summer (June–August), and fall (September–November)

Figure E.5-7: Kemp's Ridley Sea Turtle SPUE



Source: Right Whale Consortium 2018

Note: Number of turtles per 621.4 miles (1,000 kilometers) in the proposed Project area during winter (December–February), spring (March–May), summer (June–August), and fall (September–November)

Figure E.5-8: Unidentified Sea Turtle SPUE

E.5.2. Terrestrial Resources

E.5.2.1. Habitats

The terrestrial portion of the proposed Project is located within the Long Island-Cape Cod Coastal Lowland Major Land Resource Area. Much of this area exhibits sandy soils, mixed hardwood-softwood forests, and scrublands subject to periodic fires (USDA 2006). Pine-oak forest is one of the most common habitat types on Cape Cod. This area also includes important habitats such as coastal wetlands, isolated freshwater wetlands, and a few small streams, although none of these habitats are present at locations where Project work would take place. Table E.5-3 shows some of the threatened and endangered plant species potentially occurring in this area.

Table E.5-3: Threatened and Endangered Plant Species Reported near the Proposed Project

Common Name	Scientific Name
American chaffseed	*Schwalbea americana*
Mitchell's sedge	*Carex mitchelliana*
Purple needlegrass	*Aristidia purpurascens*
Rigid flax	*Linum medium var. texanum*
Dwarf bulrush	*Lipocarpha micrantha*
Heartleaf twayblade	*Listera cordata*
Bayard's green adder's-mouth	*Malaxis bayardii*
Maryland meadow beauty	*Rhexia mariana*
Short-beaked bald-sedge	*Rhynchospora nitens*
Torrey's beak-sedge	*Rhynchospora torreyana*
Slender marsh pink	*Sabatia campanulata*
Papillose nut sedge	*Scleria pauciflora*
Swamp oats	*Sphenopholis pensylvanica*
Grass-leaved ladies'-tresses	*Spiranthes vernalis*
Northern gama-grass	*Tripsacum dactyloides*
Cranefly orchid	*Tipularia discolor*

Source: Commonwealth of Massachusetts 2018

E.5.2.2. Land Animals

Table E.5-4 lists terrestrial and coastal faunal resources that are known to occur near the proposed Project. Prominent animal communities include residents of woodlands (e.g., whitetail deer [*Odocoileus virginianus*], fox [*Vulpes vulpes*], raccoon [*Procyon lotor*], among others), scrub grasslands (e.g., New England cottontail [*Sylvilagus transitionalis*], coyote [*Canis latrans*]), and wetlands (e.g., beaver [*Castor canadensis*], muskrat [*Ondatra zibethicus*], diamondback terrapin [*Malaclemys terrapin*]). Amphibians and reptiles, including turtles, snakes, and a variety of frogs, may belong to several of these communities and may move between and among them.

Table E.5-4: Terrestrial Animal Species Reported near the Proposed Project

Taxonomic Group	Common Name	Scientific Name
Amphibian	Red-backed salamander	*Plethodon cinereus*
Amphibian	Red-spotted newt	*Notophthalmus viridescens*
Amphibian	American bullfrog	*Lithobates catesbeianus*
Amphibian	Green frog	*Lithobates clamitans*
Amphibian	Northern leopard frog	*Lithobates pipiens*
Amphibian	Wood frog	*Lithobates sylvaticus*
Amphibian	American toad	*Anaxyrus americanus*
Amphibian	Fowler's toad	*Anaxyrus fowleri*
Amphibian	Northern spring peeper	*Pseudacris crucifer*
Amphibian	Gray tree frog	*Hyla versicolor*
Reptile	Eastern hognose snake	*Heterodon platirhinos*
Reptile	Eastern ribbon snake	*Thamnophis sauritus*
Reptile	Milk snake	*Lampropeltis triangulum*
Reptile	Painted turtle	*Chrysemys picta*
Reptile	Snapping turtle	*Chelydra serpentine*
Reptile	Common musk turtle	*Sternotherus odoratus*
Mammal	Coyote	*Canis latrans*
Mammal	Gray fox	*Urocyon cinereoargenteus*
Mammal	Red fox	*Vulpes*
Mammal	Raccoon	*Procyon lotor*
Mammal	Striped skunk	*Mephitis*
Mammal	Fisher	*Martes pennant*
Mammal	White-tailed deer	*Odoeoileus virginianus*
Mammal	Red squirrel	*Tamiasciurus hudsonicus*
Mammal	Virginia opossum	*Didelphis virginiana*
Mammal	Woodchuck	*Marmota monax*
Mammal	Common raccoon	*Procyon lotor*
Mammal	White-footed mouse	*Peromyscus maniculatus*
Insect	Blue dasher	*Pachydiplax longipennis*
Insect	Calico pennant	*Celithermis elisa*
Insect	Common whitetail	*Libellula lydia*
Insect	Eastern pondhawk	*Erythemis simplicicollis*
Insect	Golden-winged skimmer	*Libellula auripennis*
Insect	Slaty skimmer	*Libellula incesta*
Insect	White corporal	*Libellula exusta*
Insect	Eastern comma	*Polygonia comma*
Insect	Great spangled fritillary	*Speyeria cybele*
Insect	Mourning cloak	*Nymphalis antiopa*
Insect	Red admiral	*Vanessa atalanta*
Insect	Red-spotted purple	*Limenitis artemis astyanax*
Insect	Striped hairstreak	*Satyrium liparops*
Insect	True skipper sp.	*Hesperia sp.*
Insect	Polyphemus moth	*Antheraea polyphemus*
Insect	Six-spotted green tiger beetle	*Cicindela sexguttata*

Source: Epsilon 2020b (COP Volume III, Section 6.1)

E.6. PROTECTIVE MEASURES AND MONITORING

Thus far, there is only one operational offshore wind facility on the Atlantic coast (the Block Island Wind Farm), with several more still in various stages of development. BOEM and the offshore wind industry have learned from the first U.S. project and projects in Europe. This section highlights some of the lessons learned in regards to monitoring and mitigating impacts on the physical environment, including physical habitat.

E.6.1. Protective Measures

Scour was a significant concern and focus of the offshore wind facility industry after installation of monopile foundations in relatively shallow waters and mobile sediments resulted in extensive scour pits and scour fields (English et al. 2017). A good deal of research was conducted on scour development, and best management practices (BMPs) have been established to reduce scour occurrence. Current scour models are consistent with field data collected at offshore wind facilities, and mitigation measures for scour protection (e.g., rock placement) have been shown to be highly effective. At the moment, scour does not appear to be a major concern of offshore wind facility developers due to the effectiveness of scour protection as a mitigation, the accuracy of scour predictions, and the establishment of BMPs.

All COP submittals for offshore wind facilities to date, including Vineyard Wind's COP, have included scour protection to mitigate the possibility of scour occurrence and monitoring programs to monitor scour both on a regular time schedule and with environmentally triggered monitoring, such as post storm event monitoring. These protective measures are in line with BMPs established by international industry stakeholders.

Survey data show the Vineyard Wind Facility seabed consists of fine-grained sediments that overlay coarse-grained sands. The mixed seabed and presence of fine-grained material indicates scour is less likely to occur; however, Vineyard Wind has proposed a conservative approach that includes the installation of scour protection around all foundations.

E.6.2. Environmental Monitoring

Direct observations of the Block Island Wind Farm show turbidity associated with cable installation to be nearly indistinguishable from background turbidity measurements and 100 times lower than model predictions; overspill levee deposits were in line with model predictions (Elliot et al. 2017).

Scour around the foundation of the Block Island Wind Farm show about 0.66 foot (0.2 meter) of seabed lowering over 14 months with average monthly variability of up to 1.97 feet (0.6 meter). Data appears to suggest a correlation between the greatest levels of scour and the highest significant wave heights thus raising the possibility that increased wave action leads to increases scour during more extreme winter weather with some recovery during spring and summer months (HDR 2018).

BOEM is working with state and federal partners regarding developing a regional monitoring strategy that focuses on impacts on biological resources, and builds off the lessons from Europe. Wind developers will also have site-specific monitoring requirements related to potential impacts that might be anticipated for their project. This includes monitoring of foundations for epibenthic growth, scour, and monitoring of cable burial effectiveness.

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APPENDIX F

Supplemental Material

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APPENDIX F. SUPPLEMENTAL MATERIAL

F.1. MARINE MAMMAL SOUND EXPOSURE ESTIMATES

As discussed in Section 3.4 of this Final Environmental Impact Statement (FEIS) and in E.5.1.1 of Appendix E, marine mammals occur in the Rhode Island and Massachusetts Lease Areas (RI and MA Lease Areas). Pile-driving noise has the potential to cause Level A harassment and Level B harassment to marine mammals. Vineyard Wind submitted comprehensive acoustic modeling of underwater sound propagation and potential effects on marine species during piling installation for an 800-megawatt (MW) offshore wind energy project (the Proposed Action; Pyć et al. 2018) that provided detailed information for the pile-driving analysis. Pyć et al. (2018) modeled Scenarios 1 and 2 over a construction period of May through December (excluding the months of January through April, when endangered North Atlantic right whales [NARWs, *Eubalaena glacialis*] are likely to be present in relatively high numbers).

For estimating marine mammal densities (animals per square kilometers) for modeling, Pyć et al. (2018) used the Duke University Marine Geospatial Ecological Laboratory model results (Roberts et al. 2016a) and an unpublished updated model for NARW densities (Roberts et al. 2016b) that incorporates more sighting data, including those from the Atlantic Marine Assessment Program for Protected Species (2010 to 2014). In 2020, the Duke University Marine Geospatial Ecological Laboratory published updated density models for NARWs in the project area (Roberts et al. 2020) that incorporated additional sighting data in the RI and MA Lease Areas spanning 2011–2015 and 2017–2018 (Kraus et al. 2016; Quintana et al. 2018). This new NARW density data was subsequently used to re-model exposures of NARWs to proposed Project-related noise. The recent Roberts et al. (2020) data show higher densities during the time of year when no pile driving would occur (January 1 through April 30) and lower densities when pile driving activities are planned (May 1 through December 31). As such, the following discussion relies upon the density estimates provided in Pyć et al. (2018) as a conservative estimation of marine mammal density during construction relative to the recent Roberts et al. (2020) data. Pyć et al. (2018) calculated the density estimates for pinnipeds using Roberts et al. (2016a) density data. The model used the following National Marine Fisheries Service (NMFS) threshold criteria for Level A harassment, permanent threshold shift (PTS) to marine mammals (see Table F.1-1; NMFS 2018). Level A harassment "has the potential to injure a marine mammal or marine mammal stock in the wild" (NOAA 2017).

Pyć et al. (2018) modeled three levels of attenuation: 0 decibel (dB) (no attenuation), 6 dB, and 12 dB. The 0 dB level was modeled as a reference point to evaluate the effectiveness of the proposed mitigation of sound reduction technology (e.g., Hydro-sound Damper, bubble curtains, or similar). When comparing the two potential levels of attenuation (6 dB and 12 dB), 6 dB is the least effective modeled level and would be considered as the most impactful. Although Vineyard Wind has proposed to achieve 12 dB attenuation, the FEIS assesses an attenuation level of only 6 dB as a maximum-case scenario. Pyć et al. (2018) provides a radial distance to threshold criteria[1] for Level A Harassment for installation of one 34-foot (10.3-meter) monopile and four 10-foot (3-meter) jacket piles for each hearing group with 6 dB attenuation, considered the most impactful scenario. The Project Design Envelope includes the use of impact hammers with up to 4,000-kilojoule (kJ) energy ratings. However, the maximum hammer energy to be employed during pile driving would be 2,500 kJ (Construction and Operations Plan Volume I, Section 4.2.3; Epsilon 2020a; Pyć et al. 2018).

Table F.1-1: Permanent Threshold Shift Onset Acoustic Threshold Levels

Hearing Group	PTS Onset Thresholds to Evaluate Level A Harassment [a] (received level)	
	Impulsive	Non-impulsive
LFC	L_{pk}, flat 219 dB; L_{E24} 183 dB	L_{E24} 199 dB
MFC	L_{pk}, flat 230 dB; L_{E24} 185 dB	L_{E24} 198 dB

[1] The radial distance to threshold criteria is the radius of a circle centered on the source encompassing the sound at levels above threshold.

Hearing Group	PTS Onset Thresholds to Evaluate Level A Harassment [a] (received level)	
	Impulsive	Non-impulsive
HFC	L_{pk}, flat 202 dB; L_{E24} 55 dB	L_{E24} 173 dB
PPW	L_{pk}, flat 218 dB; L_{E24} 85 dB	L_{E24} 201 dB

Sources: Pyć et al. 2018; NMFS 2018

µPa = micropascal; $\mu Pa^2 s$ = micropascal squared second; dB = decibel; HFC = high frequency cetacean (harbor porpoise [*Phocoena phocoena*]); L_{pk} flat = peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa; L_{E24} = cumulative sound exposure over a 24-hour period and has a reference value of 1 $\mu Pa^2 s$; LFC = low frequency cetacean (all the large whales except sperm whales [*Physeter macrocephalus*]); MFC = mid-frequency cetacean (all dolphins, pilot whales, and sperm whales); PPW = Pinnipeds in the water (all seals); PTS = permanent threshold shift

[a] Dual-metric acoustic thresholds for impulsive sounds. Use whichever results in the largest isopleth (mapped distance) for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Because of the complexity and variability of marine mammal behavioral responses to acoustic exposure, NMFS has not yet released technical guidance on behavioral threshold criteria (Level B harassment; NMFS 2018). Level B harassment "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild" (NOAA 2017). The traditional method of assessing Level B harassment impacts on marine mammals is an unweighted 160 dB sound pressure level (Pyć et al. 2018). However, the application of a step function that evaluates weighted exposures as a percentage of animals responding between each step between different threshold levels has gained recent acceptance (Wood et al. 2012; Nowacek et al. 2015). Analyses of both approaches to assess the consequences of sound exposure on marine mammals can produce very different results (Farmer et al. 2018) because the unweighted 160 dB threshold assuming all animals respond equivalently generally produces greater exposure numbers than the step function response approach. NMFS currently uses a step function to assess behavioral impact (Pyć et al. 2018). Pyć et al. (2018) applied both the unweighted National Oceanic and Atmospheric Administration (NOAA; 70 Fed. Reg. 7) and the frequency-weighted Wood et al. (2012) criteria to estimate behavioral response to impulsive pile-driving sound (see Table F.1-2).

Table F.1-2: Behavioral Exposure Criteria

Marine Mammal Group	Probability of Response to Frequency-weighted SPL (dB re 1 µPa)				Unweighted (dB root mean square) [a]
	120	140	160	180	
Harbor porpoise (*Phocoena phocoena*)	50%	90%			160
Migrating mysticete whales	10%	50%	90%		160
All other species (and behaviors)		10%	50%	90%	160

Sources: Adapted from Wood et al. 2012; Pyć et al. 2018

dB = decibel; dB re 1 µPa = decibels relative to 1 micropascal; SPL = sound pressure level
Note: Probability of behavioral response frequency-weighted sound pressure level (SPL dB re 1 µPa); probabilities are not additive.
[a] Pyć et al. 2018

Using the unweighted criteria, radial distance to Level B harassment with 6 dB attenuation is lower for jacket piles (2 miles [3,220 meters]) compared to a 34-foot (10.3-meter) monopile (2.6 miles [4,121 meters]) for all marine mammals (see Table F.1-4) (Pyć et al. 2018). Using the weighted criteria, radial distance to the threshold for Level B harassment is also lower for jacket piles for low-frequency cetaceans (2.1 miles [3,302 meters]) compared to a 34-foot (10.3-meter) monopile (2.5 miles [4,007 meters]). However, for all other hearing groups, radial distances are greater for jacket piles compared to a monopile foundation (see Table F.1-4) (Pyć et al. 2018). Pile-driving noise has the potential to cause Level A harassment and Level B harassment to marine mammals. Vineyard Wind would use sound-reducing technologies to minimize harmful impacts on marine mammals, but as discussed above, attenuation level may vary with local conditions. With a proposed target of 12 dB and maximum-case scenario of 6 dB attenuation, there is a risk of Level B Harassment to marine mammals from pile driving due to the large radial distance to this threshold and the up-to-102 days that pile driving may occur.

The isopleths for Level A harassment during installation of a jacket foundation for NARW, fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), humpback whales (*Megaptera novaeangliae*), and minke whales (*Balaenoptera acutorostrata*) (4.5 miles [7,253 meters]) is too large to monitor effectively by visual observation. Isopleths to injury thresholds during pile driving of monopile foundations are smaller than those for jacket piles, although the radial distance to the Level A harassment threshold for large whales is still too large to be effectively monitored using visual observation (3.3 miles [5,443 meters]; see Table F.1-4) (Pyć et al. 2018). The maximum number of pile-driving days is 102, at the rate of one monopile installed per day (Table 5.1-5 in BOEM 2018; Pyć et al. 2018). Radial distances to sound threshold criteria were modeled using 2,500 kJ hammer energy. Vineyard Wind would utilize a soft-start approach in which the initial hammer blows occur at reduced energy levels, allowing time for mobile animals to leave the affected area before hammer energy is gradually increased to the full 2,500 kJ. Based on the geophysical data at the Project location and assessment by Vineyard Wind engineers, the full power capacity of the hammer is not necessary to install the foundations. Radial distances to thresholds for Level A harassment are greater for four jacket piles compared to one monopile for all hearing groups (Pyć et al. 2018). When comparing all hearing groups, radii are the largest for the low-frequency hearing group (mysticetes), and range from 4.5 miles (7,253 meters) for the jacket foundation to 2 miles (3,191 meters) for the monopile foundation with 6 dB attenuation. Radial distance to thresholds for Level A harassment are moderate for seals in water (0.6 mile [977 meters]) and harbor porpoise (*Phocoena phocoena*) (high-frequency hearing group; 0.4 mile [564 meters]) during installation of jacket piles. Pyć et al. (2018) assumed jacket foundation installation occurring for a maximum of 12 pile-driving days under Scenario 2 (up to ten wind turbine generators [WTGs] and two electrical service platform [ESP] jacket foundations; 2 days each month from June through September, and 1 day each month during May and October through December); or as two pile-driving days under Scenario 1 (two ESP jacket foundations; 1 day each month in July and August).

Tables F.1-3 and F.1-4 summarize the numbers of marine mammals estimated to experience sound levels above threshold criteria for Level A harassment and Level B harassment for the maximum-case scenario conditions, Scenario 2 (up to 90 monopiles and up to 12 jacket foundation) with 6 dB attenuation (Pyć et al. 2018). The Pyć report integrates results from acoustic propagation models (which estimate three-dimensional sound fields resulting from pile driving), animal movement modeling (which provide probabilistic distributions of sound level exposures based on animal movement relative to modelled sound fields), and species density maps/models (which predict animal occupancy as a function of location and month). Their report predicts the number of individual animals (for each species) that may be exposed to sound levels exceeding various criteria over the course of Scenario 2 construction. Overall, the numbers of marine mammals potentially exposed to impacts, and that may receive Level A harassment, from pile driving are higher under Scenario 2 (Pyć et al. 2018; Table F.1-4).

Tables F.1-3 and F.1-4 also provide the estimated number of marine mammals to be exposed to Level B harassment with 6 dB attenuation (Pyć et al. 2018). Numbers for small cetaceans and seals are generally higher due to their generally higher abundances in the RI and MA Lease Areas, but also due the unweighted 160 dB threshold criteria applied that does not account for the lower likelihood of exposure of mid- and high-frequency cetaceans and pinnipeds to low-frequency sounds produced by pile driving. Discussed below are the additional considerations applied to estimate the non-lethal take of marine mammals that NMFS has proposed to authorize under the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA).

Table F.1-3: Mean Number of Marine Mammals Estimated to be Exposed above Level A and Level B Harassment Thresholds during the Proposed Project using the Maximum-Case Scenario, One Foundation Installed per Day, and a Maximum-Case Scenario of 6 dB Attenuation

Species	Level A Harassment (peak)	Level A Harassment (SEL)	Level B Harassment
Fin whale (*Balaenoptera physalus*) [a]	0.1	4.13	33.11
Humpback whale (*Megaptera novaeangliae*)	0.03	9.01	30.1
Minke whale (*Balaenoptera acutorostrata*)	0.04	0.22	12.21
North Atlantic right whale (*Eubalaena glacialis*) [a]	0.03	1.36	13.25
Sei whale (*Balaenoptera borealis*) [a]	0	0.14	1.09

Species	Level A Harassment (peak)	Level A Harassment (SEL)	Level B Harassment
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	0	0	449.2
Common bottlenose dolphin (*Tursiops truncatus*)	0	0	96.21
Pilot whales (*Globicephala*)	0	0	0
Risso's dolphin (*Grampus griseus*)	0	0	1.61
Common dolphin (*Delphinus delphis*)	0.1	0	1059.97
Sperm whale (*Physeter macrocephalus*) [a]	0	0	0
Harbor porpoise (*Phocoena phocoena*)	4.23	0.17	150.13
Gray seal (*Halichoerus grypus*)	0.11	0.3	196.4
Harbor seal (*Phoca vitulina*)	0.36	0.21	214.04
Harp seal (*Pagophilus groenlandicus*)	0.73	0.87	217.35

ESA = Endangered Species Act; SEL = sound exposure level
[a] ESA-listed species

Table F.1-4: Mean Number of Marine Mammals Estimated to be Exposed above Level A and Level B Harassment Thresholds during the Proposed Project using the Maximum-Case Scenario, Two Foundations Installed per Day, and a Maximum-Case Scenario of 6 dB Attenuation

Species	Level A Harassment (peak)	Level A Harassment (SEL)	Level B Harassment
Fin whale (*Balaenoptera physalus*) [a]	0.1	4.49	29.71
Humpback whale (*Megaptera novaeangliae*)	0.03	9.59	27.23
Minke whale (*Balaenoptera acutorostrata*)	0.03	0.23	11.52
North Atlantic right whale (*Eubalaena glacialis*) [a]	0.02	1.39	11.75
Sei whale (*Balaenoptera borealis*) [a]	0	0.14	0.93
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	0.13	0	428.23
Common bottlenose dolphin	0	0	67.71
Pilot whales (*Globicephala*)	0	0	0
Risso's dolphin (*Grampus griseus*)	0	0	1.38
Common dolphin (*Delphinus delphis*)	0.44	0	897.91
Sperm whale (*Physeter macrocephalus*) [a]	0	0	0
Harbor porpoise (*Phocoena phocoena*)	4.23	0.17	125.23
Gray seal (*Halichoerus grypus*)	0.29	0.47	145.2
Harbor seal (*Phoca vitulina*)	1.01	0.86	164.48
Harp seal (*Pagophilus groenlandicus*)	0.38	0.53	162.03

ESA = Endangered Species Act; SEL = sound exposure level
[a] ESA-listed species

As shown in Tables F.1-3 and F.1-4, the greatest potential number of marine mammal exposures above the Level B and Level A harassment thresholds occur with one monopile foundation installed per day. This is because the number of exposures is calculated over 24-hour periods. There is very little difference between the daily exposures for one or two piles per day because the number of exposures is limited by the number of animals that may occur in the area on a daily basis. Therefore, under the scenario where only one pile per day is installed, the total construction time for the Project occurs over a greater number of days, resulting in a greater number of additive exposures. With two monopile foundations per day, there are half as many days of pile driving required, so there is a reduced number for the total predicted Level B harassment daily exposures over the duration of the Project. Based on the above results from the exposure modeling, take numbers for marine mammals are based on the one-pile-per-day scenario.

Although the exposure modeling indicated that no Level A harassment takes are expected for several species (i.e., minke whale, sei whale, and all small cetaceans and pinnipeds), Vineyard Wind provided additional information based on the mean group size for each species. Therefore, exposure estimation is expanded to include an assumption that if one group member were to be exposed, it is likely that all animals in the same group would receive a similar exposure level and potentially be taken. The mean group size for each species was derived from Kraus et al. (2016) as the best representation of expected group sizes within the RI and MA Lease Areas. These were calculated as the number of individuals sighted, divided by the number of sightings summed over the four seasons (from Tables 5 and 19 in Kraus et al. 2016). Sightings for which species identification was considered either definite or probable were used in the Kraus et al. (2016) data. For species that were observed very rarely during the Kraus et al. (2016) study (i.e., sperm whales [*Physeter macrocephalus*] and Risso's dolphins [*Grampus griseus*]) or observed but not analyzed (i.e., pinnipeds), data derived from surveys by the Atlantic Marine Assessment Program for Protected Species (AMAPPS; Palka et al. 2017) were used to evaluate mean group size. For sperm whales and Risso's dolphins, the number of individuals divided by the number of groups observed during 2010–2013 AMAPPS northeast summer shipboard surveys and northeast aerial surveys during all seasons was used (Appendix I of Palka et al. 2017). Though pinnipeds congregate in large numbers on land, at sea they are generally foraging alone or in small groups. For harbor seals (*Phoca vitulina*) and gray seals (*Halichoerus grypus*), Palka et al. (2017) report sightings of seals at sea during 2010–2013 spring, summer, and fall northeast AMAPPS aerial surveys. Sightings include both harbor seals and gray seals, as well as unknown seals, and thus a single group size estimate was calculated for these two species. Harp seals (*Pagophilus groenlandicus*) are occasionally recorded south of the RI and MA Lease Areas on Long Island, New York, and in the nearshore waters, usually in groups of one or two individuals. From 2002 to 2018, the Coastal Research and Education Society of Long Island reported seven sightings of harp seals (CRESLI 2018); five of these were of single individuals and two were of two animals. Calculated group sizes for all species are shown in Table F.1-5.

Table F.1-5: Mean Group Sizes of Marine Mammal Species Used to Estimate Takes

Species	Mean Group Size
Fin whale (*Balaenoptera physalus*)	1.8
Humpback whale (*Megaptera novaeangliae*)	2
Minke whale (*Balaenoptera acutorostrata*)	1.2
North Atlantic right whale (*Eubalaena glacialis*)	2.4
Sei whale (*Balaenoptera borealis*)	1.6
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	27.9
Common bottlenose dolphin (*Tursiops truncatus*)	7.8
Pilot whale (*Globicephala*)	8.4
Risso's dolphin (*Grampus griseus*)	5.3
Short-beaked common dolphin (*Delphinus delphis*)	34.9
Sperm whale (*Physeter macrocephalus*)	1.5
Harbor porpoise (*Phocoena phocoena*)	2.7
Gray seal (*Halichoerus grypus*)	1.4
Harbor seal (*Phoca vitulina*)	1.4
Harp seal (*Pagophilus groenlandicus*)	1.3

For the proposed Project, Vineyard Wind also requested Level B harassment take numbers under the MMPA that differ from the numbers modeled. The requested numbers were based on monitoring data from site characterization surveys conducted at the same location. Vineyard Wind reviewed monitoring data recorded during site characterization surveys in the Wind Development Area from 2016 to 2018 and calculated a daily sighting rate (individuals per day) for each species in each year, then multiplied the maximum sighting rate from the 3 years by the number of pile-driving days under the maximum-case scenario (i.e., 102 days). This method assumes that the largest average group size for each species observed during the 3 years of surveys may be present during pile driving on each day. Vineyard Wind used this method for all species that were documented by protected species observers during the 2016–2018 surveys. For sei whales, this approach resulted in the same number of estimated Level B harassment takes as Level A harassment takes (two); therefore, to be conservative, Vineyard Wind doubled the Level A harassment value to arrive at the requested number of Level B harassment takes. Risso's dolphins and harp seals were not documented by protected species observers during those surveys, so Vineyard Wind requested take based on two average group sizes for those species. The Level B harassment take calculation methodology described here resulted in higher expected take numbers (Table F.1-6) than those that resulted from sound exposure modeling alone for 10 out of 15 species expected to be taken. NMFS may make minor revisions to the take numbers shown in Table F.1-6 between the publication of the FEIS and the final Incidental Harassment Authorization (IHA); however, NMFS and the Bureau of Ocean Energy Management (BOEM) anticipate that any revisions would not result in changes to impact determinations.

Table F.1-6: Total Numbers of Potential Incidental Take and Percentage of Marine Mammal Stock Taken [a]

Species	Takes by Level A Harassment	Takes by Level B Harassment	Total Takes Proposed for Authorization	Total Takes as a Percentage of Stock Taken [b]
Fin whale (*Balaenoptera physalus*)	5	34	39	0.8
Humpback whale (*Megaptera novaeangliae*)	10	56	66	4.0
Minke whale (*Balaenoptera acutorostrata*)	2	98	100	4.7
North Atlantic right whale (*Eubalaena glacialis*)	0	20	20	4.9
Sei whale (*Balaenoptera borealis*)	2	4	6	0.8
Sperm whale (*Physeter macrocephalus*)	0	5	5	0.1
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	28	1,107	1,135	3.1
Common bottlenose dolphin (*Tursiops truncatus*)	8	98	106	0.1
Long-finned pilot whale (*Globicephala melas*)	9	91	100	0.5
Risso's dolphin (*Grampus griseus*)	6	12	18	0.2
Common dolphin (*Delphinus delphis*)	35	4,646	4,681	5.4
Harbor porpoise (*Phocoena phocoena*)	4	152	156	0.3
Gray seal (*Halichoerus grypus*)	2	414	416	1.5
Harbor seal (*Phoca vitulina*)	2	217	219	0.3
Harp seal (*Pagophilus groenlandicus*)	2	220	222	0.0

[a] The take numbers presented in this table represent the most likely amount of take NMFS will authorize in the IHA; however, these numbers are subject to change upon final decision.
[b.] Calculations of percentage of stock taken are based on the best available abundance estimates. For NARWs, the best available abundance estimate is derived from Roberts et al. (2020). For the pinniped species, the best available abundance estimates are derived from the most recent NMFS Stock Assessment Reports. For all other species, the best available abundance estimates are derived from Roberts et al. (2016a, 2016b) and Roberts (2018).

All of the marine mammal sound exposure and take estimate information in the Construction and Operations Plan (Volume III, Epsilon 2020b) and summarized herein was reviewed by BOEM. The sound exposure and take estimates were also reviewed by NMFS as part of Vineyard Wind's incidental take request in its revised IHA application (dated January 2019) submitted under the MMPA. The information in the application, including the effectiveness of the proposed mitigation, was evaluated to estimate the potential take numbers of marine mammals. Vineyard Wind's requested take numbers for Level A harassment authorization were based on an expectation that 12 dB sound attenuation will be effective during the proposed activity. The relevant information on sound reduction effectiveness was reviewed, such as California Department of Transportation bubble curtain "on and off" studies conducted in San Francisco Bay in 2003 and 2004 (CalTrans 2015). Based on 74 measurements (37 with the bubble curtain on and 37 with the bubble curtain off) at both near (less than 100 meters) and far (greater than 100 meters) distances, the linear averaged received level reduction is 6 dB (CalTrans 2015). Nehls et al. (2016) reported that attenuation from use of a bubble curtain during pile driving at the Borkum West II offshore wind farm in the North Sea was between 10 and 17 dB (mean 14 dB) (peak).

Based on the best available information, it is reasonable to assume some level of effective attenuation due to implementation of noise attenuation during impact pile driving. Vineyard Wind has not identified the specific attenuation system that would ultimately be used during the proposed activity (e.g., what size bubbles and in what configuration a bubble curtain would be used, whether a double curtain would be employed, whether hydro-sound dampers, noise abatement system, or some other alternate attenuation device would be used). In the absence of specific information regarding the attenuation system that would be ultimately used, and in consideration of the available information on attenuation that has been achieved during impact pile driving, the FEIS conservatively assumes that the lower level effectiveness of 6 dB sound attenuation will be achieved (although greater noise attenuation may be achieved). The maximum-case scenario with two piles driven per day resulted in slightly higher modeled takes by Level A harassment (Table F.1-4).

Similar to the estimated Level A harassment numbers requested by Vineyard Wind, the requested take numbers for Level B harassment authorization also considered visual observation data recorded during the company's site characterization surveys, as described above. In some cases, these numbers are lower than the Level B harassment exposure numbers modeled based on marine mammal densities reported by Roberts et al. (2016a, 2016b) and Roberts (2018) with 6 dB sound attenuation applied. While applying visual observation data collected by protected species observers as the basis for Level B harassment take requests can be generally considered a sound approach, a conservatively more protective approach was taken by using the higher of the calculated take numbers from the two approaches. A comparison was made of take numbers based on available visual observation data and those estimated on modeled exposures above threshold. Therefore, for each species, the higher of the two numbers was applied to estimate Level B harassment; exposure numbers modeled based on marine mammal densities reported by Roberts et al. (2016a, 2016b, 2020) and Roberts (2018) with 6 dB sound attenuation applied (Tables F.1-3 and F.1-4) or the take numbers based on visual observation data (i.e., fin whale, common bottlenose dolphin (*Tursiops truncatus*), harbor porpoise, harbor seal, and harp seal).

For NARWs, one exposure above the Level A harassment threshold was modeled over the duration of the proposed Project based on the maximum-case scenario and 6 dB effective attenuation (Tables F.1-3 and F.1-4). However, Vineyard Wind has requested no authorization for Level A harassment takes of NARWs based on an expectation that any potential exposures above the Level A harassment threshold will be avoided through enhanced mitigation and monitoring measures proposed specifically to minimize potential NARW exposures. Based on the enhanced mitigation and monitoring measures proposed specifically for NARWs (described in Chapter 3 and Appendix D), including the proposed seasonal moratorium on construction from January through April and enhanced clearance measures from November through December and May 1 through May 14, any potential take of NARWs by Level A harassment would be avoided. Therefore, takes of NARWs by Level A harassment are not expected.

The take numbers in Table F.1-6 are considered conservative estimates for the following reasons:

- Proposed take numbers are based on an assumption that all installed monopiles would be 33.8 feet (10.3 meters) in diameter, when some or all monopiles ultimately installed may be smaller;
- Proposed take numbers are based on an assumption that 102 foundations would be installed, when ultimately the total number installed may be lower;
- Proposed take numbers are based on a construction scenario that includes up to 10 jacket foundations, when it is possible no more than two jacket foundations may be installed;
- Proposed Level A take numbers do not account for the likelihood that marine mammals would avoid a stimulus when possible before that stimulus reaches a level that would have the potential to result in injury;
- Proposed take numbers do not account for the effectiveness of proposed mitigation and monitoring measures in reducing the number of takes (with the exception of NARWs, for which proposed mitigation and monitoring measures are factored into the proposed Level A harassment take number).

Vineyard Wind’s self-imposed measures of utilizing soft start, Protected Species Observers, and passive acoustic monitoring would reduce the potential impacts to marine mammals. Vineyard Wind’s self-imposed measures are described in detail in Pyć et al. (2018), Table 31. Based on the analysis, there is a **minor** to **moderate** risk of Level A harassment and Level B harassment to marine mammals from pile driving due to the large radial distance to this threshold and maximum-case of 102 days that pile driving may occur. Therefore, BOEM considers impacts from pile driving to be **minor** for NARW due to avoidance of peak seasons of occurrence, and **moderate** for all other marine mammals. BOEM could further reduce potential impacts on marine mammals by implementing mitigation measures outlined in Appendix D, which could include long-term passive acoustic monitoring; daily, pre-construction passive acoustic monitoring and visual surveys; and the sunrise and sunset prohibition on pile driving as well as requiring the use of noise reduction technologies during all pile-driving activities to achieve a required minimum attenuation (reduction) of 6 dB re 1 micropascal (root mean square). The specific technologies have not yet been selected; potential options include a Noise Mitigation System, Hydro-sound Damper, Noise Abatement System, a bubble curtain, or similar (Pyć et al. 2018). In addition to the use of one sound attenuation system, Vineyard Wind has committed to complete sound field verification and to have a second attenuation technology on hand, which would be deployed if sound field verification demonstrates a need for greater attenuation. These above measures would reduce noise impacts during construction and the likelihood of impacts to marine mammals, but would not result in a change to the significance level of impacts.

As described above, using the best available science, the Vineyard Wind 1 Project modeled the potential for marine mammal to be exposed to Project-related harassing or injurious sound levels that may result in take, as defined by the ESA. Since publication of the DEIS and the SEIS, BOEM has completed interagency consultation with the NMFS under Section 7 of the ESA, and NMFS has issued a Biological Opinion (BO) to specify the amount of take of endangered or threatened species that may result from Vineyard Wind 1 Project activities (NMFS 2020). NMFS anticipates that pile-driving activities under the Proposed Action would result in the harassment of NAWRs, fin whales, sperm whales, and sei whales. No other sources of incidental take are expected to occur. Table F.1-7 presents the maximum amount of marine mammal take that is anticipated under the maximum case scenario of (90 monopiles and 12 jacket foundations, one pile driven per day, 6 dB of sound attenuation) and is consistent with the amount of Level A and B harassment that NMFS is proposing to authorize through the MMPA IHA.

Table F.1-7: Take of Marine Mammals due to Exposure to Pile-Driving Noise (90 Monopiles and 12 Jackets, One Pile per Day, 6 dB Sound Attenuation)

Species	Harassment (TTS/Behavioral Response)	Injury (PTS)
North Atlantic right whale (*Eubalaena galcialis*)	20	NA
Fin whale (*Balaenoptera physalus*)	34	5
Sperm whale (*Physeter macrosephalus*)	5	NA
Sei whale (*Balaenoptera borealis*)	4	2

Source: NMFS 2020

NA = not anticipated; PTS = permanent threshold shift; TTS = temporary threshold shift

As described under Alternative E in Chapter 2, Vineyard Wind may install fewer larger capacity WTGs, if available, and may install only one ESP. As discussed in the NMFS BO, the anticipated amount of take is related to the amount of required pile driving. Installation of few piles would result in reduced marine mammal exposure to pile driving noise, and thereby the amount of anticipated take of marine mammals (NMFS 2020). If 9.5 MW WTGs are installed, the resulting 84 WTGs monopiles and two ESPs jacket foundations would represent a 16 percent reduction in required pile driving, and therefore anticipated take of marine mammals (Table F.1-8).

Table F.1-8: Take of Marine Mammals due to Exposure to Pile-Driving Noise (84 Monopiles and 2 Jackets, One Pile per Day, 6 dB Sound Attenuation)

Species	Harassment (TTS/Behavioral Response)	Injury (PTS)
North Atlantic right whale (*Eubalaena galcialis*)	17	NA
fin whale (*Balaenoptera physalus*)	29	5
sperm whale (*Physeter macrosephalus*)	5	NA
sei whale (*Balaenoptera borealis*)	4	2

Source: NMFS 2020

NA = Not anticipated; PTS = permanent threshold shift; TTS = temporary threshold shift

As described in Chapter 2, the Vineyard Wind 1 Project Design Envelope has been updated to include up to 14 MW WTGs. Under this scenario, pile-driving noise exposure and thereby anticipated take of marine mammals would be reduced by 43 percent (Table F.1-9).

Table F.1-9: Take of Marine Mammals due to Exposure to Pile-Driving Noise (57 Monopiles and 2 Jackets, One Pile per Day, 6 dB Sound Attenuation)

Species	Harassment (TTS/Behavioral Response)	Injury (PTS)
North Atlantic right whale (*Eubalaena galcialis*)	12	NA
fin whale (*Balaenoptera physalus*)	20	3
sperm whale (*Physeter macrosephalus*)	3	NA
sei whale (*Balaenoptera borealis*)	3	2

Source: NMFS 2020

NA = Not anticipated; PTS = permanent threshold shift; TTS = temporary threshold shift

As discussed in this FEIS and the NMFS BO, exposure estimates and pile-driving noise associated with the Vineyard Wind 1 Project and the resulting anticipated take of marine mammals is based upon achieving 6 dB reduction of pile-driving noise through the use of sound attenuation technologies. Should greater attenuation be achieved, fewer individuals than estimated above would be expected to be exposed to harassing or injurious levels of sound (NMFS 2020).

F.2. DEMOGRAPHICS, EMPLOYMENT, AND ECONOMICS

Table F.2-1: Demographic Trends 2000—2018

Jurisdiction	Population 2000	Population 2010	Population 2018	Percent Change 2000–2018	2018 Percent of Population Under 18	2018 Percent of Population 18–64 Years	2018 Percent of Population 65 or Older	2018 Median Age
Commonwealth of Massachusetts	6,349,105	6,547,629	6,830,193	7.6%	20.2%	64.0%	15.8%	39.4
Barnstable County	222,230	215,888	213,690	-3.8%	15.5%	55.4%	29.1%	52.9
Bristol County	534,678	548,285	558,905	4.5%	20.9%	62.8%	16.3%	41.0
Dukes County	14,987	16,535	17,313	15.5%	19.0%	58.8%	22.2%	46.1
Nantucket County	9,520	10,172	11,101	16.6%	21.0%	64.8%	14.3%	40.1
State of Rhode Island	1,048,319	1,052,567	1,056,611	0.8%	19.8%	63.7%	16.5%	39.9
Providence County	621,602	626,667	634,533	2.1%	20.8%	64.5%	14.7%	37.3
Washington County	123,546	126,979	126,242	2.2%	17.2%	63.4%	19.4%	44.5

Sources: U.S. Census Bureau 2012a, 2012b, 2012c, 2020a

Table F.2-2: Demographic Data (2018)

Jurisdiction	Population (2018)	Population Density (persons per mi^2)	Per Capita Income (2018)	Total Employment (Jobs, 2018)	Unemployment Rate (2018)
Commonwealth of Massachusetts	6,830,193	875.7	$41,794	3,570,257	5.4
Barnstable County	213,690	542.7	$42,578	105,075	4.7
Bristol County	558,905	1,010.5	$34,226	283,422	5.8
Dukes County	17,313	167.7	$43,822	8,684	3.2
Nantucket County	11,101	246.9	$51,270	6,471	2.8
State of Rhode Island	1,056,611	1,022.1	$34,619	527,972	6.1
Providence County	634,533	1,549.5	$30,356	310,070	6.8
Washington County	126,242	383.4	$41,000	64,575	6.1

Source: U.S. Census Bureau 2020a

mi^2 = square miles

Table F.2-3: Housing Data (2018)

Jurisdiction	Housing Units	Seasonal Vacant Units [a]	Vacant Units (Non-Seasonal)	Non-Seasonal Vacancy Rate	Median value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
Commonwealth of Massachusetts	2,882,739	127,508	153,317	5.6%	$366,800	$1,225
Barnstable County	163,181	62,705	6,184	6.2%	$290,100	$1,268
Bristol County	234,458	2,836	15,004	6.5%	$667,400	$872
Dukes County	17,789	10,950	472	6.9%	$1,056,500	$1,557
Nantucket County	12,191	7,677	792	17.5%	$249,800	$1,765
State of Rhode Island	467,412	17,699	38,828	8.6%	$249,800	$981
Providence County	265,991	1,297	26,523	10.0%	$223,600	$945
Washington County	63,737	11,129	3,497	6.6%	$328,300	$1,100

Source: U.S. Census Bureau 2020a

[a] "Seasonal housing units are those intended for occupancy only during certain seasons of the year and are found primarily in resort areas" (U.S. Census Bureau undated).

Table F.2-4: Employment of Residents, By Industry (2018)

	Massachusetts					Rhode Island		
	Total	Barnstable County	Bristol County	Dukes County	Nantucket County	Total	Providence County	Washington County
Agriculture, forestry, fishing	0.4%	1.0%	0.7%	2.7%	1.9%	0.5%	0.4%	1.2%
Construction	5.6%	9.7%	7.2%	16.1%	13.0%	5.5%	5.3%	5.9%
Manufacturing	8.9%	3.9%	11.1%	3.8%	1.9%	10.8%	11.5%	10.2%
Wholesale trade	2.2%	1.9%	3.4%	1.1%	1.7%	2.4%	2.4%	2.2%
Retail trade	10.3%	13.4%	12.8%	9.6%	12.1%	12.1%	13.0%	11.0%
Transportation, warehousing, utilities	3.8%	3.6%	4.3%	3.7%	3.8%	3.8%	4.0%	2.8%
Information	2.3%	1.7%	1.6%	1.2%	1.4%	1.7%	1.7%	1.3%
Finance, insurance, real estate	7.4%	5.9%	5.7%	6.6%	8.2%	6.8%	6.7%	6.1%

	Massachusetts					Rhode Island		
	Total	**Barnstable County**	**Bristol County**	**Dukes County**	**Nantucket County**	**Total**	**Providence County**	**Washington County**
Professional services	13.8%	12.3%	9.2%	12.9%	16.7%	10.1%	10.0%	9.8%
Educational, health care, social assistance	28.2%	24.9%	26.7%	24.1%	18.5%	27.3%	27.0%	28.1%
Arts, entertainment, recreation, accommodation, food services	8.7%	11.8%	8.9%	7.3%	11.7%	10.5%	9.9%	13.2%
Other services, except public administration	4.5%	5.1%	4.3%	6.3%	5.1%	4.5%	4.6%	4.1%
Public administration	3.9%	4.8%	4.2%	4.7%	4.1%	4.0%	3.6%	4.2%
Total:	100%	100%	100%	100%	100%	100%	100%	100%

Source: U.S. Census Bureau 2020b

Table F.2-5: At-Place Employment, By Industry (2018)

	Massachusetts					Rhode Island		
	Total	**Barnstable County**	**Bristol County**	**Dukes County**	**Nantucket County**	**Total**	**Providence County**	**Washington County**
Agriculture, forestry, fishing	<0.1%	0.1%	0.1%	<0.1%	<0.1%	<0.1%	<0.1%	0.2%
Mining, quarrying, oil and gas	<0.1%	0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	0.1%
Utilities	0.4%	0.3%	0.4%	0.3%	0.0%	0.3%	0.4%	0.3%
Construction	4.4%	7.6%	5.1%	13.1%	18.3%	4.3%	4.3%	4.1%
Manufacturing	6.8%	2.6%	11.9%	2.6%	1.3%	9.0%	8.1%	20.3%
Wholesale trade	4.5%	1.9%	7.4%	1.1%	0.6%	4.7%	4.5%	7.0%
Retail trade	10.7%	19.2%	16.6%	17.6%	17.7%	10.9%	9.0%	15.4%
Transportation and warehousing	2.9%	2.9%	4.1%	3.2%	2.0%	2.5%	2.1%	1.7%
Information	3.7%	1.7%	1.4%	2.8%	1.5%	1.5%	1.5%	0.7%
Finance and insurance	5.7%	2.6%	2.1%	3.7%	1.8%	6.8%	8.0%	2.2%
Real estate	1.5%	2.0%	0.9%	2.6%	2.6%	1.2%	1.1%	0.7%
Professional services	9.2%	6.2%	2.8%	4.1%	4.6%	5.3%	4.7%	3.8%
Management	3.3%	1.4%	2.6%	0.0%	0.8%	3.5%	4.8%	1.5%
Administrative, business support, waste management	6.3%	4.3%	4.8%	6.8%	9.7%	5.6%	5.8%	2.7%
Educational services	6.8%	1.9%	2.5%	1.0%	2.0%	6.8%	8.6%	1.3%
Health care and social assistance	18.7%	21.5%	20.9%	15.7%	11.3%	19.6%	20.9%	17.4%
Arts, entertainment, and recreation	1.9%	2.4%	1.8%	5.8%	4.9%	2.1%	2.0%	2.9%
Accommodation and food services	9.4%	16.0%	10.6%	13.4%	15.8%	11.7%	10.3%	13.3%

	Massachusetts					Rhode Island		
	Total	**Barnstable County**	**Bristol County**	**Dukes County**	**Nantucket County**	**Total**	**Providence County**	**Washington County**
Other services (ex. public admin)	3.8%	5.2%	3.9%	5.8%	4.8%	4.1%	3.9%	4.3%
Industries not classified	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Total for all sectors	100%	100.0%	100.0%	100.0%	100.0%	100%	100.0%	100.0%

Source: U.S. Census Bureau 2020b

Table F.2-6: Number of Establishments by Industry (2018)

	Massachusetts					Rhode Island		
	Total	**Barnstable County**	**Bristol County**	**Dukes County**	**Nantucket County**	**Total**	**Providence County**	**Washington County**
Agriculture, forestry, fishing	346	49	76	3	319	41	8	14
Mining, quarrying, oil and gas	61	5	6	219	14	14	6	5
Utilities	311	10	21	20	8	41	24	8
Construction	19,680	1,307	1,634	18	156	3,264	1,724	525
Manufacturing	6,360	186	605	199	21	1,293	827	150
Wholesale trade	7,427	194	591	30	14	1,301	710	146
Retail trade	23,486	1,432	2,073	17	18	3,675	1,977	507
Transportation and warehousing	4,080	149	398	36	71	733	475	80
Information	3,825	144	172	74	68	444	230	51
Finance and insurance	9,675	302	536	64	3	1,477	837	137
Real estate	7,762	390	479	95	131	1,144	644	142
Professional services	21,874	744	1,039	11	13	3,040	1,659	336
Management	1,260	31	73	55	32	185	126	9
Administrative, business support, waste management	11,123	694	742	41	32	1,796	953	263
Educational services	3,212	110	151	150	130	427	253	51
Health care and social assistance	19,615	789	1,446	92	57	3,125	1,866	372
Arts, entertainment, and recreation	3,492	248	211	3	319	592	243	139
Accommodation and food services	17,812	1,107	1,248	219	14	3,152	1,702	460
Other services (ex. public admin)	18,328	759	1,381	20	8	2,971	1,695	359
Industries not classified	578	23	43	18	156	33	18	3
Total for all sectors	180,307	8,673	12,925	1,128	1,092	28,748	15,977	3,757

Source: U.S. Census Bureau 2020b

Table F.2-7: Annual Payroll by Industry ($1,000) (2018)

	Massachusetts					Rhode Island		
	Total	**Barnstable County**	**Bristol County**	**Dukes County**	**Nantucket County**	**Total**	**Providence County**	**Washington County**
Agriculture, forestry, fishing	$47,853	$5,494	$6,100	NA	NA	$8,742	$730	$4,488
Mining, quarrying, oil and gas	$72,091	$3,416	$3,662	$1,615	NA	$10,457	$7,029	$3,151
Utilities	$1,631,320	$34,307	$57,221	$54,636	$64,255	$156,280	$126,597	$19,458
Construction	$11,385,192	$362,965	$703,007	$7,696	$3,282	$1,273,296	$833,780	$104,005
Manufacturing	$17,450,953	$130,336	$1,565,759	$3,308	$2,706	$2,298,729	$1,155,644	$538,634
Wholesale trade	$13,929,776	$89,491	$1,221,394	$54,576	$50,583	$1,461,859	$872,681	$243,903
Retail trade	$11,446,730	$511,861	$978,798	$9,894	$5,708	$1,448,889	$713,705	$216,437
Transportation and warehousing	$4,746,976	$99,778	$319,863	$7,954	$5,102	$496,370	$263,716	$34,417
Information	$15,080,682	$67,366	$212,537	$13,744	$7,114	$520,134	$325,596	$17,663
Finance and insurance	$28,835,732	$168,236	$268,690	$11,332	$11,528	$2,702,108	$2,055,681	$82,641
Real estate	$3,517,434	$82,365	$86,038	$16,924	$16,201	$255,358	$150,695	$14,669
Professional services	$36,610,588	$322,254	$336,961		$4,221	$1,630,277	$961,969	$107,903
Management	$14,038,520	$60,802	$493,838	$29,707	$47,072	$1,721,617	$1,504,666	$59,432
Administrative, business support, waste management	$10,368,529	$180,171	$371,362	$2,653	$3,976	$943,433	$632,600	$59,836
Educational services	$10,432,752	$53,103	$145,771	$58,375	$34,052	$1,177,927	$965,780	$16,551
Health care and social assistance	$33,478,652	$873,102	$2,018,835	$18,324	$24,544	$4,176,246	$2,928,733	$335,823
Arts, entertainment, and recreation	$2,525,866	$79,428	$78,424	$50,467	$57,601	$237,067	$117,178	$41,293
Accommodation and food services	$7,482,295	$438,843	$393,525	$15,889	$13,164	$1,156,072	$612,045	$148,892
Other services (e.g., public admin)	$4,787,336	$143,701	$234,127	NA	NA	$625,979	$384,114	$64,210
Industries not classified	$51,428	$1,251	$3,055	NA	NA	$1,803	$1,152	$77
Total for all sectors	$227,920,705	$3,708,270	$9,498,967	$16,924	$351,788	$22,302,643	$14,614,091	$2,113,483

Source: U.S. Census Bureau 2020b

NA = not available; withheld by the U.S. Census Bureau to avoid disclosing data for individual companies

Table F.2-8: 2017 Ocean Economy Data for Geographic Analysis Area Counties

County	Ocean Economy GDP, All Ocean Sectors[a]	Ocean Economy GDP, Tourism and Recreation Sector[a]	Ocean Economy GDP, Living Resources Sector[a]	Total County GDP (Coastal Economy, Employment Data) Total, All Industries[b]	Ocean Economy GDP, as Percent of Total County GDP (%)
Barnstable, Massachusetts	$1,217,513,000	$1,035,611,000	$77,233,000	$10,076,524,632	11%
Bristol, Massachusetts	$830,809,000	$117,691,000	$537,639,000	$24,914,035,680	3%
Dukes, Massachusetts	$122,092,000	$114,019,000	$6,978,000	$1,014,739,876	11%
Nantucket, Massachusetts	$148,643,000	$146,114,000	$2,411,000	$925,593,843	16%
Providence, Rhode Island	$778,076,000	$676,049,000	$9,389,000	$38,450,145,951	2%
Washington, Rhode Island	$1,090,160,000	$313,503,000	$63,799,000	$5,809,021,749	18%

GDP = gross domestic product; U.S. dollars
GDP calculated as Ocean Economy Employment Data GDP plus Self-Employed Workers Gross Receipts
[a] Search Parameters: Ocean Economy (Employment Data); Ocean Economy Geographies (NOAA 2020a); Ocean Economy (Self--Employed); Ocean Economy Geographies (NOAA 2020b)
[b] Search Parameters: Coastal Economy (Employment Data); Coastal Shoreline Counties; Total, all industries (NOAA 2020c)

Table F.2-9: 2017 Ocean Economy Employment [a] for Geographic Analysis Area Counties by Industry

	Marine Construction	Living Resources [b]	Offshore Mineral Extraction	Ship and Boat Building	Tourism and Recreation	Marine Transportation	Total, all Sectors [c]
Barnstable, Massachusetts	109	1,175	4	30	17,562	725	19,605
Bristol, Massachusetts	27	2,349		418	3,072	3,236	9,105
Dukes, Massachusetts		139			1,442	19	1,604
Nantucket, Massachusetts		62			1,610	9	1,682
Providence, Rhode Island	24	204	3		14,713	1,067	16,342
Washington, Rhode Island	62	792	4	9	6,141	41	11,340

[a] Total employment calculated as All Ocean Sectors Employment (NOAA 2020a) plus All Ocean Sectors Self-Employed Workers (NOAA 2020b).
[b] "Living resources" includes fishing, aquaculture, seafood processing, and seafood markets.
[c] For sectors showing no employment, data for certain businesses may have been suppressed because the number of businesses was too small to report based on privacy. This also results in total employment exceeding the sum of the sectors.

F.3. ENVIRONMENTAL JUSTICE

F.3.1. Figures

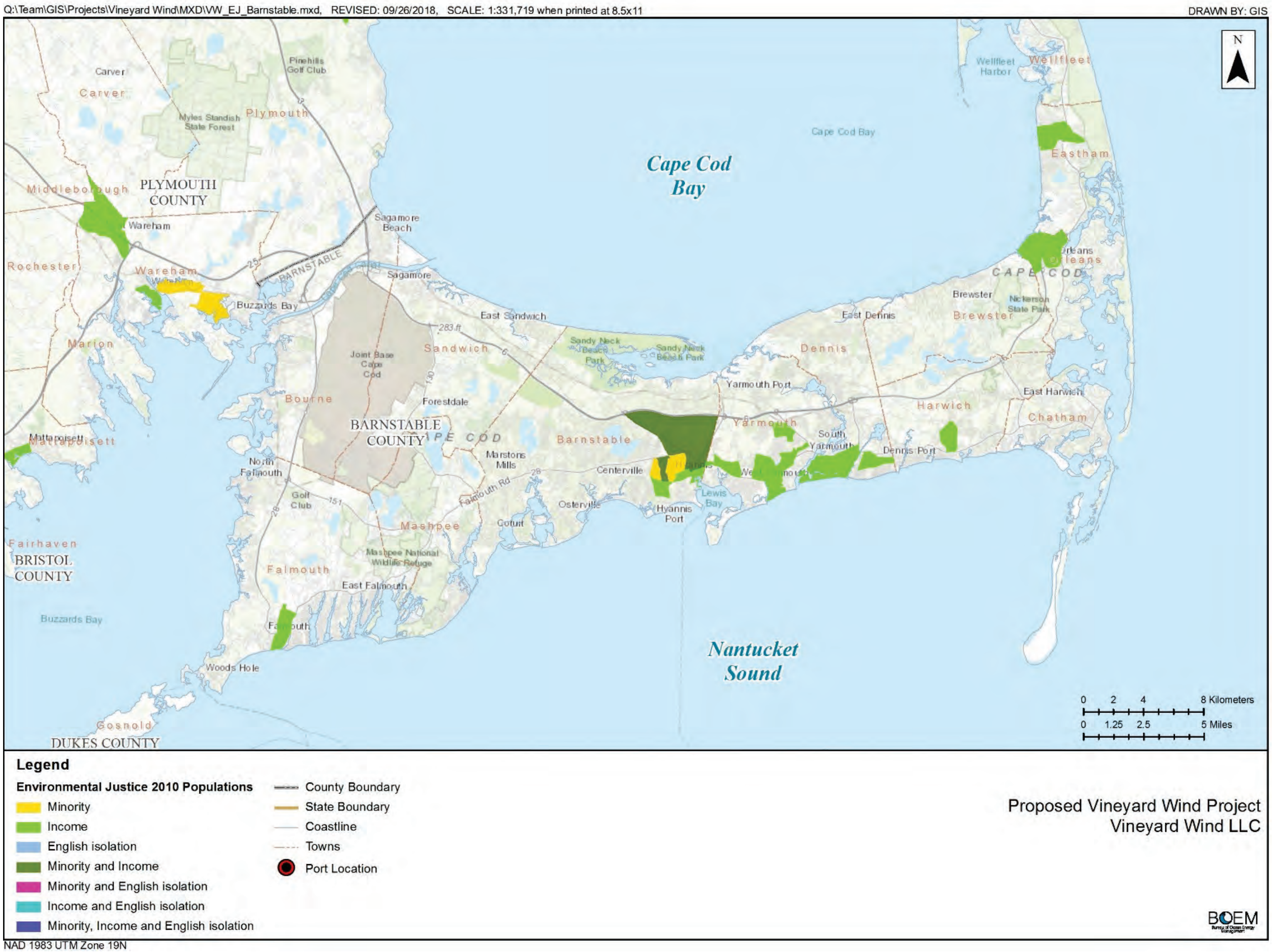

Figure F.3-1: Environmental Justice Populations in Barnstable County, Massachusetts (2010)

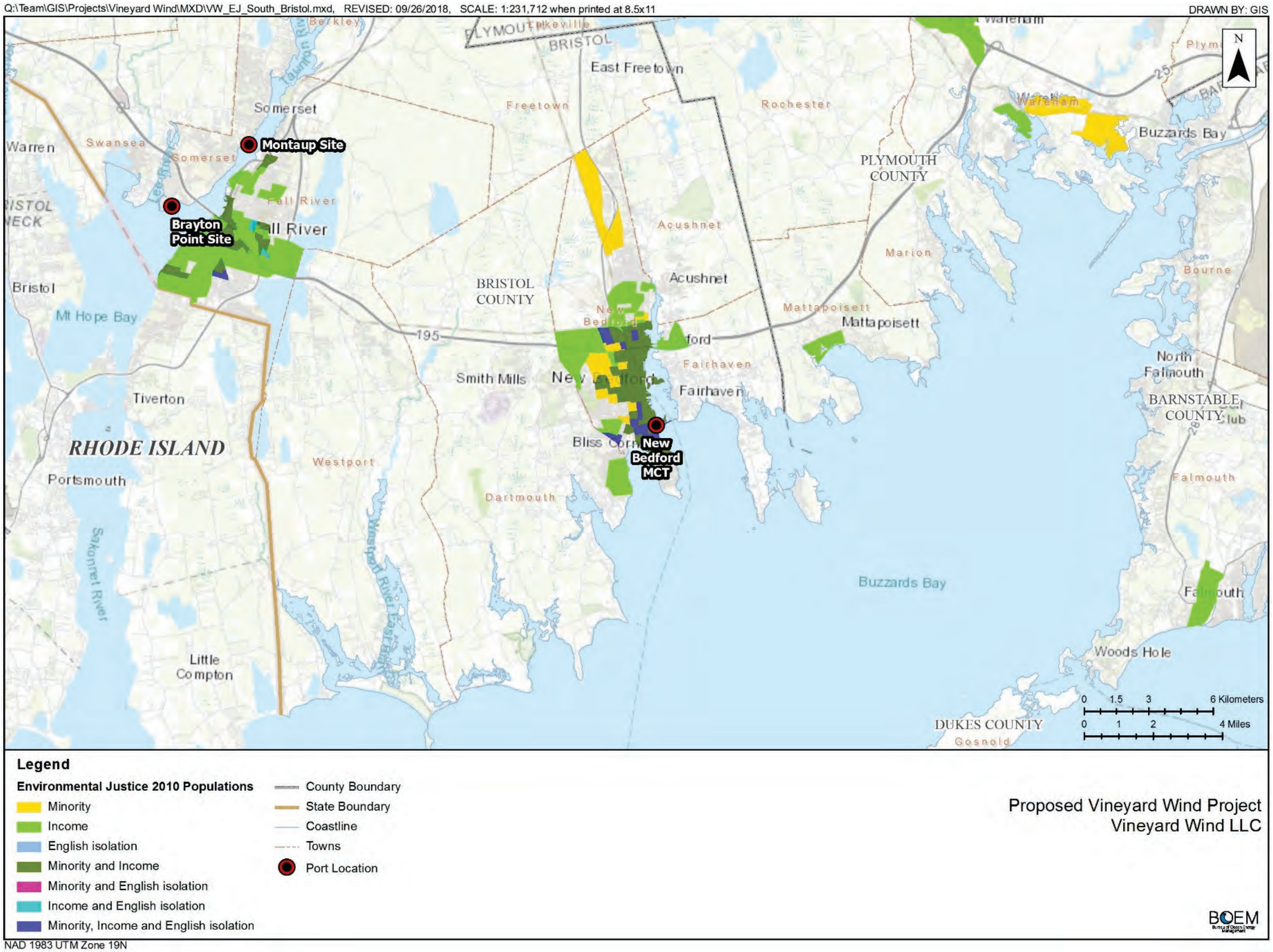

Figure F.3-2: Environmental Justice Populations in Southern Bristol County, Massachusetts (2010)

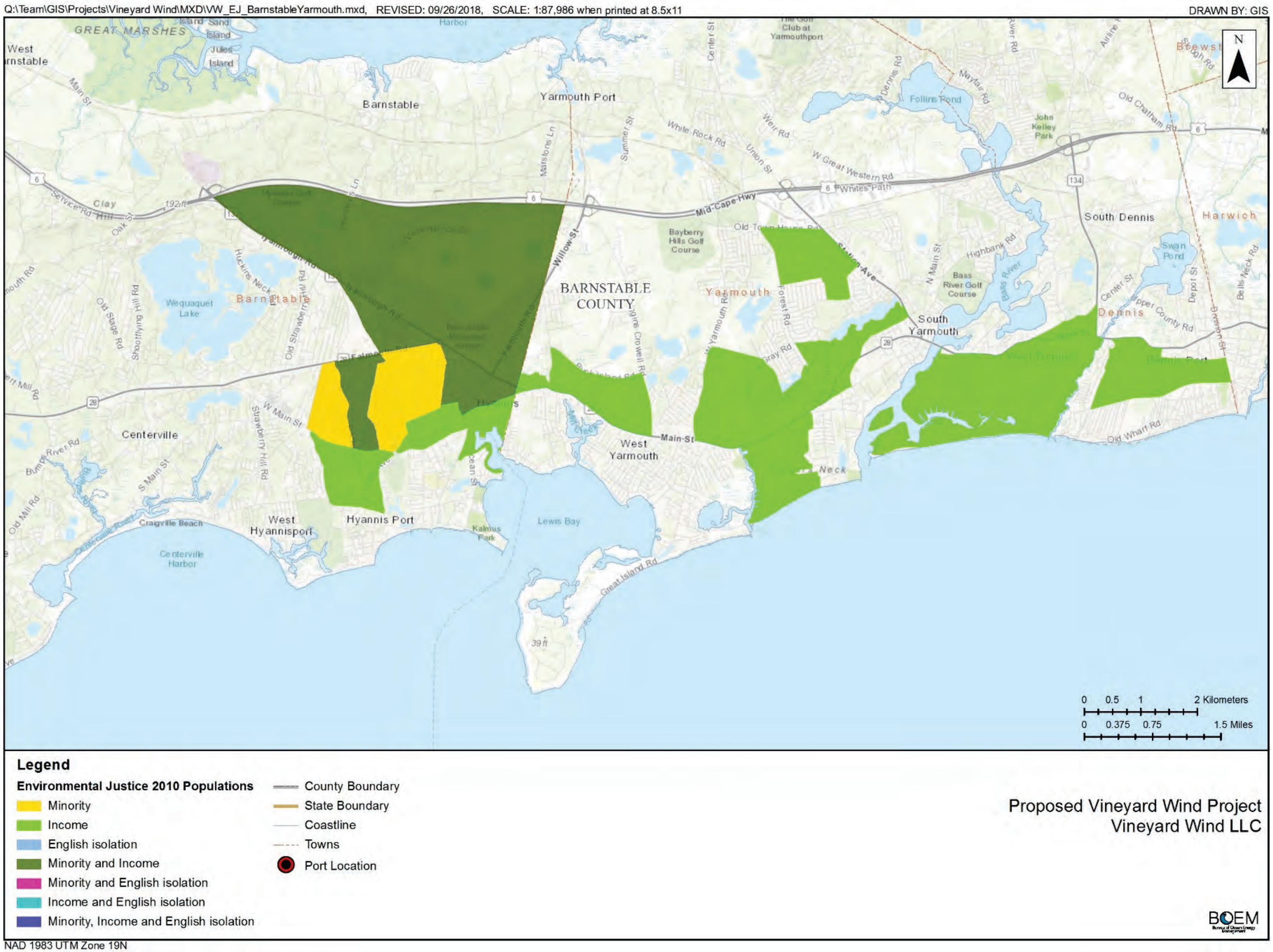

Figure F.3-3: Environmental Justice Populations in Barnstable and Yarmouth, Massachusetts (2010)

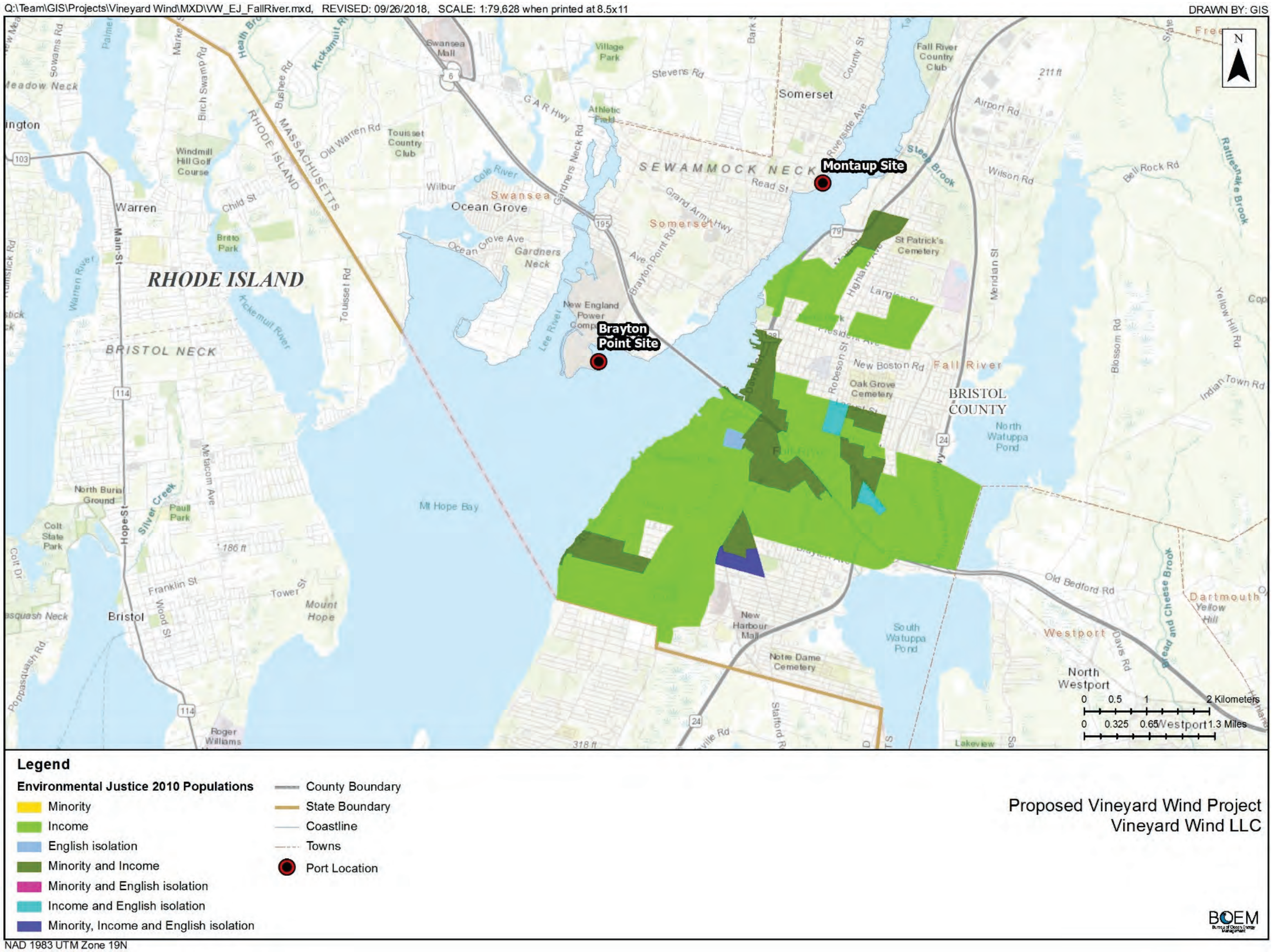

Figure F.3-4: Environmental Justice Populations in Fall River, Massachusetts (2010)

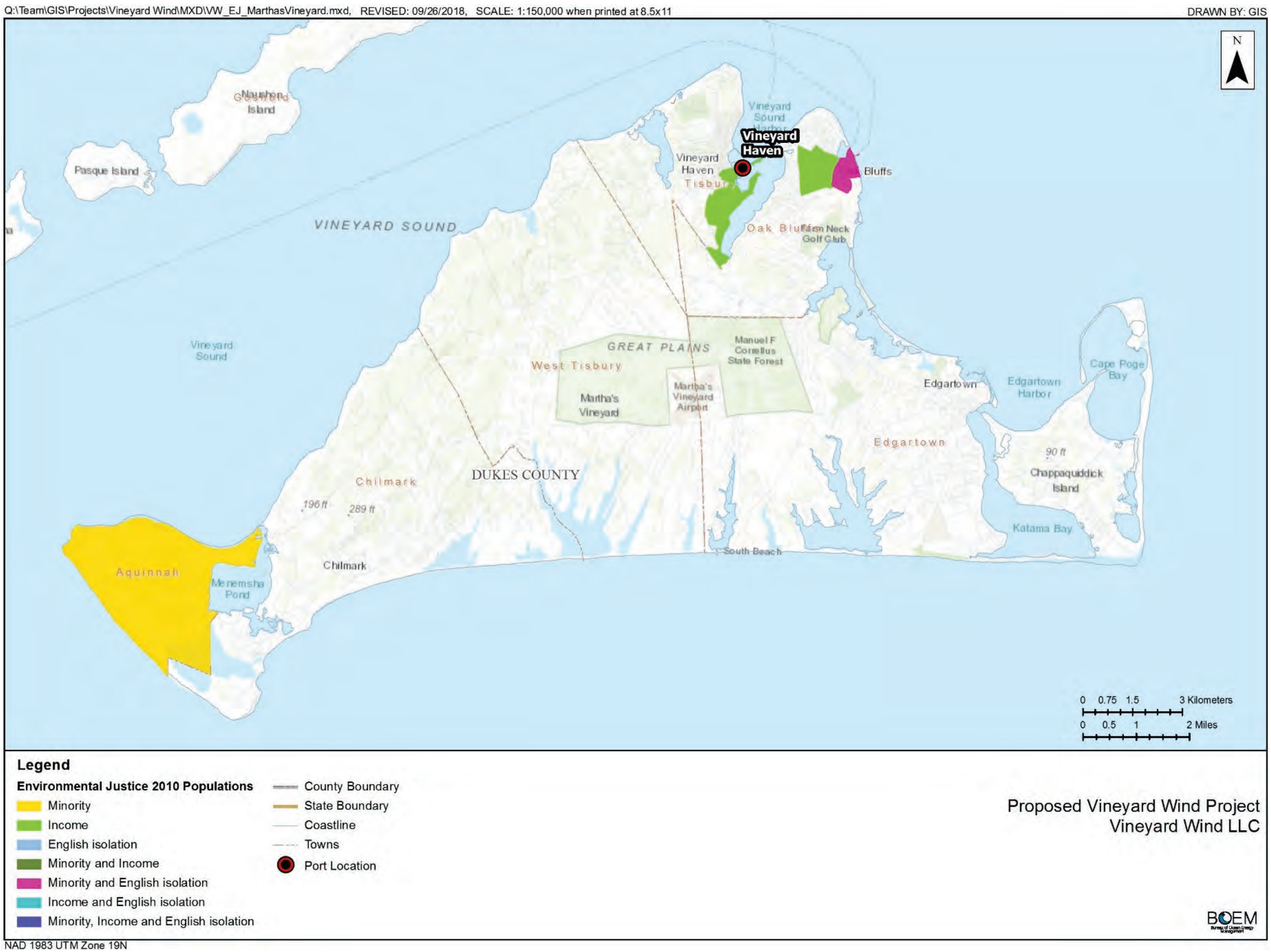

Figure F.3-5: Environmental Justice Populations in Martha's Vineyard, Massachusetts (2010)

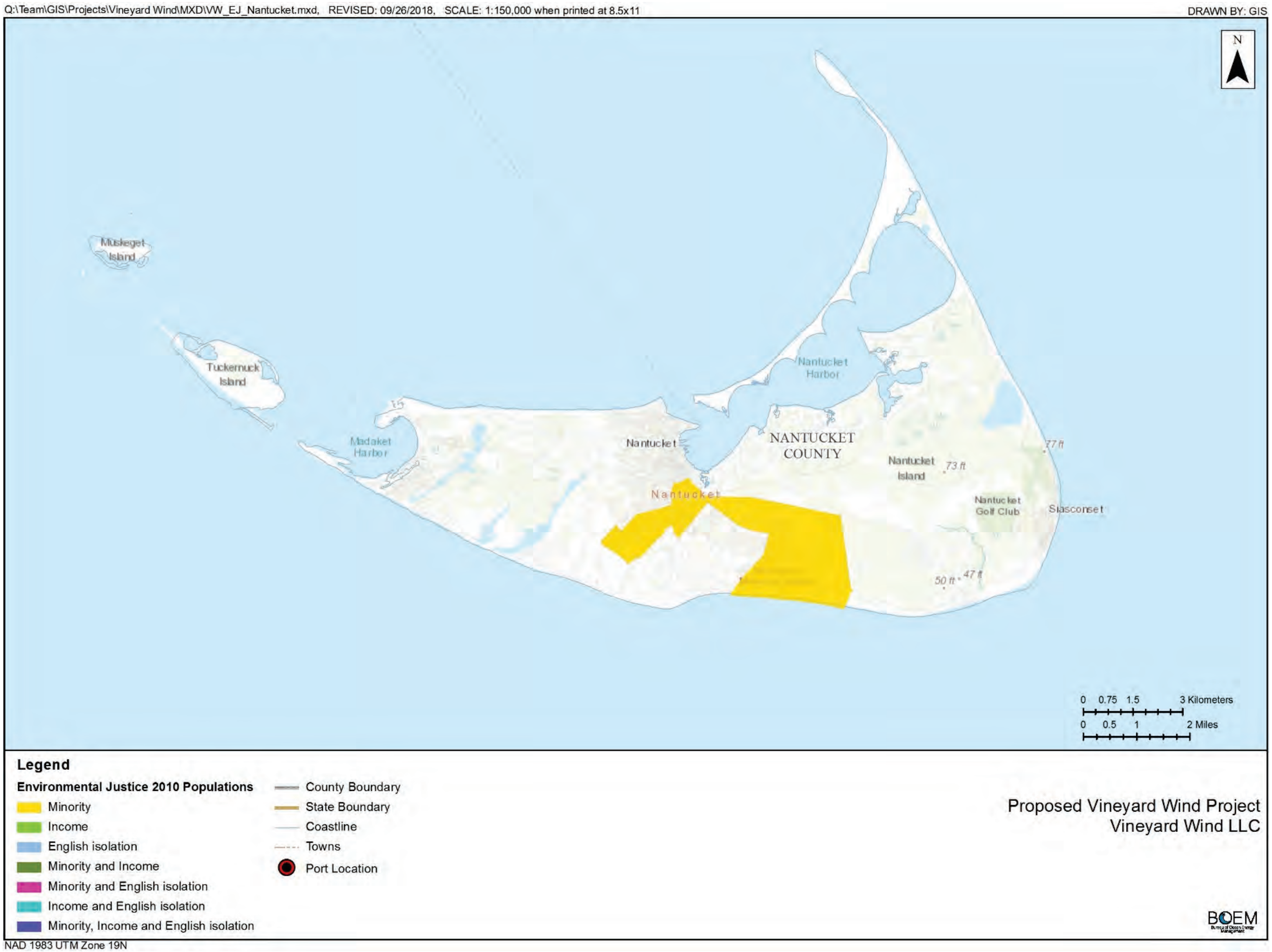

Figure F.3-6: Environmental Justice Populations in Nantucket, Massachusetts (2010)

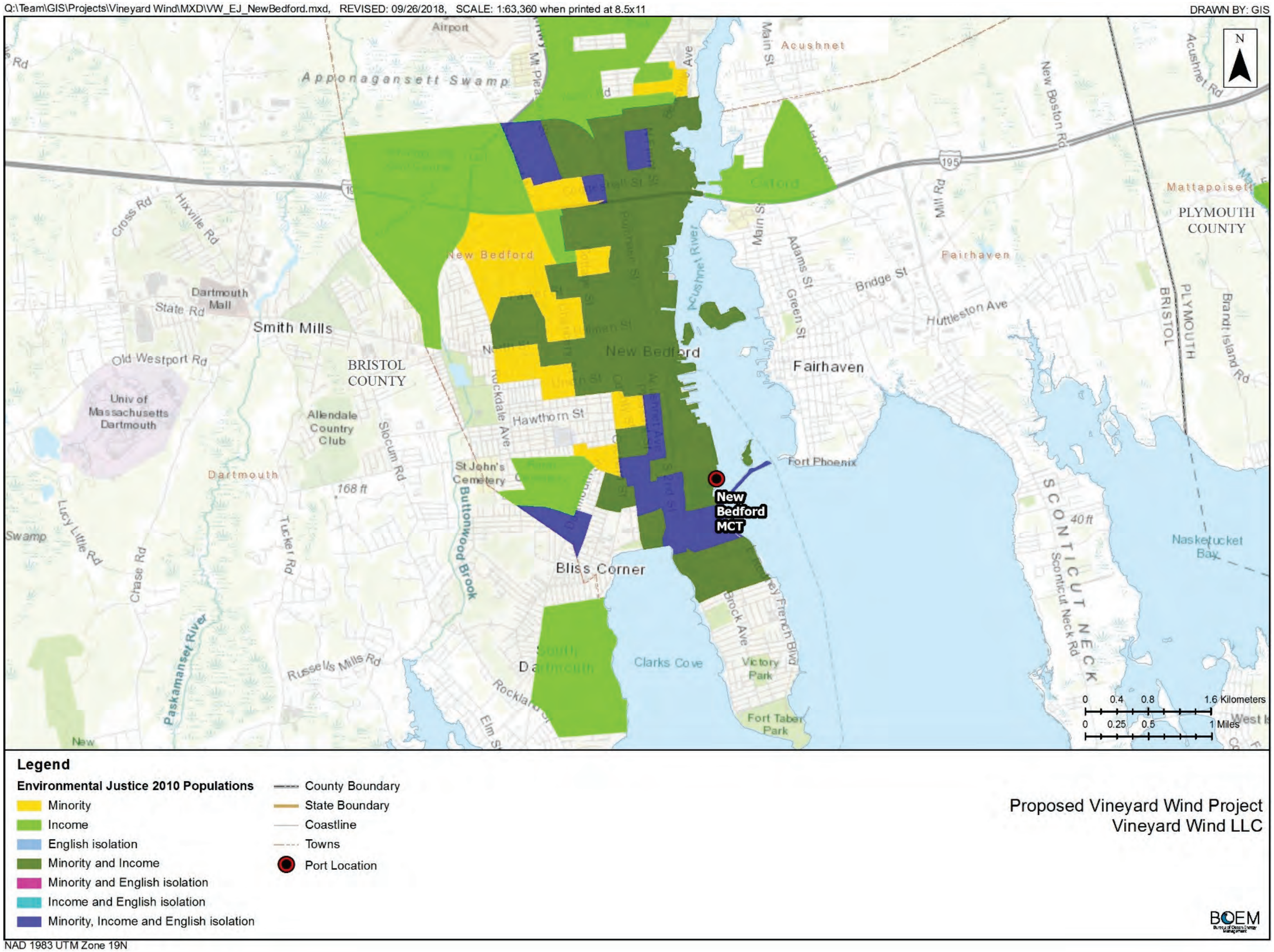

Figure F.3-7: Environmental Justice Populations in New Bedford, Massachusetts (2010)

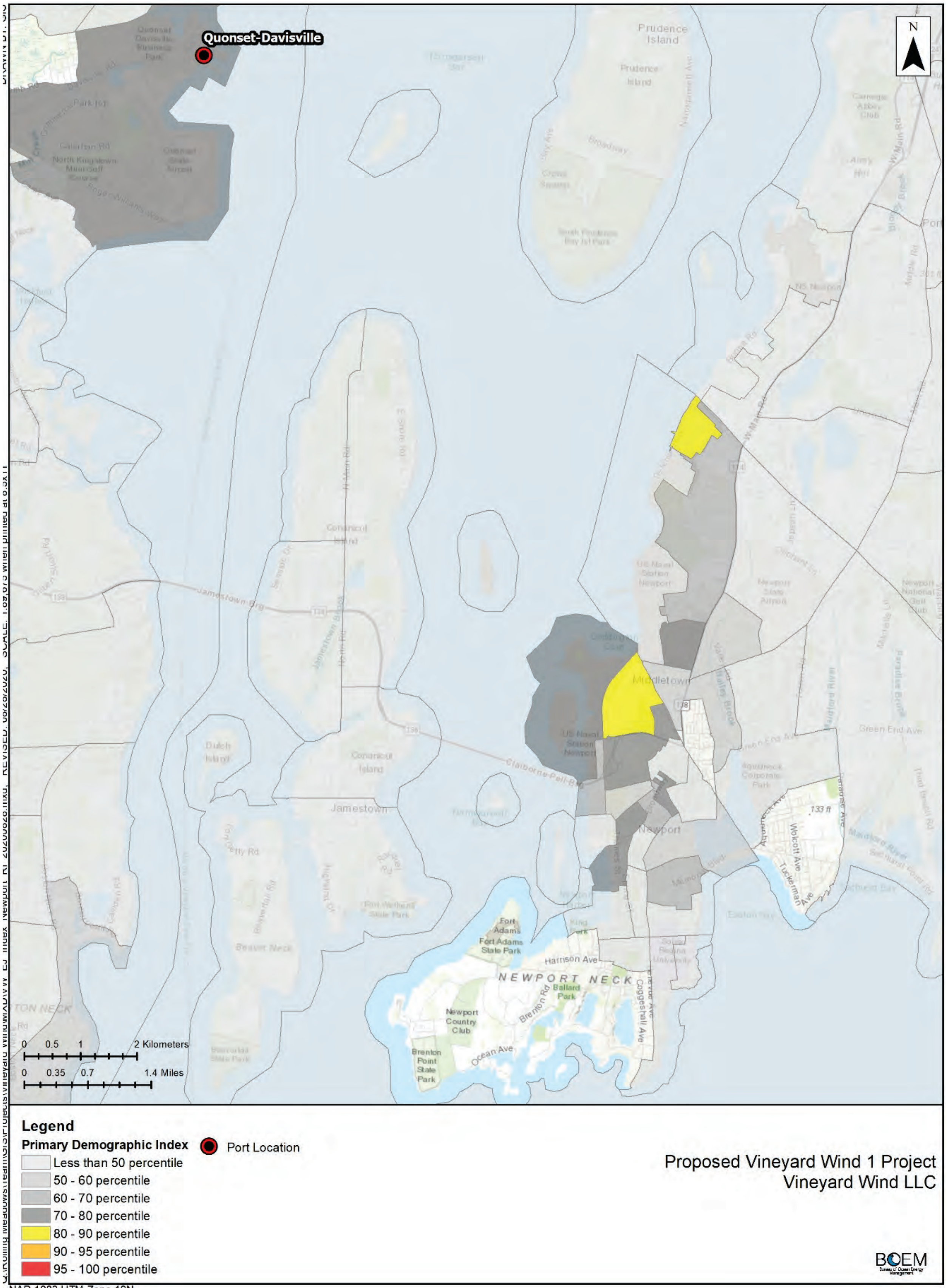

Figure F.3-8: Environmental Justice Populations in Newport, Rhode Island (2019)

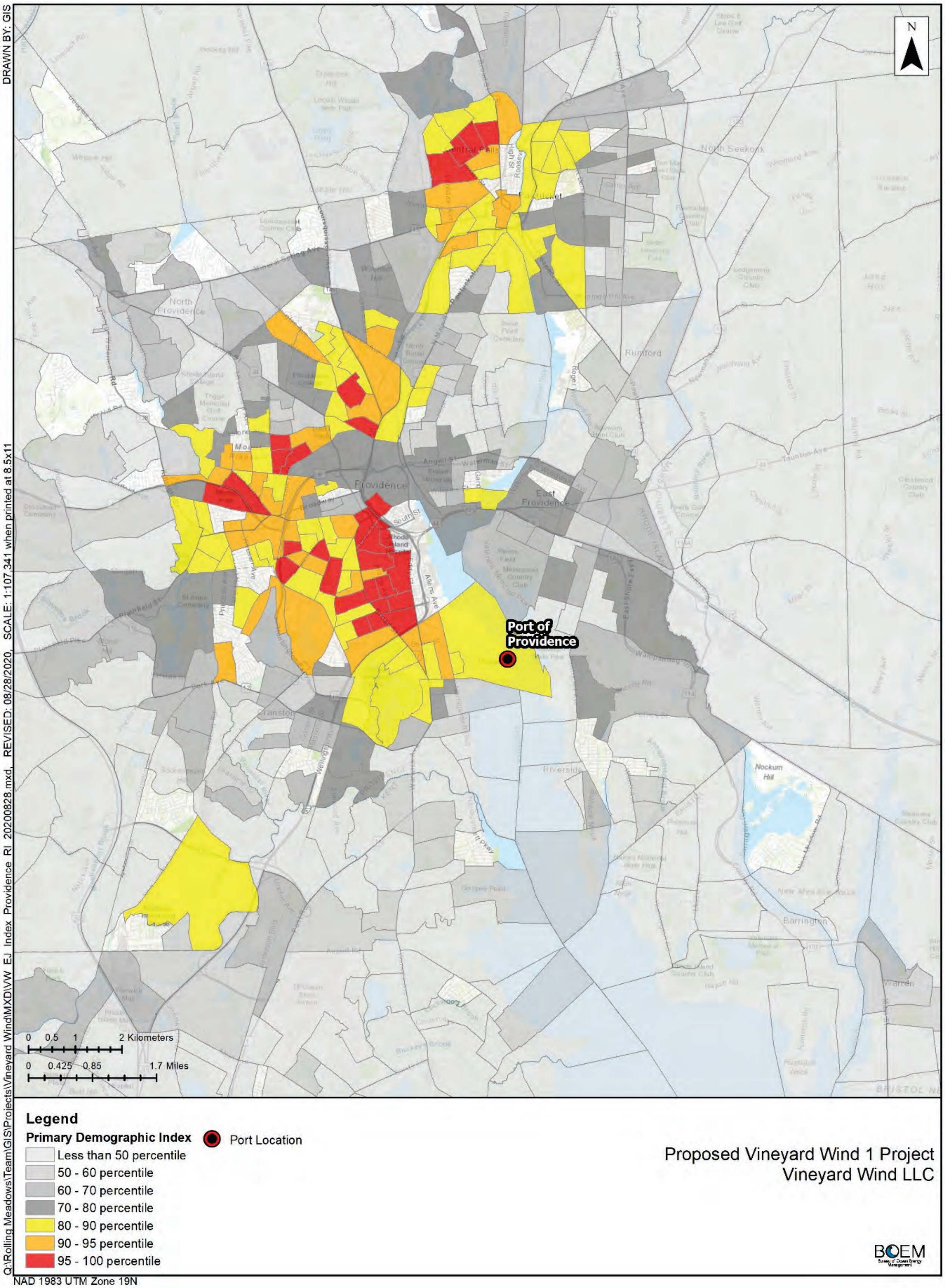

Figure F.3-9: Environmental Justice Populations in Providence, Rhode Island (2019)

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F.5. VINEYARD WIND BIRD MONITORING PLAN

Vineyard Wind 1 Offshore Wind Farm: Framework for Avian and Bat Monitoring
-DRAFT-

Prepared for, and in conjunction with:
Vineyard Wind, LLC

Prepared by:
Biodiversity Research Institute
276 Canco Road, Portland, ME 04103

Table of Contents

1. Introduction

Vineyard Wind, LLC (Vineyard Wind) is proposing an 800 megawatt (MW) wind energy project within Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0501, consisting of offshore Wind Turbine Generators (WTGs) each placed on a foundation support structure, Electrical Service Platforms (ESPs), an onshore substation, offshore and onshore cabling, and onshore operations and maintenance facilities (hereafter the Project). The 800 MW Project, called Vineyard Wind 1 (VW1), will be located in the northern portion of the Lease Area (i.e., Wind Development Area or WDA). An extensive assessment of the potential impact of the project on birds and bats was included in the Construction and Operations Plan (COP),[1] and BOEM's findings in the Supplement to the Draft Environmental Impact State (EIS) were that the Project's direct and indirect impacts to birds and bats would be negligible to minor (BOEM 2020).

1.1. Monitoring

In its COP, Vineyard Wind anticipated the development of a post-construction monitoring program for birds and bats, which would likely include (a) coordinating with BOEM and the U.S. Fish and Wildlife Service (USFWS) to install automated radio telemetry receiving stations (hereafter "Motus" receivers and transmitters) to estimate the exposure of birds listed under the Endangered Species Act (ESA); (b) document any dead or injured birds found on vessels or structures; and (c) install passive acoustic detectors for bats on the ESP. The framework detailed below responds to requirements described in the EIS and reflects the input Vineyard Wind has received from federal and state agencies, as well as non-governmental organizations with specific knowledge on birds and bats. The aim of this document is to provide an avian and bat monitoring framework that meets or exceeds federal requirements and reduces uncertainty around the potential impacts of the Project. Furthermore, as the first commercial scale project to be built, this work intends to advance the understanding of avian interactions with offshore wind farms.

1.2. Avoidance and minimization measures

VW1 has taken significant steps to avoid and minimize potential impacts to birds. VW1 has avoided exposure of coastal birds by siting the project well offshore, approximately 23 km south of Martha's Vineyard, and has avoided exposure of sea ducks (and other marine birds) by locating the Project in BOEM's Massachusetts Wind Energy Area that specifically excluded areas of "high value sea duck habitat" (BOEM 2014). The detailed analysis conducted in the COP indicates that the VW1 is in an area of low bird use relative to surrounding areas and the broader region (COP Vol. III, Section 6.2.1.1).

During construction, VW1 will minimize potential collision impacts by reducing lighting and using cable installation methods that limit suspended sediment and impact areas. During operations, VW1 will significantly minimize lighting that would attract birds by using an Aircraft Detection Lighting System (ADLS) that is expected to limit Federal Aviation Administration (FAA) and BOEM required lighting to less than 4 hours a year; will use down-shielded lighting; will limit lighting to

[1] https://www.boem.gov/renewable-energy/state-activities/vineyard-wind-construction-and-operations-plan-volume-iii

the extent practicable;[2] and, to the extent allowed by health and safety protocols, will use anti-perching devices and design measures to reduce perching opportunities. See Section 4.2 of the COP Volume III for further details on minimization measures.

1.3. Monitoring goals and objectives

The goal of monitoring is to reduce uncertainty about collision and displacement risks to bats, nocturnal migrating songbirds, Roseate Terns, and other marine birds.

Monitoring objectives are to further understanding of:

1. The species composition of bats that may be present in the WDA;
2. The species composition of vocalizing nocturnal songbird migrants that may be present in the WDA;
3. Roseate Tern use of the WDA;
4. The displacement of marine birds from the WTGs and other infrastructure, in an area consisting of the WDA plus a buffer area; and
5. The behavior of marine birds around WTGs that contributes to collision vulnerability.

The monitoring objectives were identified based upon practicability; priorities of regulators and stakeholders; species of conservation concern in the region; and existing information on species exposure and vulnerability. Acoustic surveys, individual tracking, boat-based surveys, and individual observations were selected as methods to address these objectives (Table 1). They were determined to be tractable, effective in the marine environment, and had a track record of use in Europe. While each method is targeted for specific objectives or species groups, to the extent practicable, each monitoring effort will be conducted during the same time periods and at similar locations. This will allow, in some cases, the results from different methods to be complementary to further reduce uncertainty about collision and displacement risk.

Specific bird detection radar systems were not selected due to engineering challenges of installing units on turbines and the challenges in species identifications. Emerging technologies that have not been validated in the field or have not provided reduced uncertainty about risk were not selected. VW1 will consider opportunities for testing new monitoring technologies as they arise.

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[2] From Table 4.2-1 of COP Volume III Section 4:
Construction: "To minimize impacts to birds, the Project will reduce lighting as much as is practicable during construction. During construction, the Project will follow Federal Aviation Administration ("FAA") recommendations to use red-flashing lights. In addition, when practicable, the Project will down-shield lighting and/or use down- lighting to limit bird attraction and disorientation."

Operation and Maintenance: "During O&M, the Project will reduce lighting as much as is practicable by (1) reducing the number of lights, (2) using low intensity lights, (3) avoiding white lights, and (4) as appropriate, using flashing lights rather than steady burning lights, when practicable. In addition, when practicable, the Project will use hooded lighting, colored lighting, or down-lighting to limit bird attraction and disorientation, limit outside light to necessary/required lighting, and close blinds on all windows in boat living quarters. Lighting will also be only used when necessary for work crews.

The results of the monitoring will be used to reduce uncertainty and to inform permitting of future projects. The monitoring framework objectives and methods will be periodically reviewed by VW1 and federal agencies to determine if methods should be adapted to reflect changes in knowledge or advances in technology. The methodologies described below may be updated if, in consultation with BOEM, USFWS, and other stakeholders, existing programs through a regional science entity and/or other research work affects the utility of the data collected. Alterations to the plan may be made to address technology advancements and/or technology challenges.

Table 1: Summary of monitoring methods, utility, and objectives met

Method	Utility	Objectives met
Bat passive acoustics	species composition of bats that may be present in the WDA	1
Bird passive acoustics	species composition of vocalizing nocturnal songbird migrants (and potentially terns) that may be present in the WDA	2, 3
Motus receivers and tags	presence/absence of Roseate Terns (and potentially Common Terns and migratory songbirds) in the WDA	2, 3, 5
Boat surveys	displacement of marine birds, including terns, from the WTGs and other infrastructure, in an area consisting of the WDA plus a buffer area	3, 4, 5
Human observers	behavior of marine birds, including terns, around WTGs that contributes to collision vulnerability	4, 5

1.4. Framework scope

This framework provides an overview of the proposed offshore monitoring approach and methods. Vineyard Wind will develop detailed methods prior to the beginning of operation. Vineyard Wind is also developing a standard operating procedure for operations and maintenance workers to document any dead or injured birds.

2. Acoustic Monitoring of Bats

The presence of bats in the marine environment has been documented in the U.S. (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; BOEM 2013; Hatch et al. 2013; Dowling et al. 2017). Cave-hibernating bats generally exhibit lower activity in the offshore environment than migratory tree bats (Sjollema *et al.* 2014). Acoustic detectors are a standard method used to monitor bats in the offshore environment (Peterson *et al.* 2014), and acoustic detectors installed at the ESP will determine what species of bats are flying through the WDA.

2.1. Methods

Acoustic monitoring will occur post-construction for two years, with an option for a third year. In coordination with BOEM, VW1 will determine the need for a third year, based on efficacy of the monitoring methods, field logistics, and the results of the first two years. Two ultrasonic bat detectors will be installed on the ESP in the early spring or late winter (March) for each year of monitoring, and removed in the late fall or early winter (December) after migration. The detectors will be installed at the ESP, rather than WTGs, due to logistical considerations for maintenance and data retrieval.

The detectors will collect vocalizations of cave-hibernating bats, including the northern long-eared bat, and migratory tree bats. These detectors record bat calls in full spectrum; the resulting information can be used to identify bat species in a given area. Detectors are programmed to record from 30 minutes before sunset to 30 minutes after sunrise. Placement of the microphones will comply with the recommendations in the Indiana Bat Guidelines.[3]

Trained acoustic technicians will conduct analyses of the data. All data recorded will be filtered to remove files that contained only noise or poor-quality recordings. The files that remain will be processed with USFWS approved software (e.g., Kaleidoscope Pro), to determine which files had bat calls present. A maximum-likelihood estimator (MLE) approach will be used to identify bat vocalizations among all recorded sound files. This method is used to determine species presence or probable absence at a particular site on a particular night by means of a classification matrix. Following the automated classification process, experienced acoustic technicians can manually examine a subset of high frequency (HiF) calls.

3. Acoustic Monitoring of Nocturnal Songbirds Migrants

Many North American breeding songbirds migrate to and from the tropics. On their migrations, these species mostly travel at night and at high altitudes and regularly cross large bodies of water, such as the Mediterranean Sea or the Gulf of Mexico (Bruderer & Lietchi 1999, Gauthreaux & Belser 1999). Some species are known to migrate over the U.S. Atlantic Outer Continental Shelf (OCS) as well (Drury & Keith 1962, Adams, Lambert, *et al.* 2015, Adams, Chilson, *et al.* 2015). Birds may briefly fly over the water, while others, like the Blackpoll Warbler (*Setophaga striata*), can migrate over the ocean for many days (Faaborg *et al.* 2010, Deluca *et al.* 2015). Acoustic detectors are commonly used to study songbird migration (Farnsworth 2005) and have been used to study songbird migrants at offshore wind facilities (Hüppop *et al.* 2016). Warblers, sparrows, thrushes, and other species groups make such calls while migrating, but tyrannids, vireos, and mimids generally do not. Acoustics detectors installed at the ESP will determine the species composition of nocturnal songbird migrants flying through the WDA that call during migration (spring and fall).

3.1. Methods

Acoustic monitoring will occur post-construction for two years, with an option for a third year. In coordination with BOEM, VW1 will determine the need for a third year based on efficacy of the monitoring methods, field logistics, and the results of the first two years. Two acoustic detectors recording calls between 20Hz – 12kHz, will be installed on the ESP in the early spring or late winter for each year of monitoring, and removed in the late fall or early winter after migration. The detectors will be installed at the ESP, rather than WTGs, due to logistical considerations for maintenance, data retrieval, and sound interference from turbine blades.

[3] https://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html

To reduce post-processing time, the acoustic data can be sub-sampled to focus on peak migration periods, as well as nights when migration rates are expected to be high, based on factors such as weather conditions and results from NEXRAD radar data (e.g., Welcker 2020). The sub-sampled data will be post-processed through a filter, and then a final species group identification can be conducted by a qualified biologist. Acoustic data may also be analyzed to determine tern presence during spring migration.

4. Motus Tag Study of Roseate Tern Exposure

Roseate Tern use of VW1 and the surrounding area has been assessed with aerial surveys (Veit *et al.* 2016), tracking studies (Loring *et al.* 2019), and boat-based surveys conducted by Vineyard Wind to provide data on terns in the spring (COP Vol. III, Appendix III-O). The existing data indicates low tern use of the area (see COP Vol. III, Section 6.2.1.1). Vineyard Wind will further increase understanding of tern use of the WDA with by installing Motus receivers at individual WTGs and potentially the ESP; supporting the maintenance or upgrade of two onshore receiver stations; and providing Motus tags to Roseate Tern researchers. Motus tags are currently the most effective technology for tracking smaller birds that cannot carry heavy satellite tags.

4.1. Methods

Monitoring would occur post-construction for up to three years. Vineyard Wind would work with the USFWS to ensure the operation of two existing onshore receiver stations critical for providing movement information for Roseate Terns. The onshore receivers will provide locations of tagged birds relative to the WDA; if tagged birds are detected in the WDA, the onshore towers will help to provide positions for the birds before and after they were detected within the WDA. Vineyard Wind would determine the number of offshore Motus receivers to optimize coverage of the WDA through consultation with BOEM and USFWS. Offshore receiver stations would likely be installed in the early spring or late winter for each year of monitoring and removed in the late fall or early winter after migration.

For the years that telemetry monitoring occurs, Vineyard Wind will provide up to 150 Motus tags a year to third-party avian researchers. Tags will be allocated primarily for tracking Roseate Terns, but could also be used for other species or species groups, such as Common Terns (*Sterna hirundo*) and nocturnal songbird migrants. These tags would be deployed in partnership with USFWS, Massachusetts Natural Heritage Program, and other research groups. The specific tag type will be selected based on review of commercially available and feasible technology. Following methods from Loring et al. (2019), breeding Roseate Terns would likely be captured on the colony at Great Gull Island, New York, and at three colony islands in Buzzards Bay, Massachusetts (Bird Island, Ram Island, and Penikese Island); however, final tagging locations would be determined in coordination with the USFWS and other expert parties and the current extent of breeding Roseate Tern colonies.

An analysis will be conducted of detections of tagged Roseate Terns inside and outside of the VW1 WDA. Precise position determination is difficult but could potentially be analyzed in collaboration with the USFWS and other research institutions, depending on the results of ongoing work by USFWS and collaborators to develop methods for position determination.

5. Pre- and Post-Construction Boat Surveys

Existing data provide baseline information on the exposure of birds to the WDA: the MDAT models (Curtice *et al.* 2019) and tracking studies (Loring *et al.* 2019, Spiegel *et al.* 2017) provide a regional context; the Massachusetts Clean Energy Center (Mass CEC) aerial surveys provide densities for the Project at a local context (Veit *et al.* 2016); and boat-based surveys conducted by Vineyard Wind provide data on terns in the spring (COP Vol. III, Appendix III-O). Further boat-based surveys would provide pre-construction data on marine bird distribution in the WDA plus a buffer, which could be directly compared to post-construction surveys. Importantly, these boat-based surveys may provide a relatively high rate of tern species identification and detailed behavioral observations of terns, which will be aided with *in situ* digital photography.

5.1. Methods

Monitoring will be conducted for one year pre-construction and up to three years post-construction within the WDA plus a buffer. Pre- and post-construction surveys will monitor for shifts in distribution occurring from the presence of turbines.

VW1 will conduct monthly boat-based avian surveys in the WDA (each survey will cover ~10% of the WDA) plus up to a 4 km buffer to allow for documentation of displacement of seabirds broadly based on existing data from Europe (Welcker & Nehls 2016), which is greater than the 1.85 km buffer recommended by BOEM for site assessment purposes (BOEM 2020). Four kilometers represents the displacement distance determined in some studies for auks (Welcker & Nehls 2016), which are common in this region in winter. These surveys would be focused on detecting birds and other wildlife and include observations of boats and fishing gear when possible. These boat-based surveys would use current at-sea avian survey methods. The survey protocol includes the use of distance sampling, and data would be recorded with the avian survey data collection application *SeaScribe*, which standardizes data collection and transmittal. The flight height and behavior of each bird encountered will be recorded; and terns and other species will be photographed to support species identification. In addition, at the time of survey weather, environmental variables, and turbine conditions (potentially including wind speed and direction, turbine RPM, and other relevant turbine data if available) will be recorded.

Community Distance Models (Sollmann *et al.* 2016) will be used to calculate detection-corrected estimates of density inside and outside of the WDA, pre- and post-construction, to allow for mapping of distribution as well as determination of any macro-scale avoidance behaviors.

6. Turbine Observations

There have been substantial avian monitoring efforts in Europe at offshore wind facilities, which have established the species groups that are most vulnerable to collision and displacement (Wade *et al.* 2016). These studies, however, have been generally conducted on turbines much smaller and more closely spaced than those being used by VW1 (Mendel *et al.* 2019, Desholm & Kahlert 2005). While there are multiple efforts underway to develop collision monitoring technologies (e.g., thermal camera systems), these systems are either currently under development or cannot sufficiently monitor large turbines (Adams *et al.* 2017). Furthermore, analyzing the data from any type of visual monitoring system can take a substantial amount of time (Adams *et al.* 2017). Given that VW1 will be the first large-scale offshore wind facility, there is a need to rapidly collect data on behaviors that contribute to collision and displacement vulnerability to inform other offshore wind projects. To collect data on bird behavior, VW1 will use field biologists to conduct observations of birds around the turbines using traditional behavioral study methods, such as time-activity budgets.

6.1. Methods

Monitoring would occur for up to three years post-construction within the WDA. Points counts would be conducted in the same years and around the same time as, or in conjunction with, boat-based surveys.

Point count surveys will be designed to document bird movement behavior at micro- and meso-scales around turbines, including data on flight height, position relative to turbines (including estimated closest approach), perching behavior, general movement, behavior (e.g., feeding, milling, resting, etc.), and estimates of flight speed (*if determined logistically feasible*). Observations will be made either from the boat-based survey vessel or from turbine platforms. The observation platform will be determined based on logistics, health and safety considerations, and the best observation perspective that removes potential platform bias. Behavior observation tracking could potentially be employed, such as following a single bird around turbines to document behavior of individuals through time (focal-animal sampling) over the course of the point count period, as well as provide estimates of flight height and distance to turbines through time. In addition, at the time of survey weather, environmental variables, and turbine conditions (potentially including wind speed and direction, turbine RPM, and other relevant turbine data if available) will be recorded.

Point count and focal-animal sampling data will be analyzed to determine the extent of interaction of different bird species with the turbines (or not). Metrics, such as mean closest approach and range, flight height data relative to behavior, time spent in different behaviors while around turbines, time perching on turbines, and other behaviors may provide semi-quantitative information on micro- and meso-scale behaviors around VW1.

7. Reporting

Reports will be provided to BOEM that outline the observation effort for each full year of monitoring. Once all data have been processed, QA/QC'd, and analyzed, a final report will be submitted to BOEM for comment, and ultimately provided to stakeholders.

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F.6. ESSENTIAL FISH HABITAT CONSULTATION CORRESPONDENCE

United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT
WASHINGTON, DC 20240-0001

Mr. Lou Chiarella
National Marine Fisheries Service
Habitat Conservation Division
55 Great Republic Drive
Gloucester, Massachusetts 01930-2276

Dear Mr. Chiarella:

This letter is in response to the Essential Fish Habitat (EFH) conservation recommendations provided via letter dated June 27, 2019, and in a follow-up letter dated July 27, 2020, regarding the Vineyard Wind 1 Project. The Bureau of Ocean Energy Management (BOEM) is the lead Federal agency for the EFH consultation for the Vineyard Wind Project, in coordination with the U.S. Army Corps of Engineers (USACE), who will be permitting activities associated with the construction of the project. Your June 2019 letter also provided recommendations under the Fish and Wildlife Coordination Act (FWCA).

Pursuant to Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), BOEM is required to provide a detailed response to each EFH conservation recommendation within 30 days of receipt. Due to the novel nature of this project and timing of approval decisions, the National Marine Fisheries Service (NMFS) clarified via email on July 26, 2019, that the response from BOEM must be received at least 10 days before the Record of Decision is issued. In the follow-up letter dated July 27, 2020, you recommended that we provide you with information on how we intend to address conservation recommendation #1 as well as a response to your other June 2019 conservation recommendations as soon as possible.

Below are our responses to the recommendations provided in your June 2019 letter and further clarified in your July 2020 letter. BOEM and NMFS staff have discussed these conservation recommendations on several occasions over the past year and a half, most recently on October 28, 2020, when BOEM and NMFS discussed BOEM's draft response to these recommendations. BOEM believes the conservative approach to evaluating potential impacts to EFH taken in the EFH assessment, in particular the potential impacts to complex and hard bottom habitats, do not underestimate adverse effects to EFH. Where applicable, BOEM has referenced mitigation measures to be adopted pursuant to the Endangered Species Act (ESA), as these measures may confer benefits to EFH.

1. NMFS's first conservation recommendation was for BOEM to "require the applicant to re-evaluate the benthic habitat data. Data collected through multibeam and/or side scan along the cable route should be re-analyzed and interpreted at a finer scale to adequately resolve and delineate coarse unconsolidated sediments, including pebble, cobble, and boulder habitats in the Offshore Export Cable Corridor (OECC) using Coastal and Marine Ecological Classification

Standard (CMECS) habitat classification. The presence of cobble and boulder should be specified for all substrate subgroup classifications. Presence/absence of epifauna should also be delineated within the pebble, cobble, and boulder habitats. Grab samples, sediment samples and video transect data should be used to verify the re-interpreted habitat data. This would not require additional collection of data and is critical to understand impacts to habitat. The information should be provided to resource agencies for review. Additional conservation recommendations may be necessary upon review of the re-interpreted habitat maps."

While BOEM believes that the applicant has used appropriate techniques to analyze and delineate benthic habitat in the OECC, as discussed below, Vineyard Wind has recently completed additional data in Muskeget Channel to inform cable installation (details below). These data will further characterize habitat that may be affected by the proposed action and will be made available to NMFS.

Specifically, Vineyard Wind will update the CMECS delineations shown in Figure 1 below based upon the additional survey data. The data collection included 75 benthic grabs over the entire length of the OECC (with approximately 42 in the eastern Muskeget section) and 60 underwater video transects over the entire length of the OECC (with approximately 28 transects in the eastern Muskeget section). These additional video and grab data will assist with the CMECS classification, such as in locations where boundaries between different CMECS categories are gradual or where there is less benthic ground truthing available. In addition to refining the preliminary CMECS classification, the additional data (particularly the grain size data being collected as part of the grab sample analysis) will also be used to provide an additional mapset that utilizes the CMECS Modifiers in your Recommendations for Mapping Fish Habitat (May 2020). The updated CMECS maps and the additional mapset using the CMECS Modifiers is anticipated to be received from Vineyard Wind in or around June 2021.

The refined CMECS mapsets would be shared with Vineyard Wind's cable installation contractor. Vineyard Wind anticipates that offshore cable installation would occur in 2022, if the project is approved. The route engineering for the cable installation has already occurred. This process included an assessment of several factors such as habitat type, coarse materials, boulders, magnetic anomalies, surficial geology, shallow subsurface geology, unexploded ordnance, slopes, currents, cable bending radius and other construction logistics were considered to develop the preliminary route. Further refinements to the route will be considered once the updated mapping is available; however, in many cases complex habitat is present across the full corridor width and cannot be entirely avoided. Further, any micrositing is expected to be constrained by the multiple design considerations that must be accounted for to engineer a feasible cable installation route.

Additionally, per the Nantucket Order of Conditions, special condition #20, prior to cable installation in Town of Nantucket waters, Vineyard Wind will provide updated bottom profiling data detailing the bottom composition, sediment profiles, species composition, and topography of the area to be disturbed during cable installation, and will at a minimum conduct high resolution video monitoring.

BOEM will share the results of this additional field work with NMFS for review and comment as soon as the information becomes available. However, the sharing of these additional data would not automatically constitute a continuation of this EFH consultation. If the results of this additional information indicate that impacts to EFH are greater than that assessed in BOEM's

EFH assessment, then BOEM will re-initiate the EFH consultation pursuant to 50 CFR 600.920(l). Specifically, the EFH consultation will be reinitiated if BOEM substantially revises the proposed action in a manner that may adversely affect EFH or if new information becomes available that affects the basis for the conservation recommendations in your June 2019 letter.

BOEM believes the information provided in the current EFH assessment and supporting documents is the best available information for analyzing the effects of the proposed action on EFH and developing EFH conservation recommendations. The assessment and supporting documents provide the results of an on-site inspection to evaluate the habitat and the site-specific effects of the project. The EFH assessment took a conservative approach to assessing the impacts to EFH. It presented the total number of acres disturbed for the entire OECC, the total number of acres of different habitat types within the entire OECC, and the total number of acres within 100 meters of the cable route, but did not get so specific as to state the specific number of acres of each habitat type that would be impacted by the jet plow trench. It also stated that "all of the hard-bottom habitat within the proposed Project OECC would be considered a habitat of particular concern (HAPC) for juvenile Atlantic cod juvenile cod."

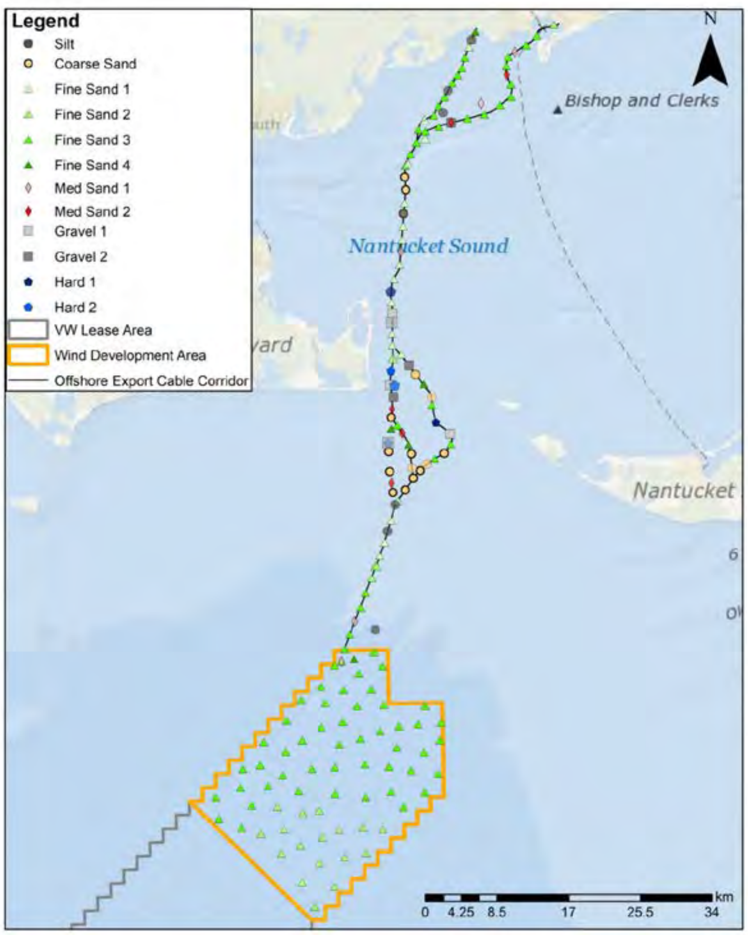

Figure 1. Analysis of all benthic grab samples based on CMECS physical classifications.

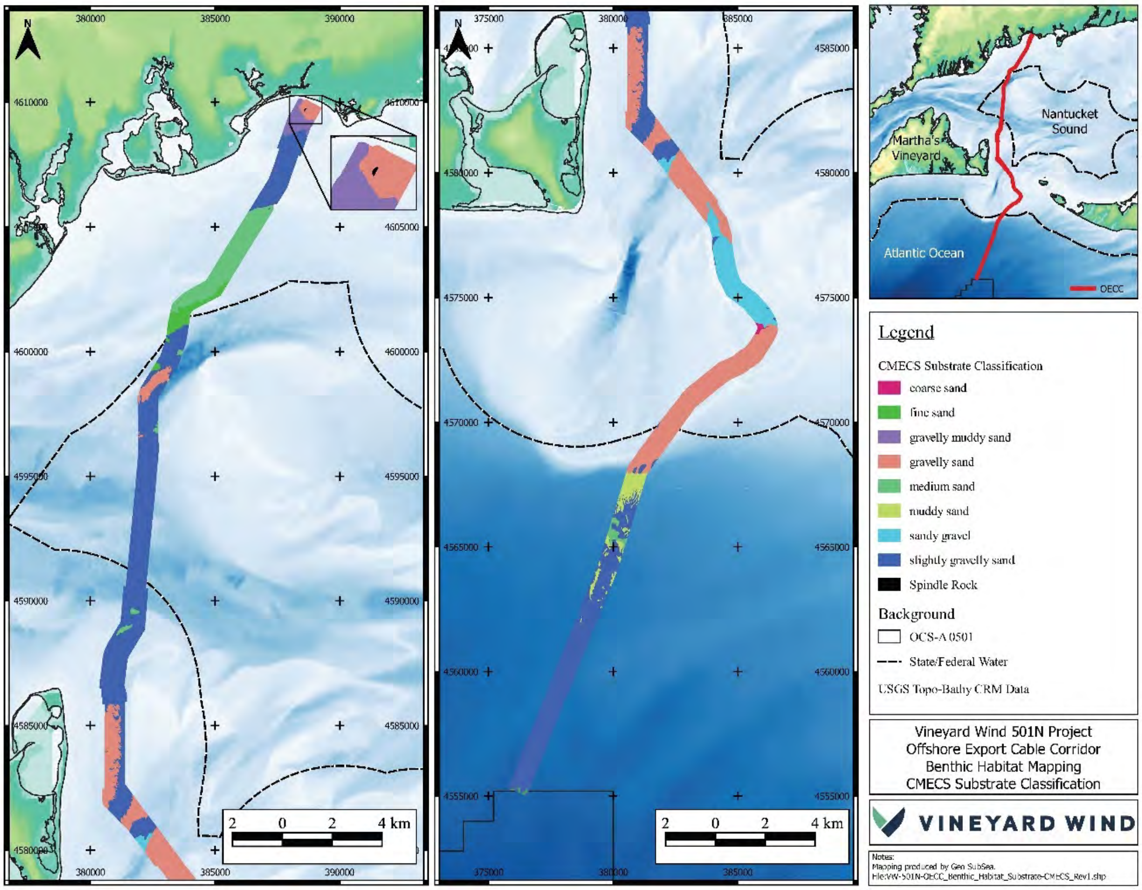

Figure 2. A CMECS-delineated map of the Vineyard Wind project area based on benthic sampling and geophysical data.

According to our statutory obligation under 50 CFR Part 600.920(d) the Federal agency and NMFS must use the best scientific information available regarding the effects of the action on EFH and the measures that can be taken to avoid, minimize, or offset such effects. Vineyard Wind has provided BOEM and NMFS with multibeam and sidescan imagery of benthic habitat from areas that might be impacted in Volume II Appendix I of the Construction and Operations Plan (COP) for both the export cable route and the wind development area (WDA). Vineyard Wind classified all the grab samples taken in 2016, 2017, and 2018 into 12 categories based on CMECS physical classifications (Figure 1; also see COP Volume II Appendix H [available here: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/MA/Vineyard-Wind/Vineyard-Wind-COP-VolumeII-Combined.pdf]). In September 2020, Vineyard Wind provided a map to BOEM interpreting these grabs and geophysical data into a CMECS-delineated map (see Figure 2) in response to these conservation recommendations.

Volume II Appendix H also includes the macroinvertebrate and macrofaunal composition of each of the grab sample locations indicated above along with benthic classification (physical and biological) of video transects conducted along the export cable route based on classifications found in Auster 1998. Additionally, Vineyard Wind delineated special, sensitive, and unique benthic habitat along the export cable corridor based upon geophysical data, videography, and grab sample data (see: Section 5.2 of Volume II of the COP). This included classifications of course deposits, complex seafloor, eelgrass beds, and biogenic surface/organics along the export cable route (see Figure 9a – 9e of EFH Assessment).

As NMFS is aware, the delineation of habitat involves the interpretation of acoustic imagery data with photo imagery and/or grab sample data along with expert opinion. The delineation of the area of potential effect into CMECS categories as requested would still leave a lot of the interpretation up to biologists and geophysicists absent 100% photographic imagery of the seafloor. It remains unclear what level of ground-truthing NMFS would consider sufficient to accept interpretations of geophysical data across large areas of a highly variable seafloor. This is evidenced when there has not been agreement on the interpretation of geophysical data when it isn't classified to match a nearby videographic image or grab sample. Because of the different scales at which the classification occurs (tens of meters versus hundreds of meters) it is very likely that both the geophysical interpretation and the sample classification are both correct. BOEM believes the information provided is meant to be as true to the sampling resolution as practicable. Nonetheless, BOEM understands if NMFS wants to make a more conservative estimate regarding the potential impacts to juvenile cod HAPC. In the recent supplement to the draft environmental impact statement, BOEM included an analysis of the total number of acres by habitat type in the benthic habitat analysis area (see Supplemental Environmental Impact Statement Section 3.3). The benthic habitat analysis area for Vineyard Wind is 941,526 acres based on a 10-mile radius around the OECC and the WDA. Within that area, the Nature Conservancy (2014) modelled 170,894 acres as being gravel/boulder habitat. The Vineyard Wind COP estimates the total amount of hard bottom/course sediment within just the OECC as 695.2 acres (see Table 5 in EFH Assessment). If all of Vineyard Wind's bottom disturbing activity in the OECC (186 acres from Table 6.5-3 in Volume III of the COP) were to occur in gravel/boulder habitat, the maximum bottom disturbance from cable emplacement in the analysis area for benthic resources would be 0.12% of the gravel/boulder habitat in the analysis area. In actuality, the percentage of gravel/boulder habitat affected would be less than 0.12% since the entire OECC does not occur in hard bottom/course deposit habitat. Vineyard Wind's habitat classification only estimates a maximum of 5.56 acres of hard bottom/course sediment to be disturbed. Thus, even a very conservative approach to estimating potential impacts to juvenile cod HAPC shows that the area impacted by Vineyard Wind is a small fraction of that which is available. It should also be reiterated that most of these bottom disturbing impacts are anticipated to be temporary (see section 5.1.2.1 of EFH Assessment). Only impacts from scour protection and cable protection measures are anticipated to be permanent (see Section 5.2.1.1 of EFH Assessment).

BOEM staff will continue to work with NMFS staff and the regulated community regarding data collection and habitat classification needs for the purposes of consultation under the MSA for future projects. The results of this effort included the "Recommendations for Habitat Mapping" transmitted to BOEM on January 31, 2020, and revised in May 2020. BOEM has been sharing these recommendations with lessees for informational purposes and their consideration in surveys and site characterizations supporting COPs. Communicating these information requests at the beginning of a project rather than after data collection has already occurred and will hopefully result in end products that better match with what NMFS is requesting. Furthermore, BOEM, along with the Massachusetts Clean Energy Center, and the Rhode Island Department of Environmental Conservation, are funding several fisheries-related studies, including "Standard Approaches for Acoustic and Imagery Data," with INSPIRE Environmental and the Northeast Data Portal. INSPIRE Environmental will develop standard approaches to synthesizing, visualizing and disseminating high resolution acoustic and imagery data for mapping of seabed habitat in the wind energy areas. This will advance baseline characterization of the seabed environment and make high-resolution mapped data available to stakeholders in a web-based, vetted and neutral forum. We believe this tool and discussions between BOEM, NMFS, and the regulated community on this topic will result in more consistent EFH Assessments for future COPs.

2. The second conservation recommendation is for BOEM to "require the applicant to avoid and minimize impacts to hard bottom and structurally complex habitats during cable installation within the cable corridor. Applicant should use the re-interpreted habitat maps identified in Conservation Recommendation No. 1 to micro-site activities to avoid and minimize impacts to hard bottom and structurally complex habitats."

BOEM believes that the applicant has provided sufficient measures to avoid and minimize impacts to hard bottom and structurally complex habitat to the greatest extent practicable using the data presented in its COP and presented in BOEM's EFH Assessment. Vineyard Wind has further stated that it will avoid hardbottom and sand waves (one definition of complex seafloor used) to the greatest extent practicable during the actual cable installation. This avoidance is sought not only as a benefit to complex habitat but for engineering purposes to ensure that the cable is buried to the target depth. Specifically, Vineyard Wind has stated that the route design engineer will apply the following criteria to develop a preliminary cable alignment for each of the two cables:

1. Quantification of the length where hard bottom crossing is unavoidable, with the lowest amount of hard bottom crossed being preferable;
2. Quantification of boulders along the route, where avoiding or minimizing the number of boulders along the route is preferable;
3. Quantification of the length and volume of dredging required along each route, with the least amount of dredging being preferable (Note: as described above, while dredging remains in the Project Envelope as a potential technique, the anticipated use of the vertical injector tool is expected to avoid the need for dredging);
4. Assessment of slopes along the route (for subsea plow operations, slopes of less than 10 degrees are required for cable installation tool accessibility);
5. Assessment of water depths along the route, where water depths greater than approximately 6 meters (20 ft) are preferable to facilitate unrestricted cable installation vessel movement;
6. Assessment of sediment types along the route, where sand or soft clays are preferable;
7. Assessment of any magnetic anomalies along the route, where maintaining a reasonable separation to any magnetic anomaly is preferable; and
8. Assessment of sediment movement and seabed morphology changes, where excessive deposition or erosion is to be avoided to avoid potential damage to the cable.

Thus, the Vineyard Wind engineers intend to design a route that avoids hard bottom to the greatest extent possible while also maintaining a feasible route, i.e., a route that maintains workable slopes and avoids high concentrations of boulders or very stiff soils where cable burial would be challenging. In general, isolated areas of hard bottom will be avoided, such as at Spindle Rock. In other limited areas, such as in Muskeget Channel, hard bottom extends across the entire corridor and may not be entirely avoided, but the micro-siting described above will still be applied in these areas to minimize disturbance to hard bottom.

Based on the above, it is not clear if the analysis in conservation recommendation #1 would result in any significant changes to the cable path or impacts to EFH within the OECC due to these existing constraints of cable installation.

Further, following the completion of cable installation and the placement of any cable protection (if necessary), the entire export cable route and inter-array cable placements will be surveyed to determine the cable locations. High resolution geophysical (HRG) techniques, like a multi-beam bathymetry system, are expected to be used during survey operations to describe water depths, seabed features, and identify the final cable positions. The entire export cable and inter-array placements will again be surveyed after the first year of operation, and again after the second year of operation. The entire export cable route will be monitored continuously with the as-built Distributed Temperature Sensing (DTS) System. The results of the Post-Lay, Year 1, and Year 2, multi-beam export cable surveys must be provided for BOEM's review within 45 calendar days of survey completion and include any remedial actions taken or scheduled to occur. The entire cable route and inter-array cable placements will continue to be surveyed using multibeam bathymetry every third year after the 2-Year survey. Cable survey and DTS data and analysis must be provided in Annual Compliance Reports. If DTS data indicate burial conditions have deteriorated or changed significantly and remedial actions are warranted, DTS data, seabed stability analysis, and remedial actions taken or scheduled must be provided to BOEM within 45 days of the observations. If conditions warrant an adjustment to the frequency of bathymetric survey monitoring after the Year 2 survey, information, analysis, and a revised monitoring plan may be provided to BOEM for concurrence. Within Town of Nantucket waters a post-construction monitoring of the cable route would be conducted within 60 days of cable installation, detailing impacts.

3. The third conservation recommendation requests that BOEM "require the applicant to develop a mitigation plan for all remaining unavoidable adverse impacts to juvenile cod HAPC and other sensitive hard bottom habitats, based on the re-interpreted habitat maps. Applicant should consult with the resource agencies in the development of this plan and give the resource agencies 30 days to review and comment upon the plan. Applicant should ultimately file the plan with BOEM for approval. Applicant's filing should include all resource agency comments and applicant's response to those comments."

The EFH Assessment indicates the primary unavoidable permanent habitat impacts are from the placement of cable protection measures, scour protection measures, and the foundations themselves. Of these three, only cable protection measures will be located in juvenile cod HAPC.

The measure described in conservation recommendation #5 below is meant to mitigate potential adverse impacts from cable protection measures in juvenile cod HAPC. BOEM believes that an appropriate responsive measure for this conservation recommendation is to require Vineyard Wind to submit a plan (separate or part of the benthic habitat monitoring plan) to monitor the effectiveness of natural and engineered stone as a mitigation measure to minimize impacts to juvenile cod HAPC. This plan would be submitted to BOEM and NMFS for review and comment. Vineyard Wind must address any agency comments before finalizing and implementing this plan.

4. Conservation recommendation #4 asks BOEM to prohibit the applicant from dumping dredge material within and immediately adjacent to hard bottom habitats or within juvenile cod HAPC. Hard bottom habitat and HAPC shall be delineated based upon the re-interpreted habitat maps identified in Conservation Recommendation No. 1 (above).

Vineyard Wind has indicated that it does not believe the dredging of sand waves will be necessary based on their preferred installation technique of a vertical injector tool. However, if the dredging of sand waves is necessary to achieve target burial depth, the dredged material would be deposited within approximately 250 meters east or west of the dredged area. This discharge would occur within the surveyed installation corridor where seafloor characteristics are comparable (i.e., within an area characterized by sand waves).

Additionally, if dredging is necessary, Vineyard Wind will clearly identify a limited number of dredge disposal sites within known sand wave areas and to the maximum extent practicable, ensure that these sites do not contain resources that would be damaged by sediment deposition. To do this Vineyard Wind should utilize the additional habitat data collected under conservation recommendation #1. In addition, Vineyard Wind shall report the locations of dredge disposal sites to BOEM, Massachusetts Department of Environmental Protection (MassDEP), and Massachusetts Coastal Zone Management Office (CZM) within 30 days of disposal of materials. These locations must be reported in latitude and longitude degrees to the nearest 10 thousandth of a decimal degree (roughly the nearest meter), or as precise as practicable.

The current juvenile cod HAPC description is very broad and is inclusive of “areas adjacent to mixed sand and gravel.” With that definition, avoidance cannot be guaranteed since the OECC is characterized by extremely fragmented and patchy occurrences of mixed sand and gravel habitats. Thus, while mixed sand and gravel habitats will be avoided, sand wave areas adjacent to these habitat types may be impacted through the deposition of similar substrate. If dredging occurs it would only be done to insure the burial of the cable in sand wave areas.

5. Conservation recommendation #5 requests that BOEM require scour protection along the cable route to use natural rounded cobble and boulders (2.5-10 inches in diameter for cobble or > 10-inch diameter for boulder). Engineered stone or concrete mattresses should not be permitted to be used as scour protection within hard bottom and structurally complex habitats.

It is unlikely that it is technically and financially feasible for the lessee to obtain rounded cobble and boulders that would meet the engineering requirements for cable protection. BOEM’s EFH assessment does raise concerns about the ability of benthic epifauna to colonize concrete mattresses, thereby reducing the potential utilization of that material as habitat. Therefore, BOEM will require that the final cable protection measures consist of natural or engineered stone that does not inhibit epibenthic growth and provides three-dimensional complexity, both in height and in interstitial spaces. Vineyard Wind would also be required to consider nature-inclusive designs for optimized cable protection (Hermans et al. 2020 accessed at: https://edepot.wur.nl/518699). Vineyard Wind will submit to NMFS and BOEM for review and comment the technical specifications of the preferred cable protection measures prior to the selection and implementation of hard bottom cable protection measures in the OECC.

6. Conservation recommendation #6 requests BOEM to “require the applicant to develop an anchoring plan to ensure anchoring is avoided and minimized in sensitive habitats, including hard bottom, structurally complex habitats during construction and maintenance operations. The

re-interpreted maps and maps delineating eelgrass habitat adjacent to the cable corridor should be provided to all cable construction and support vessels to ensure no anchoring of vessels be done within or immediately adjacent to eelgrass habitat. The anchoring plan should be provided to the resource agencies for review and comment."

BOEM will require an anchoring plan for all areas where anchoring is being utilized in order to avoid construction impacts to sensitive habitats, including hard bottom and structurally complex habitats to the maximum extent practicable. Vineyard Wind will consider any new data on benthic habitats (CR #1) to avoid/minimize impacts to benthic habitat to the maximum extent practicable. The anchoring plan should include the planned location of anchoring activities, sensitive habitats and locations, seabed features, potential hazards, and any related facility installation activities such as cables, wind turbine generators (WTG), and electric service platforms (ESP), as appropriate. All vessels deploying anchors will use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor. The anchoring plan must be provided for BOEM and the National Oceanic and Atmospheric Administration (NOAA) review and comment before construction begins.

7. Conservation recommendation #7 states that BOEM should require the applicant to use noise mitigating measures during construction, such as soft start procedures, to ensure fish species have the opportunity to evacuate the area prior to pile driving activity. Applicant should develop a plan outlining noise mitigation procedures in consultation with the resource agencies prior to any construction activities. This consultation should include a minimum of 30 days for the resource agencies to review and provide comments. Applicant should file its noise mitigation plan with BOEM for approval before the applicant can begin construction. The noise mitigation plan should include a process for notifying resource agencies within 24 hours if any evidence of a fish kill during construction activity is observed, and contingency plans to resolve issues.

BOEM will require that Vineyard Wind employ noise mitigation measures including noise abatement, and soft starts. Vineyard Wind has also agreed as part of the proposed action to avoid pile driving between January 1 and April 30 to avoid potential impacts on the highly endangered North Atlantic right whale. The final noise mitigation plan is included in the final Biological Opinion (September 11, 2020) for the ESA consultation (see: https://repository.library.noaa.gov/view/noaa/27243). BOEM will require the reporting of dead non-ESA listed fish of 10 or more individual fish within established exclusion zones as a part of the protected species observer reporting requirement.

Vineyard Wind would implement sound attenuation technology that would target at least a 12-decibel reduction in pile driving noise, and that must achieve at least a 6-decibel reduction in pile driving noise, as described above. The attenuation system may include one of the following or some combination of the following: a Noise Mitigation System, Hydro-sound Damper, Noise Abatement System, and/or bubble curtain. Vineyard Wind would also have a second back-up attenuation device (e.g., bubble curtain or similar) available, if needed, to achieve the targeted reduction in noise levels, pending results of sound field verification testing. One monopile and one jacket may be installed without attenuation in order to establish baseline noise measurements from which to determine the amount of attenuation provided by the attenuation mitigation technology.

If Vineyard Wind uses a bubble curtain, NMFS Office of Protected Resources would require the bubble curtain to distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring shall be in contact with the mudline for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent mudline contact. No parts of the ring or other objects shall prevent full mudline contact. Vineyard Wind would require that construction contractors train personnel in the proper balancing of airflow to the bubblers, and would require that construction contractors submit an inspection/performance report for approval by Vineyard Wind within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards would occur prior to impact driving.

8. "BOEM should require passive acoustic monitoring (PAM) to be conducted along a range of gradients from the proposed turbine locations. This should include measurements of both sound pressure and particle motion taken before, during, and after construction. Resource agencies should be provided a draft of the acoustic monitoring plan for review and comment. The plan should also include sound verification monitoring during pile driving activities. Additional noise dampening technology should be applied should real-time monitoring indicate noise levels are not attenuated to the minimum required 6 decibels. Acoustic monitoring reports should be provided to the resource agencies."

BOEM will require Vineyard Wind to measure underwater sound pressure levels resulting from pile driving. Vineyard Wind will conduct field measurements of pile driving sound using hydrophones and equipment capable of detecting the broad band of frequencies that may be produced by pile driving. Additionally, two sound abatement systems are proposed with one as a backup that will be deployed as necessary to achieve the targeted level of effectiveness of noise reduction.

The final Biological Opinion (September 11, 2020) includes the following PAM measures (modified to only address those relevant for fish (Atlantic sturgeon):

1. Vineyard Wind will prepare a PAM plan that describes all equipment, procedures, and protocols related to the required use of PAM for monitoring. This plan must be submitted to NMFS and BOEM for review at least 90 days prior to the planned start of pile driving.
2. Vineyard Wind must carry out field measurements as described in the requirements for the sound source verification plan below (4) for the first monopile and first jacket foundation to be installed. The purpose of these measurements is to validate the accuracy of the modeled distances described in the Effects of the Action section of the Opinion to isopleths of concerns as detailed below in 4.
3. In the event that future piles are installed that have a larger diameter or are installed with a larger hammer or stronger hammer energy, Vineyard Wind must carry out field measurements for those additional piles.
4. Vineyard Wind must prepare and submit a Sound Source Verification Plan to NMFS, USACE, and BOEM for review and NMFS's approval at least 90 days prior to the planned start of pile driving. This plan must describe how Vineyard Wind will ensure that the location selected is representative of the rest of the piles of that type to be installed and, in the case that it is not, how additional sites will be selected for sound source verification or how the results from the first pile can be used to predict actual installation noise propagation for subsequent piles. The plan must describe how the effectiveness of the sound attenuation methodology will be evaluated based on the results. The plan must be sufficient to document sound at the source as well as to

document propagation and distances to isopleths of concern to allow for comparison to the distances assessed in the Effects of the Action section of the Opinion (i.e., to the injury and behavioral disturbance zones for Atlantic sturgeon).

5. Before driving any additional piles, Vineyard Wind must review the initial field measurement results and make any necessary adjustments to the sound attenuation system and/or the exclusion or monitoring zones as detailed below. If the initial field measurements indicate that the isopleths of concern are larger than those considered in the Opinion, BOEM and USACE must ensure that additional sound attenuation measures are put in place before additional piles are installed. Vineyard Wind must provide the initial results of the field measurements to NMFS, USACE, and BOEM as soon as they are available. NMFS, USACE, and BOEM will discuss these as soon as feasible with a target for that discussion within two business days of receiving the results. BOEM and NMFS will provide direction to Vineyard Wind on whether any additional modifications to the sound attenuation system are required.

As stated in the EFH Assessment, there are currently no established particle velocity thresholds for injury or behavior modification for fish. Through BOEM's Environmental Studies Program and specifically the Real-time Opportunity for Development Environmental Observations, BOEM has been exploring methodologies to record particle velocity and the reporting of particle velocity information. Thus, while the study of particle velocity is a worthwhile research area, it is not appropriate as a measure to conserve or protect EFH to be required of the Vineyard Wind Project. Therefore, BOEM will only require that the lessee monitor sound pressure levels.

9. Conservation recommendation #9 asks BOEM to require all pile driving activity beginning in May of any year to be sequenced to begin pile driving activity at the most offshore WTG location, working from offshore to inshore to minimize impacts to longfin inshore squid spawning activity and settlement of juvenile cod.

Vineyard Wind has already committed to avoidance of all pile driving between January 1 and April 30. While this measure is primarily focused on the highly endangered North Atlantic right whale, this measure will also confer benefits to cod that also spawn in the winter/spring time frame. Vineyard Wind has also indicated that sequencing construction from offshore to inshore is logistically not feasible. Monopiles are sized individually for each location and are then transported to the site based on the appropriate sizes and weights for the transportation vessel (i.e. a vessel likely needs to carry a mix of shorter and longer monopiles). Installation of the monopiles follows a carefully planned process to avoid delays in the overall construction schedule, which is already significantly constrained by time-of-year and other pile driving restrictions. Foundations near the ESP need to be installed at a relatively early stage. The foundation installation sequence also needs to broadly follow the inter-array cable sequence (i.e. monopiles need to be installed along strings of cables). Further, any foundation installation plans are subject to weather conditions and installation plans will likely have to be adjusted in the field to account for weather; therefore, it is not possible to guarantee that half of the foundations could be installed in one season and the other half of the foundations could be installed in a separate season. This requirement would also create significant risk of construction delays by precluding the most efficient loading, transportation, and installation of the monopiles. Given these construction logistics considerations, it is not feasible for Vineyard Wind to install the northern piles in the fall and the southern piles in the spring.

In studies on fish and invertebrates, exposure to boat noise and white noise has resulted in reduced prey capture rate, increased food handling or discrimination error, and decreased time spent foraging[1,2,3]. These results also look to hold true in preliminary results from exposure of squid to pile driving noise[4]. Specifically, pile driving noise can cause an alarm response in squid. However, squid displayed alarm responses at the highest rates within the first five pile driving impulses, with lower response rates thereafter. In regards to feeding, squid exposed to pile driving noise generally had lower prey capture rates, and squid were more likely to abandon pursuit of prey if noise started during their pursuit[5].

Regarding juvenile cod settlement, there have been studies to evaluate the impacts of seismic airguns on larval cod,[6] but there have been few empirical studies of pile driving noise on fish larvae[7]. Bolle et. al. (2012) showed that common sole larvae exposure to pile driving noise did not result in increased mortality during the first seven days after exposure. No statistically significant differences in mean mortality were found between the control and exposure groups for any of the larval stages. In Booman et. al. (1996) cod and saithe were examined in the post yolk sac larval stages and significant effects were observed for cod at exposures of 223 decibels. Bolle et. al. postulated that this difference in effect could be due to the steep rise time in seismic surveys in comparison to pile driving or differences between species. With this in mind it should be noted that acoustic disturbance from the Vineyard Wind 1 project at 207 decibel peak pressure is 157 meters from an unattenuated pile. Pile driving for the Vineyard Wind 1 project will use an acoustic attenuation system that would reduce the threshold distance down to a modelled 38 meters from the pile, thus at the received levels at inshore juvenile cod HAPC there is not anticipated to be any effect on larval settlement. This is in addition to the previously noted period where no pile driving will take place between January 1 and April 30.

10. Conservation recommendation #10 asks BOEM to "require the applicant to develop a Before-After-Gradient (BAG) monitoring plan to measure habitat alteration effects at the area of impact and along an extended gradient. For a subsample of turbines, the gradient should extend from individual turbines to areas well outside the expected extent of primary and secondary effects. This should include hypothesis-driven data collection on fish communities, benthic habitat changes, epifaunal growth, as well employ different methods of data collection, in addition to the existing proposal. The plan should incorporate beam trawl sampling under a BAG approach to collect data on smaller fish species, juvenile and macroinvertebrates. The plan

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[1] Mensinger, A. F., Putland, R. L., & Radford, C. A. (2018). The effect of motorboat sound on Australian snapper Pagrus auratus inside and outside a marine reserve. Ecology and Evolution, 8, 6438–6448. https://doi.org/10.1002/ece3.4002

[2] Purser, J., & Radford, A. N. (2011). Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (Gasterosteus aculeatus). PLoS ONE, 6(2). https://doi.org/10.1371/journal.pone.0017478

[3] Sabet, S. S., Neo, Y. Y., & Slabbekoorn, H. (2015). The effect of temporal variation in sound exposure on swimming and foraging behaviour of captive zebrafish. Animal Behaviour, 107, 49–60.

[4] Jones, I. T., Stanley, J. A., & Mooney, T. A. (2020). Impulsive pile driving noise elicits alarm responses in squid (Doryteuthis pealeii). Marine Pollution Bulletin, 150. https://doi.org/10.1016/j.marpolbul.2019.110792

[5] Personal communication with principal investigators regarding Bureau of Ocean Energy Management Environmental Studies Program NMFS Interagency Agreement Number M17PG00029.

[6] Booman C, Dalen J, Leivestad H, Levsen A, van der Meeren T et al. (1996) Effekter av luftkanonskyting pa egg, larver og yngel. Undersokelser ved Havforskningsinstituttet og Zoologisk Laboratorium UIB. Rapport Fisken og Havet Nr. 3-1996. Bergen: Havforskningsinstituttet.

[7] Bolle LJ, de Jong CAF, Bierman SM, van Beek PJG, van Keeken OA, et al. (2012) Common Sole Larvae Survive High Levels of Pile-Driving Sound in Controlled Exposure Experiments. PLoS ONE 7(3): e33052. doi:10.1371/journal.pone.0033052

should adopt both NEAMAP and NEFSC trawl survey protocols, including sampling of stomach content and age structures, as part of any trawl sampling, to be consistent with existing regional surveys. This would allow any detectable changes in the local ecosystem to be compared against long-term datasets. A monitoring plan incorporating these components should be provided to the resource agencies for review and comment."

BOEM is adopting this conservation recommendation and is requiring Vineyard Wind to conduct fishery resource monitoring surveys. As of July 19, 2019, Vineyard Wind has begun the trawl surveys developed through a collaborative process led by University of Massachusetts School of Marine Science and Technology. The protocol was shared, and comments requested of NMFS prior to adoption. However, the protocol only follows the Northeast Area Monitoring and Assessment Program, which uses an otter trawl, not a beam trawl, for sampling. To switch from an otter trawl to beam trawl at this point, or add a separate beam trawl survey, is not feasible given that sampling has already begun.

In addition to the trawl survey, Vineyard Wind is also conducting a drop camera survey to examine the benthic macroinvertebrate community and substrate habitat in the area proposed for offshore windfarm development by Vineyard Wind. This data will provide a baseline for future environmental assessment of windfarm development and can be linked to the existing University of Massachusetts School of Marine Science and Technology (SMAST) drop camera data set. The objectives of this survey are to provide 1.) distribution and abundance estimates of dominant benthic megafauna, 2.) classification of substrate type across the survey domain, and 3.) comparison of benthic communities and substrate types between the development area, control area, and broader regions of the U.S. continental shelf. Further, this survey will 4.) classify substrate within aliquots sampled in the lobster trap survey of the area.

11. Conservation recommendation #11 asks BOEM to require the applicant to revise the Benthic Habitat Monitoring Plan to incorporate the revised benthic habitat maps. Consistent with conservation recommendation #10, we recommend a BAG approach that evaluates benthic habitat impacts in the WDA and along the cable route. Monitoring along the cable route should include measurements of the electromagnetic field (EMF) to address questions related to effects and recovery of benthic habitat. The plan should include a power analysis to ensure an adequate sample size, sufficient time to monitor recovery, and adequate methods to detect project effects on benthic habitats. A revised version should be provided to the resource agencies for review and comment.

BOEM will require Vineyard Wind to comply with most of this conservation recommendation. In October 2020, Vineyard Wind provided its updated benthic monitoring plan (COP Appendix III-D) dated September 2020 to BOEM. This version did not differ significantly from what was included in BOEM's EFH Addendum transmitted to NMFS on June 26, 2020. The revised plan utilized a power analysis to define the sample size. The revised plan also incorporated a combination Before-After Control Impact-Before After Gradient (BACI-BAG) design which places sample stations at regular distances along impact monitoring transects from the impact source (such as the area of export cable installation), and also includes sample stations placed outside impact monitoring areas to serve as controls. The proposed combination BACI-BAG design incorporates elements of each sampling design and will allow for a rigorous assessment of impacts and recovery. The revised plan also includes representative sample locations. BOEM will share any comments from NMFS on the current benthic monitoring plan with Vineyard

Wind for response. Additionally, BOEM will require that Vineyard Wind consider all new habitat data (collected as discussed in #1 above) in their monitoring plan.

There are currently no EMF thresholds for aquatic animals in terms of electromagnetic fields. Through its Environmental Studies Program, BOEM has invested in measuring existing alternating current cables and direct current cables to understand how the modelling of EMF compares with in-situ measurements. BOEM believes the completed studies (https://www.boem.gov/Renewable-Energy-Completed-Studies/) adequately address this question for both the measurement of EMF as well as the evaluation of fish and crustacean behavior, and that no additional measurements of EMF are necessary for the technologies currently proposed.

12. Conservation recommendation #12 asks BOEM to require the applicant to provide technical and financial support for a regional research and monitoring program through the full cycle of the project. This program should include consistent monitoring approaches for site-specific studies that nest within a sub-regional, regional, and ecosystem-level framework to ensure this information can be most useful. Studies addressing habitat alteration impacts that may affect species migration patterns, sensitive life history stages, and knowledge gaps related to particle motion should be considered priority research needs at the regional level. Where appropriate, adaptive management approaches should be considered to account for unanticipated effects to fishery resources and habitats. The EFH consultation should be reinitiated prior to decommissioning turbines to ensure that the impact to EFH as a result of the decommissioning activities have been evaluated and minimized to the extent practicable.

Generally, while BOEM has the authority to require mitigation and monitoring through terms and conditions of plan approval, these terms and conditions must be clear, enforceable, and tied to direct impacts identified through the environmental review and consultation process. BOEM also has to comply with Secretarial Order 3360, which rescinded several policies in regards to compensatory mitigation and states that “Implemented properly and appropriately, compensatory mitigation can be an appropriate tool used to reduce or off-set impacts from specific actions. Compensatory mitigation can be effectively used to facilitate development of our nation's resources by reducing impacts, but we must be guided by Congressional directives. The Department recognizes the appropriateness of compensatory mitigation in certain instances and the role it serves in the legal use and management of public lands under the jurisdiction of the Department.”

Although regional research and monitoring is something that BOEM fully supports, there are many challenges to requiring financial support to a regional research and monitoring program that may not be tied to specific project impacts. As a result, BOEM’s preference remains for voluntary, self-identified monitoring strategies that can be approved and enforced through COP approval. It should further be noted, that along with other offshore wind developers, Vineyard Wind is an active participant in both the Responsible Offshore Development Alliance and the Regional Wildlife Science Entity, which will likely be the vehicles to achieve the regional studies for many of the marine resources of concern. BOEM looks forward to continued participation with these groups as well.

Lastly, regarding recommendations under the FWCA, BOEM has considered the information provided by NMFS. BOEM has confirmed that Jonah crab will be enumerated in Vineyard Wind’s proposed ventless trap survey and that the data will be made publicly available. The protocol being used is the same that was used in the BOEM-funded ventless trap survey in the

Rhode Island/Massachusetts Wind Energy Area, in consultation with the NMFS Northeast Fisheries Science Center. BOEM also recognizes the importance of NMFS being able to continue its mission to survey and assess living marine resources. BOEM is committed to working with NMFS to find a solution to surveying areas occupied by offshore wind infrastructure. BOEM and NMFS are currently collaborating in several forums to ensure that information collected in support of the renewable energy program will have added value to NMFS management of living marine resources.

The final terms and conditions of COP approval will not be fully known until a Record of Decision is reached on the Final Environmental Impact Statement; however, a draft table of measures is provided as an attachment to this letter. If needed, BOEM will update our response to these EFH conservation recommendations with the final adopted measures after COP approval.

Thank you again for your continued collaboration on the review of offshore wind development. If you have any questions. Please feel free to contact Michelle Morin at (703) 787-1722 or michelle.morin@boem.gov.

Sincerely,

James F. Bennett
Chief
Office of Renewable Energy Programs

Attachment

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

December 11, 2020

James Bennett
Chief, Office of Renewable Energy Programs
Bureau of Ocean Energy Management
United States Department of the Interior
45600 Woodland Road VAM-OREP
Sterling, Virginia 20166

Dear Mr. Bennett:

We have reviewed your December 1, 2020 response to our June 27, 2019 letter regarding the essential fish habitat (EFH) conservation recommendations for the Vineyard Wind Project. I provide these comments to clarify our EFH conservation recommendations and also confirm our agencies' mutual understanding of these recommendations based on our October 22nd interagency discussion.

Prior to receipt of your December 1st response, your staff and our habitat team had a call to discuss our recommendations on October 22, 2020. We appreciate the opportunity to discuss these recommendations with you. Based, upon our review of your response to our recommendations, particularly your responses to recommendations #1, #10, and #11 involving habitat characterization and monitoring, we think it is important to clarify the intent of our conservation recommendations, and provide feedback on ways to improve our offices coordination on EFH issues.

Habitat Characterization

We appreciate BOEM requiring additional sampling along the Muskeget Channel area to better characterize benthic habitats, including the juvenile cod Habitat Area of Particular Concern (HAPC), that will be impacted by cable installation. However, as we discussed on October 22, 2020, it is not clear, based on the information you provided, the methodology that Vineyard Wind will use to collect, analyze, and interpret the additional data that will be collected in the channel. We also appreciate that you reference our Recommendations for Habitat Mapping. As we discussed, coordination with us will also be critical to ensure that the additional data characterizes habitat sufficiently to help minimize project impacts, including impacts associated with cable routing, dredge disposal, and anchoring. Although this topic was discussed on our October 22nd call, it does not appear that any coordination component was incorporated into your written response. Therefore, we recommend that the Term and Condition be revised to specify a coordination requirement to ensure our comments are addressed prior to additional sampling. This will not only ensure that our concerns are addressed, but will also make the best use of project resources by providing for a more thorough result from Vineyard Wind's sampling efforts.

As we have discussed in the past, and as provided in our June 27, 2019 letter, we disagree with the portion of your December 1, 2020 response that suggests that the habitat data provided was adequate and the EFH Assessment represented the best available information. The maps provided in the EFH assessment were based on state definitions that are not appropriate for the federal consultation process, as they do not align with federal mandates and resource definitions. Further, these maps did not depict the extent of complex habitat evident in the benthic sampling and sidescan sonar frame grabs included in the project documents. The updated figure from your December 1st response demonstrates our concern. Based on the Coastal and Marine Ecological Classification Standard (CMECS) definitions illustrated in Figure 2, approximately half of the offshore export cable corridor (OECC) is hard bottom and/or coarse sediment, which is ten times the area considered in the EFH assessment. This is new information that could affect the basis of our EFH conservation recommendations.

Despite our concern with this new information provided in Figure 2 of your December 1st response, we are not requesting reinitiation of consultation at this time. You have agreed to include an additional provision to monitor and evaluate the effectiveness of natural and engineered stone placed as cable protection within juvenile cod HAPC to assess its value as mitigation, and we find that satisfactory. We appreciate that you have included a requirement for Vineyard Wind to coordinate and address our comments for this monitoring provision. We would like to see this requirement duplicated in your provision related to the selection of source material. As currently proposed, Vineyard Wind is only required to solicit our comments prior to their final selection of source material, and there is no requirement for them to address our comments. The requirement to use natural and engineered stone that provides complexity is intended to mitigate impacts to juvenile cod HAPC and comply with our CR #5; therefore, it is crucial to ensure that the final design and seafloor expression of materials is consistent with the HAPC designation. If particular types and sizes of materials that are inconsistent with the habitat needs of juvenile cod as described in the HAPC definition are needed for engineering purposes, further coordination will allow for the evaluation of potential alternatives (e.g. placing a layer of rounded mixed diameter pebble and cobble over the selected engineered stone). Due to the importance of this issue, we recommend that the Term and Condition for cable protection material selection be revised to include a provision for Vineyard Wind to solicit and address our comments.

We would also like to clarify our position on the evaluation of impacts for the EFH assessment and consultation. Based on your December 1st response, and our October 22nd discussion, there appears to be confusion related to how project impacts must be addressed for the purposes of assessing EFH impacts compared to the National Environmental Policy Act (NEPA) criteria. Your December 1st response assumes the entire OECC impact area (186 acres) is hard and complex habitat, consistent with the juvenile cod HAPC. This impact would only account for 0.12% of the available gravel and boulder habitat within your defined analysis area. While defining an analysis area for the NEPA process is standard, this approach is not consistent with the EFH regulations and your responsibilities under these regulations. Specifically, the EFH regulations require you to evaluate the site-specific project impacts to designated EFH and measures that would avoid, minimize, and offset identified potential adverse impacts. The existence of similar habitat within a defined geographic area surrounding or adjacent to, the project impact area does not diminish, reduce, or affect: 1) the analysis and evaluation of potential adverse effects a project will have on designated EFH; nor 2) the requirement to use the best scientific information available to determine what measures can be taken to avoid, minimize, or offset such effects. This is the reasoning behind our June 27, 2019 CR#1, as accurate baseline data is not only necessary to adequately assess impacts to EFH, but also to assess any proposed avoidance and minimization measures.

Monitoring of Project Impacts

Trawl Survey

Our conservation recommendation for the development of a hypothesis driven, gradient design monitoring plan (CR#10) was intended to assess the localized effects (i.e. at the project level) of the project. Specifically, we were seeking an evaluation of the effects of habitat alteration to finfish and invertebrate communities along a gradient at increasing distances from the turbine sites within the Wind Development Area (WDA). Your response suggests that you are meeting our recommendation because a fishery monitoring trawl survey is already underway by Vineyard Wind within the WDA; however, these surveys do not address the study design considerations or include beam trawls as we recommended. We provided comments on this trawl survey on February 28, 2019 in a letter submitted by our Northeast Fisheries Science Center, however, these comments were never addressed nor did we receive a response to these comments from the applicant. In your December 1st response to our CR#10, you state that switching methodologies, or including additional sampling methods in the ongoing trawl survey would not be feasible. Without modification, it is not clear how the ongoing survey will provide useful information that would address our conservation recommendation. We want to clarify that the ongoing trawl survey was not a recommendation under CR#10.

Drop Camera Study

Your response also discusses a drop camera study that is included in the monitoring plan, and referenced in your letter and draft Terms and Conditions as addressing our CR#10. Unfortunately, we have not been consulted on this proposed drop camera monitoring plan. While we believe that it may provide some useful information on the distribution of habitats in the offshore WDA, it is not currently designed in a way that it could be used to assess benthic habitat changes resulting from the project at a meaningful scale. We would be happy to follow up with specific comments but this survey should not be considered as addressing part of our recommendation.

Benthic Monitoring Plan

We understand that you are choosing not to require additional fisheries sampling methods. However, we do think that the benthic monitoring plan could help partially address our recommendations (#10 and #11) if additional components are included and the monitoring plan is revised to allow for the assessment of changes to specific habitat types. The addition of other non-impact survey gear such as baited underwater video cameras to the benthic monitoring plan could allow for an assessment of changes in juvenile fish use of habitat and partially address this conservation recommendation.

We have reviewed the updated Benthic Monitoring Plan that you plan to use to address our CR #11. We have some significant concerns that, as designed, it is not likely to generate the data needed for hypothesis-driven comparisons pre- and post-construction. It is critical to ensure any monitoring plan is designed to collect adequate baseline information and to detect changes by habitat type that can be attributed to project activities and not confounded by other factors (e.g., natural environmental changes). We appreciate that you have included a requirement for Vineyard Wind to coordinate with us and address our comments prior to finalizing the benthic monitoring plan. We will follow up shortly with additional comments on the proposed benthic monitoring plan and look forward to further coordination and discussion on this plan as it is developed.

Nantucket Monitoring Requirements

As we have previously stated and discussed with you on October 22, 2020, it is not clear why you do not plan to expand the Town of Nantucket monitoring requirements outside of Nantucket waters. The proposed monitoring requirements will provide data and information that would address questions that should be a component of benthic monitoring, but the use of these data will be severely limited if monitoring is not expanded beyond Nantucket waters. We recommend that you reconsider expansion of these monitoring measures to include the entire OECC within Muskeget Channel.

Provisions for Coordination

We appreciate that you have incorporated coordination with our agency into many of your recommended Terms and Conditions for the COP approval. Based on our discussion on October 22, 2020, we expected that the requirement for coordination would also include a corresponding provision to ensure that our comments are addressed prior to finalizing any reviewed document. As we discussed in October, without such a provision there is no assurance that our comments will be incorporated in a meaningful manner. Without a requirement to address our comments, there is the potential for our comments to be misunderstood, or incorporated in a manner that does not adequately address the basis for our comments. Therefore, we recommend this be added to the provisions for the identification and selection of dredge disposal locations and the anchoring plan.

Your response indicates that you have also included Vineyard Wind's post-construction cable monitoring reports as partially addressing our CR #2. While we do not agree that these reports will serve to address our CR, within Nantucket waters where pre-construction surveys are also required, they will allow for an evaluation of how effective the measures employed were in avoiding particular habitat types. Currently, your draft Term and Condition for this item does not require Vineyard Wind to provide us with a copy of these reports. We request that such a provision be included so that the reports are also submitted to our office for review.

Agency Coordination

In your letter you noted the coordination timeline for this consultation. To clarify, the EFH regulations under 50 CFR 600.920(k)(1) states that a federal action agency should provide a response to our recommendations within 30 days of receipt and that this response must be provided at least 10 days prior to final approval of the federal action if the response is inconsistent with our recommendations. While a response to our recommendations is technically due 10 days prior to the agency decision, we recommend that, going forward, the response and/or discussions occur much earlier in the process. We are extremely interested in a coordinated and collaborative approach to these projects to ensure that we can address any questions or implementation issues and concerns related to our EFH conservation recommendations early in the process. We encourage you to reach out to us for clarification related to any comments or recommendations that we provide. This will allow for better collaboration on projects going forward and ensure there are no unexpected issues raised late in the project review timeline.

Conclusion

We appreciate your December 1, 2020 response to our EFH conservation recommendations for the Vineyard Wind Project and your willingness to discuss these issues in October. We hope this letter clarifies the points raised in your response letter and those discussed during the inter-agency call in October. Specifically, we want to ensure that the provisions put forward in BOEM's Terms and Conditions for the project include coordination and measures to incorporate our feedback related to the additional habitat data to be collected, the anchoring plan to be developed, the scour protection and subsequent monitoring to mitigate for impacts to juvenile cod HAPC, and evaluation of dredge disposal sites. We also want to clarify that the ongoing trawl survey was not intended to be part of our CR#10, but rather we were recommending a hypothesis-driven monitoring plan using different sampling techniques to evaluate the effects of site specific habitat alteration.

Should you have any questions, please feel free to contact Alison Verkade at alison.verkade@noaa.gov. We look forward to further coordination with you on this project and future offshore wind projects.

Sincerely,

Louis A. Chiarella
Assistant Regional Administrator
for Habitat Conservation

cc:
Brian Hooker, BOEM
Michelle Morin, BOEM
Jennifer Bucatari, BOEM
Thomas Nies, NEFMC
Christopher Moore, MAFMC
Lisa Havel, ASMC

APPENDIX G

Project Design Envelope and Maximum-Case Scenario

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APPENDIX G. PROJECT DESIGN ENVELOPE AND MAXIMUM-CASE SCENARIO

Vineyard Wind LLC (Vineyard Wind) would implement a Project Design Envelope (PDE) concept. This concept allows Vineyard Wind to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as wind turbine generators (WTGs), foundations, submarine cables, and offshore substations.[1]

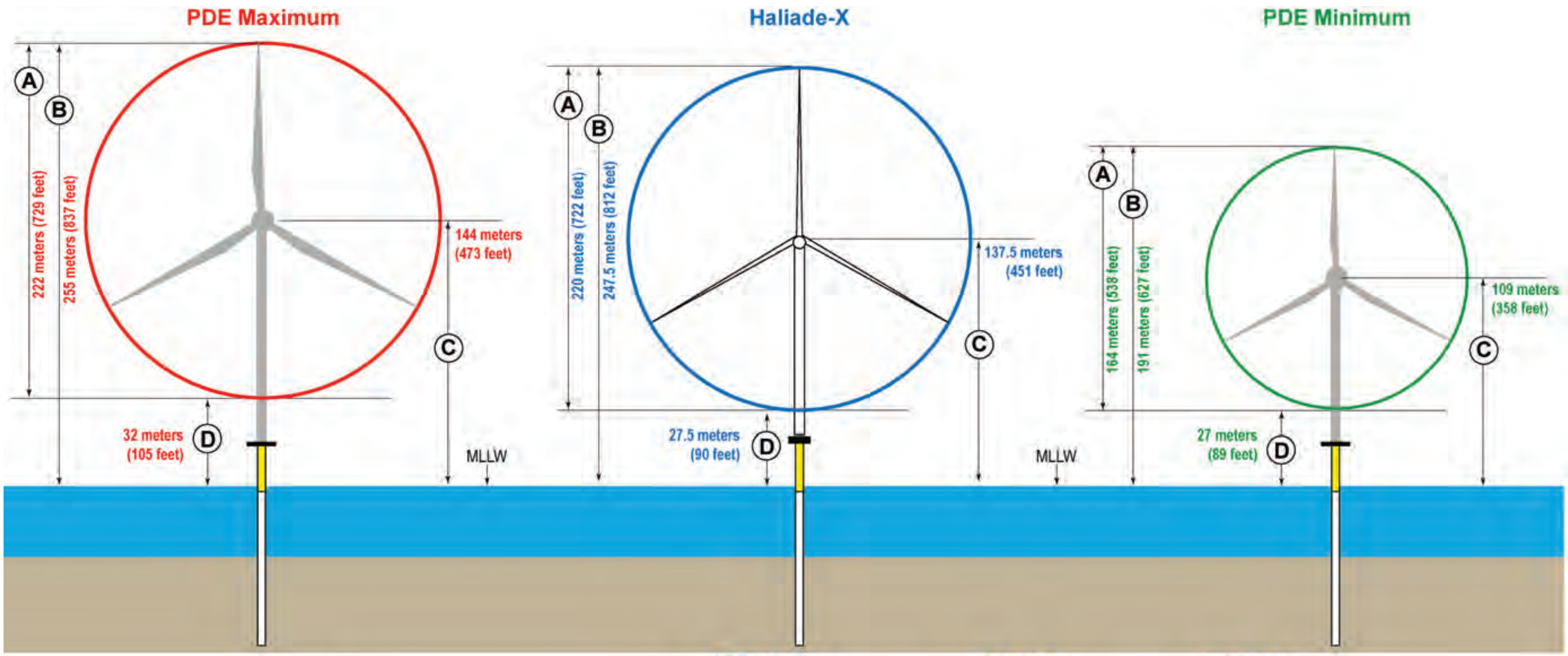
The Bureau of Ocean Energy Management (BOEM) invited Vineyard Wind and other lessees to submit Construction and Operation Plans (COPs) using the PDE concept—providing sufficiently detailed information within a reasonable range of parameters to analyze a "maximum-case scenario" within those parameters for each affected environmental resource. BOEM identified and verified that the maximum-case scenario based on the PDE provided by Vineyard Wind, and analyzed in this Final Environmental Impact Statement (FEIS), could reasonably occur if approved. This approach is intended to provide flexibility for lessees and allow BOEM to analyze environmental impacts in a manner that minimizes the need for subsequent environmental and technical reviews. In addition, the PDE approach may enable BOEM to expedite review by beginning National Environmental Policy Act evaluations of COPs before a lessee has finalized all of its design decisions.

This FEIS assesses the impacts of the reasonable range of Project designs that are described in the Vineyard Wind COP by using the maximum-case scenario process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This FEIS considers the interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. For example, since Vineyard Wind is only proposing up to an 800-megawatt (MW) facility with turbines ranging from 8 to 14 MW, this FEIS does not analyze 100 14 MW turbines because this would result in a 1,400 MW project. This FEIS also analyzes the planned action impacts of the maximum-case scenario alongside other reasonably foreseeable past, present, and future actions. As described in Chapter 2, this FEIS also evaluates the relevant updates of the Vineyard Wind COP that have been made since the Draft Environmental Impact Statement (DEIS) was published, namely the potential use of larger, up to 14 MW WTGs instead of up to 10 MW WTGs[2]. In doing so, potential impacts of the Proposed Action and each action alternative are evaluated using the maximum-case scenario. Figure G-1 shows the relationship of the General Electric Haliade-X WTG proposed for the Project and the PDE.

Certain resources evaluated in this FEIS may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. For example, larger WTGs could be more impactful for aviation (because they are taller), whereas smaller WTGs could be more impactful to birds and bats (because there would be a greater number). This appendix provides an update to Appendix G of the DEIS and presents detailed tables outlining the most impacting design parameter by resource area.

[1] Additional information and guidance related to the PDE concept can be found here: https://www.boem.gov/Draft-Design-Envelope-Guidance/

[2] On December 1, 2020, Vineyard Wind withdrew the COP to conduct additional reviews associated with the inclusion of the General Electric Haliade-X WTG into the final Project design. In response to Vineyard Wind's December 1, 2020, letter, BOEM published a Federal Register Notice on December 16, 2020, informing the public that "preparation of an Environmental Impact Statement" for the COP was "no longer necessary" for the sole reason that "the COP ha[d] been withdrawn from review and decisionmaking" (see 85 Fed. Reg. 7361121 [Dec. 16, 2020]). Accordingly, BOEM "terminated" the "preparation and completion" of the Environmental Impact Statement (EIS). On January 22, 2021, Vineyard Wind notified BOEM via letter that it had completed its review and had concluded that inclusion of the Haliade-X turbines did not warrant any modifications to the COP. Accordingly, Vineyard Wind informed BOEM that it was rescinding its temporary withdrawal and asked BOEM to resume its review of the COP. After conducting an independent review of the information provided by Vineyard Wind, BOEM has confirmed that: (1) the Haliade-X turbines fall within the design envelope analyzed in the June 2020 Supplement to the EIS; (2) Vineyard Wind's already-submitted COP contains all the necessary information to complete the FEIS; and (3) an additional supplemental EIS is not needed under 40 Code of Federal Regulations § 1502.9. BOEM will publish a Federal Register Notice informing stakeholders that it has resumed the National Environmental Policy Act process.



	PDE Maximum	Haliade-X	PDE Minimum
A = Rotor Diameter	222 meters (729 feet)	220 meters (722 feet)	164 meters (538 feet)
B = Total Blade Tip Height above MLLW	255 meters (837 feet)	247.5 meters (812 feet)	191 meters (627 feet)
C = Hub Height above MLLW	144 meters (473 feet)	137.5 meters (451 feet)	109 meters (358 feet)
D = Tip Clearance during Operation Above MLLW	32 meters (105 feet)	27.5 meters (90 feet)	27 meters (89 feet)

Figure G-1: Project Design Envelope Parameters in Comparison to the General Electric Haliade-X Proposed for the Project

Table G-1: Proposed Action Design Envelope Parameters

Capacity and Arrangement		
Wind Facility Capacity	Approximately 800 MW [a]	
Wind Turbine Generator Foundation Arrangement Envelope	Up to 100 monopiles	Up to 10 may be jacket foundations
Wind Turbine Generators (WTGs)	**Minimum**	**Maximum**
Turbine Generation Capacity	8 MW	14 MW
Number of Turbine Positions [b]	57	106
Number of Turbines Installed	57	Up to 100
Total Tip Height	627 ft (191 m) MLLW [c]	837 ft (255 m) MLLW [c]
Hub Height	358 ft (109 m) MLLW [c]	473 ft (144 m) MLLW [c]
Rotor Diameter	538 ft (164 m) MLLW	729 ft (222 m) MLLW
Tip Clearance	89 ft (27 m) MLLW [c]	105 ft (32 m) MLLW [c]
Platform Level/Interface Level Height for Monopile	62 ft (19 m) MLLW [c]	75 ft (23 m) MLLW [c]
Tower Diameter for WTG	20 ft (6 m)	28 ft (8.5 m)
Monopile Foundations	**Minimum**	**Maximum**
Diameter	25 ft (7.5 m)	34 ft (10.3 m)
Pile footprint	490 ft^2 (45.5 m^2)	908 ft^2 (84.3 m^2)
Height between Seabed and MLLW (water depth)	121 ft (37 m)	162 ft (49.5 m)
Penetration	66 ft (20 m)	148 ft (45 m)
Transition Piece Tower Diameter	20 ft (6 m)	28 ft (8.5 m)
Transition Piece Length	59 ft (18 m)	98 ft (30 m)
Platform Level/Interface Level Height	62 ft (19.5 m)	75 ft (22.5 m)
Number of Piles/Foundation	1	1
Number of Piles Driven/Day within 24 hours [d]	1	2
Typical Foundation Time to Pile Drive [e]	approximately 3 hours	approximately 3 hours
Hammer size	Up to 4,000 kJ	Up to 4,000 kJ
Jacket (Pin Piles) Foundation	**Minimum**	**Maximum**
Diameter for WTG and ESP	5 ft (1.5 m)	10 ft (3 m)
Jacket Structure Height for WTG	180 ft (55 m)	262 ft (80 m)
Jacket Structure Height for ESP	180 ft (55 m)	213 ft (65 m)
Platform Level/Interface Level Height for WTG and ESP	74 ft (22.5 m) MLLW	94 ft (28.5 m) MLLW
Pile Penetration for WTG	98 ft (30 m)	197 ft (60 m)
Pile Penetration for ESP	98 ft (30 m)	246 ft (75 m)
Pile Footprint for WTG	59 ft (18 m)	115 ft (35 m)
Pile Footprint for ESP	59 ft (18 m)	248 ft (45 m)
Number of Piles/Foundation	3 to 4	3 to 4
Number of Piles Driven/Day within 24 Hours [d]	1 (up to 4 pin piles)	
Typical Foundation Time to Pile Drive [e]	approximately 3 hours	
Hammer Size	Up to 3,000 kJ	
Scour Protection for Foundations	**Minimum**	**Maximum**
Scour Protection Area at Each Monopile WTG and ESP	up to 16,146 ft^2 (1,500 m^2)	up to 22,600 ft^2 (2,100 m^2)
Scour Protection Volume at Each Monopile WTG and ESP	up to 52,972 ft^3 (1,500 m^3)	up to 127,133 ft^3 (3,600 m^3)
Scour Protection Area at Each Jacket WTG	up to 13,993 ft^2 (1,300 m^2)	up to 19,375 ft^2 (1,800 m^2)
Scour Protection Volume at Each Jacket WTG	up to 45,909 ft^3 (1,300 m^3)	up to 91,818 ft^3 (2,600 m^3)
Scour Protection Area at Each Jacket ESP	up to 13,993 ft^2 (1,300 m^2)	up to 26,900 ft^2 (2,500 m^2)
Scour Protection Volume at Each Jacket ESP	up to 45,909 ft^3 (1,300 m^3)	up to 134,196 ft^3 (3,800 m^3)
Electrical Service Platform (ESP)		
Maximum Dimensions	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	
Number of Conventional ESPs	1 (800 MW)	2 (400 MW each)
Number of Transformers per ESP	1	2
Foundation Type	Monopile	Jacket
Number of Piles/Foundation	1	3 to 4

Capacity and Arrangement		
Maximum Height	215 ft (65.5 m) MLLW	218 ft (66.5 m) MLLW
Inter-Array Cable (66 kV)	**Minimum**	**Maximum**
Number of Foundations per Inter-Array Cable	6	10
Inter-Array Cable Length		171 mi (275 km)
Protection Method (rock placement, concrete mattresses, half-shell)		Up to 10% of route
Target Burial Depth	5 ft (1.5 m)	8 ft (2.5 m)
Export and Inter-Link Cable (220 kV)	**Minimum**	**Maximum**
Number of Export Cables within Corridor		2
Target Burial Depth	5 ft (1.5 m)	8 ft (2.5 m)
Maximum Length of Export Cable (assuming two cables)		98 mi (158 km)
Typical separation distance of Export Cable (assuming two cables)		328 ft (100 m)
Total Corridor Width for Export Cable (two cables) [f]	2,657 ft (810 m)	3,280 ft (1,000 m)
Protection Method (rock placement, concrete mattresses, half-shell)		Up to 10% of route
Maximum Length of Inter-Link Cable		6.2 mi (10 km)
Export Cables Dredging (width corridor per cable)		65.6 ft (20 m)
Export Cables Total Dredging Area		up to 69 acres (0.28 km^2)
Export Cables Total Dredging Volume		up to 214,500 cy (164,000 m^3)

cy = cubic yards; ESP = electrical service platform; ft = foot; ft^2 = square feet; ft^3 = cubic feet; kJ = kilojoule; km = kilometer; km^2 = square kilometers; kV = kilovolt; m = meter; m^2 = square meters; m^3 = cubic meters; mi = mile; MLLW = mean lower low water; MW = megawatt; WTG = wind turbine generator

[a] Vineyard Wind's Proposed Action is for an approximately 800 MW offshore wind energy project. This FEIS evaluates the potential impacts of a facility up to 800 MW to ensure that it covers projects constructed with a smaller capacity.

[b] Additional WTG positions allow for spare turbine locations or additional capacity to account for environmental or engineering challenges.

[c] Elevations relative to mean higher high water are approximately 3 feet (1 meter) lower than those relative to MLLW.

[d] Work would not be performed concurrently. No drilling is anticipated; however, it may be required if a large boulder or refusal is met. If drilling is required, a rotary drilling unit would be mobilized. Similarly, vibratory hammering could be used if deemed appropriate by the installation contractor.

[e] Vineyard Wind has estimated that typical pile driving for a monopile is expected to take less than approximately 3 hours to achieve the target penetration depth, and that pile driving for the jacket foundation would take approximately 3 hours to achieve the target penetration depth. Different hammer sizes are used for installation of the monopile and jacket foundations.

[f] Corridor width for siting purposes; each trench would be approximately 3.2 feet (1 meter) wide and there would be an up to 3.3 to 6.6-foot-wide (1- to 2-meter-wide) temporary disturbance zone from the tracks or skids of the cable installation.

Table G-2: Design Parameters Consistent for All Scenarios

Project Element	Description
Foundation Construction Method	Pile driving
Foundation and Wind Turbine Generator (WTG) Installation Vessel Type	Jack-up vessel, vessel on dynamic positioning, feeder barges/ vessels
Electrical Service Platform Installation Vessel Type	Jack-up vessel, vessel on dynamic positioning, feeder barges/ vessels, specialized crane vessel
Inter-array Cable Installation Method (includes a pre-lay grapnel run)	Jetting or jet plow but could use mechanical plow, mechanical trenching
Inter-array Cable Installation Vessel Type	Jack-up vessel, vessel on dynamic positioning, feeder barges/ vessels
Export Cable Installation Method (includes a pre-lay grapnel run)	Jet plow, mechanical plow, mechanical trenching, dredging in rare instances when needed to achieve burial depth
Export Cable Installation Vessel Type	Anchored vessel, vessel on dynamic positioning with feeder barges
WTG Coloring	RAL 9010 Pure White or RAL 7035 Light Grey
Federal Aviation Administration (FAA) Obstruction Lighting	Two synchronized L-864 aviation red flashing obstruction lights—WTG nacelle; 30 flashes per minute will be used for air navigation lighting (note that if the WTG's total tip height is 699 feet or greater, there would be at least three additional low-intensity L-810 flashing red lights at a point approximately midway between the top of the nacelle and sea level)
FAA Obstruction Lighting Method	Aircraft Detection Lighting System that would automatically activate all FAA lights (see row above) when aircraft approach; alternatively, the proposed Project may use a system that automatically adjusts lighting intensity to in response to visibility conditions
United States Coast Guard Lighting	Two yellow flashing lights, each turbine approximately 20–23 meters above mean lower low water; will be visible at 2 and/or 5 nautical miles
Navigational Boating Warning Tools	Sound signals and automatic identification system transponders
Landfall Site and Transition Method	Covell's Beach (Barnstable) via horizontal directional drilling
Length of Onshore Cable	5.3 miles (8.5 kilometers)
Landfall Transition	Underground concrete transition vaults
Onshore Cable Construction Protection	Underground duct banks of polyvinyl chloride pipes encased in concrete

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Table G-3: Project Design Envelope Maximum-Case Scenario per Resource

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Wind Facility Capacity [a]	800 MW	800 MW	NA	800 MW	800 MW	NA	800 MW	800 MW	800 MW	800 MW	800 MW	800 MW	800 MW	NA	800 MW	800 MW
WTG Foundation Arrangement Envelope	NA	NA	NA	Evaluate both scenarios	Evaluate both scenarios	NA	Evaluate both scenarios	Evaluate both scenarios	Evaluate both scenarios	NA	Evaluate both scenarios	NA	Evaluate both scenarios	NA	Evaluate both scenarios	NA
WTGs and Foundation																
Turbine Size	8 MW due to more turbine construction	8 MW due to more turbines	NA	8 MW due to more turbines	8 MW due to more turbines	NA	8 MW due to more seafloor disturbance	NA	8 MW due to more surface occupancy	14 MW for economics; 10 MW for environmental justice	Range of 8 MW to 14 MW due to amount of disturbance (smaller) and visual effects (larger)	Range of 8 MW to 14 MW due to amount of disturbance (lower) and visual effects (greater)	8 MW due to more surface occupancy	NA	8 MW due to more potential for collision	14 MW due to total height
Number of Turbine Positions [b]	106 due to total number of trips required for construction	106 due to the total potential sediment disturbance, spills	NA	106 due to more potential for collision and more air space being occupied	106 due to more potential for collision and more air space being occupied	NA	106 due to the total potential surface disturbance	106 due to more potential for loss of area and change of habitat	106 due to more potential for noise and loss of area	106 due to more potential for noise and loss of area	106 due to more potential effects on resources due to disturbance	106 due to more potential for loss of area and change of habitat	106 due to more potential for collision and loss of area	NA	106 due to more potential for collision/ allisions	106 due to total number potential hazards
Number of Turbines Installed	100	100	NA	100	100	NA	100	100	100	57 for economics; 100 for environmental justice	100 due to amount of disturbance; 57 for visual effects	100	100	NA	100	100
Tip Height [c]	NA	NA	NA	627 ft (191 m) MLLW	837 ft (255 m) MLLW	NA	NA	NA	NA	837 ft (255 m) MLLW	627 ft (191 m) MLLW	837 ft (255 m) MLLW	627 ft (191 m) MLLW	NA	627 ft (191 m) MLLW	837 ft (255 m) MLLW
Hub Height [c]	NA	NA	NA	358 ft (109 m) MLLW	473 ft (144 m) MLLW	NA	NA	NA	NA	473 ft (144 m) MLLW	358 ft (109 m) MLLW	473 ft (144 m) MLLW	358 ft (109 m) MLLW	NA	358 ft (109 m) MLLW	473 ft (144 m) MLLW
Rotor Diameter [c]	NA	NA	NA	538 ft (164 m)	729 ft (222 m) MLLW	NA	NA	NA	NA	729 ft (222 m) MLLW	538 ft (164 m)	729 ft (222 m) MLLW	538 ft (164 m)	NA	538 ft (164 m)	729 ft (222 m) MLLW
Tip Clearance [c]	NA	NA	NA	89 ft (27 m) MLLW	105 ft (32 m) MLLW	NA	NA	NA	NA	105 ft (32 m) MLLW	105 ft (32 m) MLLW	105 ft (32 m) MLLW	89 ft (27 m) MLLW	NA	89 ft (27 m) MLLW	105 ft (32 m) MLLW
Platform Level/ Interface Level Height for Monopile [c]	NA	NA	NA	62 ft (19 m) MLLW	75 ft (23 m) MLLW	NA	NA	NA	NA	75 ft (23 m) MLLW	62 ft (19 m) MLLW	75 ft (23 m) MLLW	62 ft (19 m) MLLW	NA	62 ft (19 m) MLLW	75 ft (23 m) MLLW
Tower Diameter for WTG	NA	28 ft (8.5 m)	NA	NA	NA	NA	NA	NA	NA	NA	28 ft (8.5 m)	28 ft (8.5 m)	28 ft (8.5 m)	NA	28 ft (8.5 m)	28 ft (8.5 m)
Monopile Foundation																
Diameter	NA	34 ft (10.3 m)	NA	34 ft (10.3 m)	34 ft (10.3 m)	NA	34 ft (10.3 m)	34 ft (10.3 m)	34 ft (10.3 m)	NA	34 ft (10.3 m)	34 ft (10.3 m)	34 ft (10.3 m)	NA	34 ft (10.3 m)	NA
Pile Footprint	NA	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	NA
Height between Seabed and MLLW (water depth)	NA	162 ft (49.5 m)	NA	162 ft (49.5 m)	NA	NA	NA	NA	NA	NA	162 ft (49.5 m)	121 ft (37 m)	121 ft (37 m)	NA	121 ft (37 m)	162 ft (49.5 m)
Penetration	NA	148 ft (45 m)	NA	NA	NA	NA	148 ft (45 m)	148 ft (45 m)	148 ft (45 m)	NA	148 ft (45 m)	NA	148 ft (45 m)	NA	148 ft (45 m)	NA
Transition Piece Tower Diameter	NA	28 ft (8.5 m)	NA	NA	NA	NA	28 ft (8.5 m)	NA	NA	NA	28 ft (8.5 m)	28 ft (8.5 m)	28 ft (8.5 m)	NA	28 ft (8.5 m)	28 ft (8.5 m)

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Transition Piece Length	NA	98 ft (30 m)	NA	98 ft (30 m)	NA	NA	NA	NA	NA	NA	98 ft (30 m)	98 ft (30 m)	59 ft (18 m)	NA	59 ft (18 m)	98 ft (30 m)
Platform Level/ Interface Level Height	NA	74 ft (22.5 m)	NA	74 ft (22.5 m)	74 ft (22.5 m)	NA	NA	NA	NA	NA	74 ft (22.5 m)	64 ft (19.5 m)	64 ft (19.5 m)	NA	64 ft (19.5 m)	74 ft (22.5 m)
Number of Piles/ Foundation	NA	1	NA	NA	NA	NA	1	1	1	NA	1	1	1	NA	1	NA
Number of Piles Driven/Day within 24 hours [d]	NA	2	NA	NA	NA	NA	2	2	2	NA	2	2	2	NA	2	NA
Hammer size for Monopile Foundation	NA	NA	NA	4,000 kJ	NA	NA	4,000 kJ	4,000 kJ	4,000 kJ	NA	NA	4,000 kJ	4,000 kJ	NA	4,000 kJ	NA
Typical Foundation Time to Pile Drive [e]	NA	approximately 3 hours	NA	approximately 3 hours	NA	NA	approximately 3 hours	approximately 3 hours	approximately 3 hours	NA	approximately 3 hours	approximately 3 hours	approximately 3 hours	NA	approximately 3 hours	NA
Scour Protection Area at Each Monopile WTG and ESP	NA	up to 22,600 ft^2 (2,100 m^2)	NA	up to 22,600 ft^2 (2,100 m^2)	NA	NA	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	NA	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	NA	up to 22,600 ft^2 (2,100 m^2)	NA
Scour Protection Volume at Each Monopile WTG and ESP	NA	up to 127,133 ft^3 (3,600 m^3)	NA	up to 127,133 ft^3 (3,600 m^3)	NA	NA	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	NA	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	NA	up to 127,133 ft^3 (3,600 m^3)	NA
Jacket (Pin Piles) Foundation																
Diameter for WTG and ESP	NA	10 ft (3 m)	NA	10 ft (3 m)	10 ft (3 m)	NA	10 ft (3 m)	10 ft (3 m)	10 ft (3 m)	NA	10 ft (3 m)	10 ft (3 m)	10 ft (3 m)	NA	10 ft (3 m)	NA
Jacket Structure Height for WTG	NA	262 ft (80 m)	NA	262 ft (80 m)	262 ft (80 m)	NA	NA	NA	NA	NA	262 ft (80 m)	180 ft (55 m)	180 ft (55 m)	NA	262 ft (80 m)	262 ft (80 m)
Jacket Structure Height for ESP	NA	NA	NA	213 ft (65 m)	213 ft (65 m)	NA	NA	NA	NA	NA	213 ft (65 m)	180 ft (55 m)	180 ft (55 m)	NA	213 ft (65 m)	213 ft (65 m)
Platform Level/Interface Level Height for WTG and ESP	NA	94 ft (28.5 m) MLLW	NA	94 ft (28.5 m) MLLW	94 ft (28.5 m) MLLW	NA	NA	NA	NA	NA	94 ft (28.5 m) MLLW	74 ft (22.5 m) MLLW	74 ft (22.5 m) MLLW	NA	94 ft (28.5 m) MLLW	94 ft (28.5 m) MLLW
Pile Penetration for WTG	NA	197 ft (60 m)	NA	197 ft (60 m)	NA	NA	197 ft (60 m)	197 ft (60 m)	197 ft (60 m)	NA	197 ft (60 m)	NA	197 ft (60 m)	NA	197 ft (60 m)	NA
Pile Penetration for ESP	NA	246 ft (75 m)	NA	246 ft (75 m)	NA	NA	246 ft (75 m)	246 ft (75 m)	246 ft (75 m)	NA	246 ft (75 m)	NA	246 ft (75 m)	NA	246 ft (75 m)	NA
Pile Footprint for WTG	NA	NA	NA	115 ft (35 m)	NA	NA	115 ft (35 m)	115 ft (35 m)	115 ft (35 m)	NA	115 ft (35 m)	NA	115 ft (35 m)	NA	115 ft (35 m)	NA
Pile Footprint for ESP	NA	NA	NA	248 ft (45 m)	NA	NA	248 ft (45 m)	248 ft (45 m)	248 ft (45 m)	NA	248 ft (45 m)	NA	248 ft (45 m)	NA	248 ft (45 m)	NA
Number of Piles/ Foundation	NA	3 to 4	NA	3 to 4	NA	NA	3 to 4	3 to 4	3 to 4	NA	3 to 4	3 to 4	3 to 4	NA	3 to 4	NA
Number of Piles Driven/Day within 24 hours [d]	NA	2 monopiles (up to 4 pin piles)	NA	2 monopiles (up to 4 pin piles)	NA	NA	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	NA	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	NA	2 monopiles (up to 4 pin piles)	NA
Hammer size for Jacket Foundation	NA	NA	NA	3,000 kJ	NA	NA	3,000 kJ	3,000 kJ	3,000 kJ	NA	NA	3,000 kJ	3,000 kJ	NA	3,000 kJ	NA

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Typical Jacket Time to Pile Drive	NA	less than approximately 3 hours	NA	less than approximately 3 hours	NA	NA	less than approximately 3 hours	less than approximately 3 hours	less than approximately 3 hours	NA	less than approximately 3 hours	less than approximately 3 hours	less than approximately 3 hours	NA	less than approximately 3 hours	NA
Scour Protection Area at Each Jacket WTG	NA	up to 19,375 ft^2 (1,800 m^2)	NA	up to 19,375 ft^2 (1,800 m^2)	NA	NA	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	NA	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	NA	up to 19,375 ft^2 (1,800 m^2)	NA
Scour Protection Volume at Each Jacket WTG	NA	up to 91,818 ft^3 (2,600 m^3)	NA	up to 91,818 ft^3 (2,600 m^3)	NA	NA	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	NA	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	NA	up to 91,818 ft^3 (2,600 m^3)	NA
Scour Protection Area at Each Jacket ESP	NA	up to 26,900 ft^2 (2,500 m^2)	NA	up to 26,900 ft^2 (2,500 m^2)	NA	NA	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	NA	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	NA	up to 26,900 ft^2 (2,500 m^2)	NA
Scour Protection Volume at Each Jacket ESP	NA	up to 134,196 ft^3 (3,800 m^3)	NA	up to 134,196 ft^3 (3,800 m^3)	NA	NA	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	NA	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	NA	up to 134,196 ft^3 (3,800 m^3)	NA
Electrical Service Platforms																
ESP Dimensions	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)
Number of ESPs	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	NA	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	NA	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	NA	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area
Number of Transformers per ESP	NA	2	NA	2	2	NA	2	2	2	2	2	2	2	NA	2	2
ESP Foundation Type	NA	Jacket	NA	Jacket	Jacket	NA	Jacket	Jacket	Jacket	Jacket	Jacket	Jacket	Jacket	NA	Jacket	Jacket
ESP Number of Piles/Foundation	NA	3 to 4	NA	3 to 4	3 to 4	NA	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	NA	3 to 4	3 to 4
ESP Maximum Height	NA	NA	NA	218 ft (66.5 m) MLLW	218 ft (66.5 m) MLLW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	218 ft (66.5 m) MLLW
Inter-array Cable (66 kV)																
Number of Foundations per Inter-Array	NA	6 to 10	NA	6 to 10	NA	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	NA	6 to 10	NA
Inter-Array Cable Length	NA	171 mi (275 km)	NA	171 mi (275 km)	NA	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	NA	171 mi (275 km)	NA
Target Burial Depth	NA	5 ft (1.5 m)	NA	NA	NA	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	NA
Inter-array Cable Installation Method (includes a pre-lay grapnel run)	Evaluate all traffic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Protection Method (rock placement, concrete mattresses, half-shell)	NA	up to 10% of inter-array route	NA	up to 10% of inter-array route	NA	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	NA	up to 10% of inter-array route	NA
Export and Inter-link Cable (220 kV)																
Number of Export Cables	NA	2	NA	NA	NA	2	2	2	2	2	2	2	2	2	2	NA
Burial Depth	NA	5 ft (1.5 m)	NA	NA	NA	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	NA
Maximum Length of Export Cable (assuming Two cables)	NA	98 mi (158 km)	NA	NA	NA	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	NA
Typical separation distance of Export Cable (assuming two cables)	NA	492 ft (100 m)	NA	492 ft (100 m)	NA	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	NA
Total Corridor Width for Export Cable (assuming two cables) [f]	NA	3,280 ft (1,000 m)	NA	NA	NA	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	NA
Maximum Length of Inter-Link Cable	NA	6.2 mi (10 km)	NA	NA	NA	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	NA
Export Cable Installation Method (includes a pre-lay grapnel run)	NA	Dredging the entire route	NA	Dredging the entire route	NA	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	NA
Export Cables Dredging (width corridor per cable)	NA	66 ft (20 m)	NA	66 ft (20 m)	NA	66 ft (20 m)	66 ft (20 m)	66 ft (20 m)	66 ft (20 m)	NA	66 ft (20 m)	NA	66 ft (20 m)	66 ft (20 m)	66 ft (20 m) wide corridor per cable	NA
Export Cables Total Dredging Area	NA	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	up to 69 acres (279,400 m^2)	NA
Export Cables Total Dredging Volume	NA	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	NA
Protection Method (rock placement, concrete mattresses, half-shell)	NA	Up to 10% of export route	NA	Up to 10% of export route	NA	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	NA

cy = cubic yard; DP = dynamic positioning; ESP = electrical service platform; ft = foot; ft^2 = square feet; ft^3 = cubic feet; kJ = kilojoule; km = kilometer; kV = kilovolt; m = meter; m^2 = square meters; m^3 = cubic meters; mi = mile; MLLW = mean lower low water; MW = megawatt; NA = not applicable; WTG = wind turbine generator

[a] Vineyard Wind's Proposed Action is for an approximately 800 MW offshore wind energy project. This FEIS evaluates the potential impacts of a facility up to 800 MW to ensure that it covers projects constructed with a smaller capacity.

[b] Additional positions allow for spare turbine locations or additional capacity to account for electrical losses.

[c] Elevations relative to mean higher high water are approximately 3 feet (1 meter) lower than those relative to MLLW.

[d] Work would not be performed concurrently. No drilling is anticipated; however, it may be required if a large boulder or refusal is met. If drilling is required, a rotary drilling unit would be mobilized or vibratory hammering would be used. Similarly, vibratory hammering could be used if deemed appropriate by the installation contractor.

[e] Vineyard Wind has estimated that typical pile driving for a monopile is expected to take less than approximately 3 hours to achieve the target penetration depth and that pile driving for the jacket foundation would take approximately 3 hours to achieve the target penetration depth. The hammer size used for installation of the monopile and jacket foundation differs.

[f] Corridor width for siting purposes; each trench would be approximately 3.2 feet (1 meter) wide and there would be an up to 3.3 to 6.6-foot-wide (1- to 2-meter) temporary disturbance zone from the tracks or skids of the cable installation. Corridor width for siting purposes; each trench would be approximately 3.2 feet (1 meter) wide and would directly disturb an approximately 6.4-foot-wide (2-meter) corridor.

APPENDIX H

Analysis of Incomplete or Unavailable Information

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APPENDIX H. ANALYSIS OF INCOMPLETE OR UNAVAILABLE INFORMATION

In accordance with Section 1502.22 of the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA), when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an Environmental Impact Statement and when information is incomplete or unavailable, the agency shall always make clear that such information is lacking.

Given the substantial geographic and temporal scale of the impacts analysis of future activities (including offshore wind), some information regarding future activities is unavailable or only available in qualitative or summary form. For example, project-specific information is available only from the ten Construction and Operations Plans (COPs) lessees have submitted for Bureau of Ocean Energy Management (BOEM) review (including the COP for the proposed Vineyard Wind 1 Offshore Wind Energy Project [Project]). Considering that such information is lacking for other offshore wind activities considered reasonably foreseeable, and several of the COPs submitted are currently under review to determine whether they contain complete and sufficient information for environmental review, a series of assumptions were necessary to conduct the impacts analysis. These assumptions are listed in Appendix A, and additional information is provided in Chapter 1. While it is not known whether or to what degree future offshore wind activities will proceed according to these assumptions, these assumptions are adequate to allow the analysis to proceed with a reasonable degree of certainty.

In addition, information is also incomplete or unavailable regarding the likely consequences of various activities on the resources analyzed.[1] When incomplete or unavailable information was identified, BOEM considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information, if the cost of obtaining it was exorbitant, and if it could not be obtained, applied acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information. For example, conclusive information on many impacts of the offshore wind industry may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. In its place, subject matter experts (SMEs) have used the scientifically credible information available and accepted scientific methodologies to evaluate impacts on the resources while this information is unavailable.

H.1. INCOMPLETE OR UNAVAILABLE INFORMATION ANALYSIS FOR RESOURCE AREAS

H.1.1. Air Quality

Although a quantitative emissions inventory analysis of the region over the next 30 years would more accurately assess the overall change in emissions from the proposed Project, any action alternative would lead to reduced emissions and can only lead to a net improvement in air quality. The differences among action alternatives with respect to direct emissions due to construction, operations and maintenance, and decommissioning of the proposed Project are expected to be small. As such, the analysis provided in this Final Environmental Impact Statement (FEIS) is sufficient to support sound scientific judgements and informed decision making related to the use of the offshore portions of the Wind Development Area (WDA) and Offshore Export Cable Corridor (OECC). Therefore, BOEM does not believe that there is incomplete or unavailable information on air quality that is essential to a reasoned choice among alternatives.

H.1.2. Water Quality

No incomplete or unavailable information related to the analysis of impacts on water quality was identified.

[1] The impacts of climate change would contribute to significant adverse impacts for all resource areas. However, the resource impacts from climate change would not differ among alternatives, and are not further identified here, since these impacts are not essential for a reasoned choice among alternatives.

H.1.3. Terrestrial and Coastal Fauna

Although the preferred habitats of terrestrial and coastal fauna are generally known, exact abundances and distributions of various fauna are likely to remain unknown for the foreseeable future. However, the species inventories and other information from nearby areas provide an adequate basis for evaluating the fauna likely to inhabit the onshore areas potentially affected by the proposed Project, and the differences among action alternatives with respect to terrestrial and coastal fauna for the Project are expected to be small. Additionally, the onshore activities proposed involve only common, industry standard activities for which impacts are generally understood. As such, the analysis provided in this FEIS is sufficient to make a reasoned choice among the alternatives, and there is no incomplete or unavailable information needed to conduct the impact assessment.

H.1.4. Birds

There is incomplete information on the exact migratory routes of passerines and shore birds that fly over the Atlantic Outer Continental Shelf (OCS) (including those that fly at night) where some may fly overland or along the coast before crossing the ocean. In addition, there will always be some level of incomplete information on the distribution and habitat use of marine birds in the offshore portions of the WDA, as habitat use and distribution varies between season, species, and years. However, the WDA has been surveyed approximately 49 times from 2007 to 2015, and the results were used to inform the predictive models and analyze the potential adverse impacts on bird resources in the Draft Environmental Impact Statement (DEIS), Supplement to the DEIS, and the FEIS. Additionally, there will always be some level of uncertainty regarding the potential for collision risk and avoidance behaviors for some of the bird species that may be present within the offshore portions of the WDA, as the Vineyard Wind 1 Project represents the first utility-scale offshore wind project in the United States.

To put the potential for bird mortality associated with operating wind turbine generators (WTGs) on the OCS in context, this FEIS used some data collected at onshore wind facilities and makes assumptions regarding the applicability of these data to offshore environments. The estimated mortality provided in the FEIS could be larger than expected due to differences in species groups present, differences in the life history and behavior of those species, as well as differences in the offshore marine environment compared to onshore habitats. Similarly, the FEIS also provides an estimate of potential mortality using the Band (2012) collision risk model and Avian Stochastic collision risk model. Modeling is commonly used to predict the potential mortality rates for marine bird species in Europe and the United States (BOEM 2015, 2019a). Model inputs include monthly bird densities, flight behavior, avoidance behavior, and other factors to determine the estimated number of annual collisions with operating WTGs. Due to inherent data limitations, these models often represent only a subset of marine bird populations potentially present. Collison risk models were used to estimate the potential mortality associated with future offshore wind development. Twelve common marine bird species had enough species-specific information (e.g., density estimates, flight height distributions, avoidance rates) to be used in the model, and these species represent a wide range of marine bird species on the Atlantic OCS spanning five taxonomic orders. Although detailed species-specific information (e.g., flight height distributions, avoidance rates) is not known for many of the other marine bird species that use the Atlantic OCS, many of these species are taxonomically similar and have similar ecologies as those modeled. The datasets used by both Vineyard Wind and BOEM to assess the potential for exposure of marine birds to the WDA represent the best available data and provide context at both local and regional scales.

The regional scale assessment of potential exposure to the WDA includes data that were collected on a large regional and temporal scale, and includes aerial and boat survey data collected from 1978 to 2014 to develop long-term average annual and seasonal models. Further, sufficient information on collision risk and avoidance behaviors observed in related species at European offshore wind projects is available and was used to analyze and corroborate the potential for these impacts as a result of the proposed Project (e.g., Petersen et al. 2006; Skov et al. 2018). However, the estimates of potential collision mortality in the FEIS are not provided to quantify the anticipated mortality associated with the development of Atlantic offshore wind energy facilities, and are not relied upon to reach an impact level determination, but rather are provided to assess the potential for collision mortality associated with the reasonably foreseeable development on the Atlantic OCS generally, and the proposed Vineyard Wind 1 Project specifically. As such, the analysis provided in the FEIS is sufficient to support sound scientific judgements and informed decision-making related to bird distribution and use of the offshore portions of the WDA as well as to the potential for collision risk and avoidance behaviors in bird resources. Therefore, BOEM does not believe that there is incomplete or unavailable information on avian resources that is essential to a reasoned choice among alternatives.

H.1.5. Bats

There will always be some level of incomplete information on the distribution and habitat use of migratory tree bats in the offshore portions of the WDA, as habitat use and distribution varies among seasons and species. Additionally, there is some level of uncertainty regarding the potential collision risk to individual bats that may be present within the offshore portions of the WDA, as the Vineyard Wind 1 Project represents the first utility-scale offshore wind project in the United States. However, sufficient information on collision risk to migratory tree bats observed at land-based U.S. wind projects exists, and it was used to analyze and corroborate the potential for this impact as a result of the proposed Project. In addition, as described in the FEIS Section A.8.4 of Appendix A, the likelihood of an individual migratory tree bat encountering an operating WTG during migration is very low and, therefore, the differences among action alternatives with respect to bats for the Project are expected to be small. As such, the analysis provided in this FEIS is sufficient to support sound scientific judgements and informed decision making related distribution and use of the offshore portions of the WDA as well as to the potential for collision risk of migratory tree bats. Therefore, BOEM does not believe that there is incomplete or unavailable information on bat resources that is essential to a reasoned choice among alternatives.

H.1.6. Coastal Habitats

No incomplete or unavailable information related to the analysis of impacts on coastal habitats was identified.

H.1.7. Benthic Resources

Although there is uncertainty regarding the temporal distribution of benthic (animal) resources and periods during which they might be especially vulnerable to disturbance, Vineyard Wind's surveys of benthic resources in 2016, 2017, and 2018, and other broad-scale studies (Guida et al. 2017; The Nature Conservancy 2014) provided a suitable basis for generally predicting the species, abundances, and distributions of benthic resources in the geographic analysis area for benthic resources. Uncertainty also exists regarding the impact of impact-producing factors (IPFs) on benthic resources. For example, specific stimulus-response information on acoustics and electromagnetic fields (EMFs) are not fully known for all benthic species, but there is information from benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States. Similarly, specific secondary impacts such as changes in diets through the food chain resulting from habitat modification and synergistic behavioral impacts from multiple IPFs are not fully known. Again, results of benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States provide for a broad understanding of the overall impacts of these IPFs combined, if not individually. As such, the analysis provided in this FEIS is sufficient to support sound scientific judgements and informed decision-making related to the overall impacts. Therefore, BOEM does not believe that there is incomplete or unavailable information on benthic resources that is essential to a reasoned choice among alternatives.

H.1.8. Finfish, Invertebrates, and Essential Fish Habitat

There is uncertainty regarding the spatial and temporal occurrence of finfish, invertebrates, and essential fish habitat throughout the entire geographic analysis area. However, broad-scale information is available from sources such as federal fisheries management plans, Guida et al. (2017), and surveys completed to support COP submission. There is also uncertainty regarding behavioral impacts from each IPF individually and combined. Again, BOEM is able to draw on years of fish monitoring results in Europe as well analogous activities in the United States (e.g., bridge construction, oil and gas platforms, etc.). Thus, BOEM extrapolated or drew assumptions from what is known about similar species and/or situations. Additional information, extrapolations, and assumptions are presented in FEIS Section 3.3 and references therein, in the Biological Assessment (BA) (BOEM 2019a, 2020a), and in the Essential Fish Habitat Assessment (BOEM 2019b, 2020b). As such, the analysis provided in this FEIS provides sufficient information on the likely effects of each IPF and the potential impacts that could result from the proposed Project and past, present, and reasonably foreseeable actions. Therefore, BOEM does not believe that there is incomplete or unavailable information on finfish, invertebrates, and essential fish habitat that is essential to a reasoned choice among alternatives.

H.1.9. Marine Mammals

There is some incomplete information regarding the interaction of marine mammals with EMF fields produced by submarine cables. These gaps remain partly owing to difficulties in evaluating impacts at population scale around these deployments (Taormina et al. 2018). Scientific studies examining effects of altered EMF on marine mammals have not been conducted. The large size of marine mammals and other logistical constraints make experimental studies infeasible. However, a summary of existing relevant evidence is provided in the BOEM-sponsored report by Normandeau et al. (2011) cited in FEIS Section 3.4. Using this information, BOEM's SMEs have estimated that marine mammals would likely have a low risk of impacts related to EMF from submarine cables, because the high mobility of marine mammals would tend to reduce exposure time.

There is uncertainty regarding the response of large whale species to new structures due to the novelty of this type of development on the Atlantic OCS. Although 2,066 new structures are anticipated under the expanded planned action scenario, spacing would be sufficient to allow unobstructed access within and between wind facilities. While avoidance of WDAs due to new structures is possible, it is unlikely, due to the whales' size relative to WTG spacing. Additionally, while there is some uncertainty regarding how hydrodynamic changes around foundations may affect prey availability, these changes are expected to have limited impacts on the local conditions around WTG foundations. It is anticipated that the hydrodynamic impacts and the reef effect both may result in potential impacts on marine mammal prey species in the immediate vicinity of WTG foundations. The potential consequences of these impacts on the Atlantic OCS are unknown. Monitoring studies would be able to determine more precisely any changes in whale behavior.

There is also uncertainty regarding the combined planned action acoustic impacts associated with pile-driving activities. The available information relative to impacts on marine mammals from pile driving associated with offshore wind development is primarily limited to information on harbor porpoises and seals, as the vast majority of this research has occurred at European offshore wind projects where large whales are uncommon. At this time, it is unclear if marine mammals would cease feeding, and when individuals would resume normal feeding, migrating, or breeding behaviors once daily pile-driving activities cease, or if secondary impacts would persist. Under the expanded planned action scenario, individual whales may be exposed to acoustic impacts from multiple projects in 1 day or to acoustic impacts from one or more projects over the course of multiple days. The consequences of these exposure scenarios have been analyzed with the best available information, but a lack of real-world observations on species' responses to pile driving results in uncertainty. Additionally, it is currently unclear how sequential years of construction of multiple projects would impact marine mammals.

Finally, there are no data relative to the impacts of elevated turbidity on marine mammals; therefore, it is conservatively assumed that normal movements may be altered. However, these movements would be expected to be too small to be meaningfully measured and no adverse impacts would be expected from marine mammals swimming through turbidity plumes to leave the turbid area (NOAA 2020).

BOEM believes that the overall costs of obtaining this information are exorbitant and the means to obtain it are not known. Although the above information is unavailable, BOEM extrapolated or drew assumptions from what is known about similar species and/or situations. Additional information, extrapolations, and assumptions are presented in Section 3.4 of this FEIS and references therein, in the BA submitted to NOAA (BOEM 2019a, 2020a), and in the Biological Opinion issued by NOAA (NMFS 2020). BOEM used the best available information to predict potential impacts on marine mammals, and the analysis provided in the FEIS is sufficient to support sound scientific judgements and informed decision-making related to the proposed uses of the offshore portions of the WDA. Therefore, BOEM does not believe that there is incomplete or unavailable information on marine mammals that is essential to a reasoned choice among alternatives.

H.1.10. Sea Turtles

The effects of EMF on sea turtles, both foraging and migrating, are not completely understood. However, the available relevant information is summarized in the BOEM-sponsored report by Normandeau et al. (2011) cited in Section 3.5 of the FEIS and utilized in the BA for the proposed Project (BOEM 2019a, 2020a). Although the thresholds for EMF disturbing various sea turtle behaviors are not known, no adverse effects on sea turtles from the numerous submarine power cables around the world have been documented to occur. In addition, no nesting beaches, critical habitat, or other biologically important habitats were identified in the OECC or landfall location.

There is also uncertainty relative to sea turtle responses to construction activities on the Atlantic OCS. Some potential for displacement from construction areas exists. However, if this displacement occurs, it is unclear whether individuals would be displaced into lower quality habitat, or into areas with higher risk of fatal vessel interactions. Additionally, it is currently unclear whether concurrent construction of multiple projects or construction completed over sequential years would be the most impactful to sea turtles. There is also uncertainty regarding the combined planned action acoustic impacts associated with pile-driving activities. However, it is assumed that sea turtles would resume normal feeding, migrating, or breeding behaviors once daily pile-driving activities cease, or if secondary impacts would continue. Under the expanded planned action scenario, individual sea turtles may be exposed to acoustic impacts from multiple projects in 1 day or to acoustic impacts from one or more projects over the course of multiple days. The consequences of these exposure scenarios have been analyzed with the best available information. Despite a lack of real world observations on species' responses to pile driving, the anticipated impacts have been assessed on the species hearing abilities, behavior, and observed responses to other impulsive sounds. Considering the best available information, NMFS has determined that with the required mitigation, monitoring, and reporting conditions, the Project is not expected to jeopardize the continued existence of any species of sea turtles (NMFS 2020).

Some uncertainty exists regarding the potential for sea turtle responses to Federal Aviation Administration and navigation lighting associated with offshore wind development. Given the placement of the new structures far from nesting beaches, no impacts to nesting female or hatchling sea turtles would be expected. However, at this time, it is unclear whether the required lighting on WTGs and electrical service platforms would be visible under the water surface, and if so, how sea turtles would respond to such light. Although the potential impacts of offshore lighting on juvenile and adult sea turtles is uncertain, WTG lighting is not anticipated to have any detectable impacts (adverse or beneficial) on any age class of sea turtles in the offshore environment given the current lack of evidence that platform lighting leads to impacts on sea turtles as shown by decades of oil and gas platform operation in the Gulf of Mexico, which can have considerably more lighting than offshore WTGs (BOEM 2019a, 2020a).

Finally, information regarding the impacts of elevated turbidity on juvenile and adult sea turtles was not identified, although it is assumed that normal movements may be altered. However, these movements would be expected to be too small to be meaningfully measured and no adverse impacts would be expected from sea turtles swimming through turbidity plumes to leave the turbid area (NOAA 2020).

BOEM believes that the overall costs of obtaining this information are exorbitant and the means to obtain it are not known. Although the above information is unavailable, BOEM extrapolated or drew assumptions from what is known about similar species and/or situations. Additional information, extrapolations, and assumptions are presented in FEIS Section 3.5 and references therein, in the BA submitted to NOAA (BOEM 2019a, 2020a), and in the Biological Opinion issued by NOAA (NMFS 2020). As such, the analysis provided in the FEIS is sufficient to support sound scientific judgements and informed decision-making related to the proposed uses of the offshore portions of the WDA. BOEM used the best available information to predict potential impacts on sea turtles. Therefore, BOEM does not believe that there is incomplete or unavailable information on turtles that is essential to a reasoned choice among alternatives.

H.1.11. Demographics, Employment, and Economics

Vineyard Wind's economic analysis estimated the employment and economic requirements and outputs for the Proposed Action, but BOEM's estimates for changes in jobs, expenditures, and economic outputs for demographic, employment, and economic impacts for Alternatives C through F were based on comparisons with

Vineyard Wind's estimate. This provided sufficient information for the evaluation of demographics, employment, and economics to support a reasoned choice among alternatives. There is some inherent uncertainty in forecasting how economic variables in various areas will evolve over time. However, the differences among action alternatives with respect to demographics, employment, and economics are not expected to be significant. Therefore, BOEM does not believe that there is specific incomplete or unavailable information on demographics, employment, and economics that is essential to a reasoned choice among alternatives.

H.1.12. Environmental Justice

Evaluations of impacts on environmental justice communities rely on assessment of impacts on other resources. As a result, while there is no incomplete or unavailable information related to the analysis of environmental justice impacts itself, incomplete or unavailable information related to other resources—including but not limited to the data discussed in Sections H.1.13, H.1.14, H.1.15, and H.1.17—also affect the analysis of impacts on environmental justice communities. As discussed in the sections previously referenced, the incomplete and unavailable information was either not relevant to a reasoned choice among alternatives or BOEM's SMEs used alternative methods to perform an analysis that would allow the decision maker to make a reasoned choice among the alternatives considered. Further, the differences among action alternatives with respect to environmental justice are not expected to be significant. Therefore, BOEM does not believe that there is specific incomplete or unavailable information on environmental justice that is essential to a reasoned choice among alternatives.

H.1.13. Cultural, Historical, and Archaeological Resources

Information pertaining to the identification of historic properties within certain portions of the marine archaeology area of potential effect will not be available until after the Record of Decision is issued and the COP is approved. However, the differences among action alternatives with respect to cultural, historical, and archeological resources are not expected to be significant. Further, note that BOEM will prepare a Memorandum of Agreement with the Section 106 Consulting Parties allowing for deferred identification and evaluation of historic properties within this portion of the area of potential effect in accordance with BOEM's existing Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585, ensuring that potential historic properties are identified, effects assessed, and adverse effects resolved prior to construction. Therefore, BOEM does not believe that this incomplete or unavailable information on marine archaeological resources is essential to a reasoned choice among alternatives.

H.1.14. Recreation and Tourism

No incomplete or unavailable information related to the analysis of impacts on recreation and tourism was identified.

H.1.15. Commercial Fisheries and For Hire Recreational Fishing

Fisheries are managed in the context of an incomplete understanding of fish stock dynamics and effects of environmental factors on fish populations. Although the fisheries information used in this assessment has limitations (e.g., vessel trip report data is an imprecise measurement of where fishing occurred; vessel monitoring systems are not required of all fishing vessels; available historical data lacks consistency, making comparisons challenging), it is the best available data and is sufficient information to support the findings presented in this FEIS. Therefore, BOEM does not think that additional research to overcome the limitations of the best available information would be essential to a reasoned choice among alternatives.

As discussed in Section H.1.18, BOEM has concluded that the information provided by NOAA in FEIS Section 3.12.2.5 and Appendix B Table 3.12-1 regarding scientific research and surveys are sufficient to support the impact findings presented in the FEIS, including how the scientific survey impacts may affect stock assessments and commercial and for-hire fishery catch quotas. Therefore, BOEM does not believe that there is incomplete or unavailable information on scientific surveys that is essential to a reasoned choice among alternatives.

H.1.16. Land Use and Coastal Infrastructure

No incomplete or unavailable information related to the analysis of impacts on land use and coastal infrastructure was identified.

H.1.17. Navigation and Vessel Traffic

The navigation and vessel traffic impact analysis in the DEIS, Supplement to the DEIS, and this FEIS is based on Automatic Identification System (AIS) data from vessels required to carry AIS (i.e., those 65 feet [19.8 meters] or greater in length) since March 2015, as well as Vessel Monitoring System (VMS) data for individual vessel trips. Fishing vessels at least 65 feet long were not required to carry AIS until March 2015 (80 Fed. Reg. 17326); therefore, AIS data prior to March 2015 are more limited than data available after March 2015. VMS data for fishing vessels provided to BOEM by the National Marine Fisheries Service (NMFS) were the basis for polar histograms and other analytical outputs used in evaluating commercial and for-hire recreational fishing trips (FEIS, Section 3.10). Vineyard Wind's Navigational Risk Assessment (COP Volume III, Appendix III-I; Epsilon 2020) also includes observations about VMS data, based on maps of 2006 to 2016 VMS data provided by NMFS and the Northeast Regional Ocean Council, as well as BOEM's own data analysis. These observations supplement the AIS data by identifying areas of fishing vessel concentration within the WDA and surrounding area. As shown in Table 3.11-2 in Appendix B, some smaller recreational and fishing vessels carry an AIS; however, the AIS analysis likely excludes most vessels less than 65 feet (19.8 meters) long that traverse the WDA. In addition, the VMS data provided by NMFS exclude some non-federally managed commercial fishing, federally managed commercial fishing that does not require VMS, and recreational fishing vessel trips through the WDA and across the OECC. Nonetheless, the combination of AIS and VMS data described above represents the best available vessel traffic data, and is sufficient to enable BOEM to make a reasoned choice among alternatives.

The U.S. Coast Guard's (USCG's) Final Massachusetts and Rhode Island Port Access Route Study (MARIPARS), evaluating the need for establishing vessel routing measures, was published in the *Federal Register* on May 14, 2020 (USCG 2020). The Final MARIPARS recommended an aligned, regular, and gridded layout throughout the Rhode Island and Massachusetts Lease Areas that provides adequate sea room to facilitate predictable safe navigation throughout the contiguous leases. The recommendation includes three "lines of orientation," or predictable headings that vessels can take at any location within the contiguous lease areas. The Final MARIPARS stated that 1-nautical-mile-wide east-to-west paths would facilitate traditional fishing methods in the area, and 1-nautical-mile-wide north-to-south paths would provide the USCG with adequate access for search and rescue access. Finally, 0.6- to 0.8-nautical-mile-wide northwest-to-southeast paths would allow commercial fishing vessels to continue their travel from port, through the lease areas, and to fishing grounds. The five Rhode Island and Massachusetts offshore wind leaseholders have proposed a collaborative regional layout for wind turbines (1 x 1 nautical mile apart in fixed east-to-west rows and north-to-south columns, with 0.7-nautical-mile theoretical transit lanes oriented northwest-southeast) across their respective BOEM leases (Geijerstam et al. 2019) that meets the layout rules set forth in the Draft MARIPARS recommendations. Though the USCG attached the RODA proposal (RODA 2020) recommending additional transit corridors through the lease areas to the MARIPARS *Federal Register* Docket, the Final MARIPARS concluded that if the layout in the recommendations were implemented, the USCG would not pursue any additional routing measures. As a cooperating agency with BOEM, BOEM and USCG will continue to consult over the course of the NEPA process for the proposed Project as it relates to navigational safety and other aspects, including the impacts associated with alternatives assessed.

As stated in Section 3.11, WTG and ESP structures could potentially interfere with marine radars. Marine radars have varying capabilities and the ability of radar equipment to properly detect objects is dependent on radar type, equipment placement, and operator proficiency; however, trained radar operators, properly installed and adjusted vessel equipment, marked wind turbines, and the use of AIS all would enable safe navigation with minimal loss of radar detection (USCG 2020). Vineyard Wind will conduct a marine radar study in 2021 to quantify the potential impacts of the proposed Project on marine radars, and to identify necessary mitigation strategies (Baird 2020).

Based on the foregoing, BOEM does not believe that there is incomplete or unavailable information on navigation and vessel traffic that is essential to a reasoned choice among alternatives.

H.1.18. Other Uses

As specified in the FEIS, this category includes other uses of the OCS not addressed in other resource sections. In the context of the NEPA analysis, this includes marine mineral resources, military and national security uses, aviation and air traffic, offshore energy uses (aside from the proposed Project), land-based radar systems, and scientific research surveys. There is no incomplete or unavailable information related to the analysis of marine mineral resources, military and national security uses, aviation and air traffic, and offshore energy uses (aside from the aspects described in this appendix for the proposed Project, and the reasonably foreseeable offshore wind projects for which BOEM has not received COPs), and land-based radar systems.

As discussed in FEIS Section 3.12.2.5 for scientific research and surveys, preliminary analyses of the impacts on survey areal coverage show substantial impacts to NMFS' ability to continue using current methods to fulfill its mission of precisely and accurately assessing fish and shellfish stocks for the purpose of fisheries management, and assessing protected species for the purpose of protected species management. Section 3.12.2.5 also discusses potential approaches and opportunities to lessen impacts on scientific research and surveys in the long term. Regardless of such actions, long-standing NMFS surveys would not be able to continue as currently designed, and extensive costs and efforts would be required to adjust survey approaches. Therefore, BOEM has concluded that the information provided by NOAA in FEIS Section 3.12.2.5 and Appendix B Table 3.12-1 regarding scientific research and surveys are sufficient to support the impact findings presented in the FEIS. Therefore, BOEM does not believe that there is incomplete or unavailable information on scientific surveys that is essential to a reasoned choice among alternatives.

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APPENDIX I

List of Preparers and Reviewers, References Cited, and Glossary

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APPENDIX I. LIST OF PREPARERS AND REVIEWERS, REFERENCES CITED, AND GLOSSARY

I.1. LIST OF PREPARERS AND REVIEWERS

I.1.1. BOEM Contributors

Name	Role/Resource Area
NEPA Coordinator	
Bucatari, Jennifer	NEPA Compliance; Environmental and Physical Settings; Other Uses
Resource Scientists and Contributors	
Baker, Arianna	Navigation and Vessel Traffic
Baker, Kyle	Marine Mammals; Sea Turtles
Bigger, David	Birds; Bats; Terrestrial and Coastal Fauna
Brune, Genevieve	Land Use
Carrier, Brandi	Cultural Resources; Recreation and Tourism
Cody, Mary	Marine Mammals; Sea Turtles
Draher, Jennifer	Water Quality; Navigation
Farmer, Isis	NEPA Compliance
Heinze, Martin	Demographics, Employment, and Economics
Hesse, Jeffery	Other Uses
Hoffman, Willie	Cultural Resources
Hooker, Brian	Finfish, Invertebrates, and Essential Fish Habitat; Commercial Fisheries and For Hire Recreational Fishing; Benthic Resources; Coastal Habitats; Recreation and Tourism
Howson, Ursula	Finfish, Invertebrates, and Essential Fish Habitat; Commercial Fisheries and For Hire Recreational Fishing; Benthic Resources; Coastal Habitats; Recreation and Tourism
Jensen, Mark	Demographics, Employment, and Economics
Krevor, Brian	Environmental Justice
Lilley, Meredith	Project Coordinator
McCarty, John	Recreation and Tourism
McCoy, Angel	Meteorologist; Technical Design Elements
Miller, Jennifer	Geophysicist, Environmental and Physical Settings
O’Connell, Daniel	Geotechnical Engineer, Technical Design Elements
Slayton, Ian	Air Quality; Appendix A
Warner, Richard	Cultural Resources; Recreation and Tourism

I.1.2. Reviewers

Name	Title	Agency
Brown, William Y.	Chief Environmental Officer	BOEM
Morin, Michelle	Chief, Environment Branch for Renewable Energy	BOEM
Melendez-Arreaga, Pedro	Attorney-Advisor	Department of the Interior, Office of the Solicitor
Vorkoper, Stephen	Attorney-Advisor	Department of the Interior, Office of the Solicitor
Creed, Jordan	Environmental Protection Specialist	Bureau of Safety and Environmental Enforcement
Timmerman, Timothy	Director	Environmental Protection Agency Region 1, Office of Environmental Review
Engler, Lisa	Director	Massachusetts Office of Coastal Zone Management
Crocker, Julie	Endangered Fish Branch Chief	NOAA National Marine Fisheries Service
Tuxbury, Susan	Fishery Biologist	NOAA National Marine Fisheries Service
Carduner, Jordan	Fishery Biologist	NOAA National Marine Fisheries Service
Cardiasmenos, Tim	NEPA Coordinator	NOAA National Marine Fisheries Service
Christel, Doug	Fishery Policy Analyst	NOAA National Marine Fisheries Service

Name	Title	Agency
Coit, Janet	Director	Rhode Island Department of Environmental Management
Willis, Jeffrey	Executive Director	Rhode Island Coastal Resource Management Council
Ciochetto, David	Principal Ocean Engineer	Rhode Island Coastal Resource Management Council
Boyd, James	Coastal Policy Analyst	Rhode Island Coastal Resource Management Council
Jacek, Christine	Permit Project Manager	U.S. Army Corps of Engineers
DesAutels, Michele	Chief, Maritime Energy & Marine Planning	U.S. Coast Guard
Detweiler, George	Marine Transportation Specialist, Headquarters	U.S. Coast Guard
Geoffrion, Commander Sarah	Prevention Department Head, Sector Southeastern New England	U.S. Coast Guard

I.1.3. Consultants

Name	Role/Resource Area
Environmental Resources Management	
Project Management/Coordinators	
Costello, Kate	Technical Editor; All Sections
DeWitt, Andrew	Deputy Project Manager; All Sections
Fisher, Michelle	Technical Editor; All Sections
Graham, James	Partner-in-Charge; All Sections
Heater, Heather	Project Manager; All Sections
Hiatt, Kris	Document Manager/Technical Editor; All Sections
Smith, Emily	Technical Editor; All Sections
Thorpe, Monika	Geographic Information Systems
Subject Matter Expert Leads	
Bedard, Justin	Cultural Resources
Gray, Davis	Water Quality
Gregory, Amanda	Water Quality
Guffey, Samuel	Terrestrial and Coastal Faunas other than Birds; Coastal Habitats; Benthic Resources; Finfish, Invertebrates, and Essential Fish Habitat
Gustavson, Kent	Commercial Fisheries and For Hire Recreational Fishing
Hamel, Rich	Air Quality
Hamer, Caitlin	Commercial Fisheries and For Hire Recreational Fishing
Huff, Jenifer	Demographics, Employment, and Economics; Environmental Justice; Recreation and Tourism; Land Use and Coastal Infrastructure
Klausmann, Al	Air Quality
Laird, Emily	Visual Impact Assessment
Low, Tara	Other Uses (Marine Minerals, Military Use, Aviation, Offshore Energy); Appendix A
Raffel, Noam	Visual Impact Assessment
Steffen, Bradley	Birds; Bats; Marine Mammals; Sea Turtles
Stormer, Amanda	Terrestrial and Coastal Faunas other than Birds; Coastal Habitats
Sussman, Benjamin	Demographics, Employment, and Economics; Environmental Justice; Recreation and Tourism; Land Use and Coastal Infrastructure; Navigation and Vessel Traffic; Visual Impact Assessment
Todorov, Melinda	Navigation and Vessel Traffic

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I.3. GLOSSARY

Term	Definition
affected environment	environment as it exists today that could be potentially impacted by the proposed Project
automatic identification system	automatic tracking system used on vessels to monitor ship movements and avoid collision
algal blooms	rapid growth of the population of algae, also known as algae bloom
allision	a moving ship running into a stationary ship
anthropogenic	generated by human activity
archaeological resource	historical place, site, building, shipwreck, or other archaeological site on the American landscape
ballast	material used to improve stability of a vessel or other vehicle or structure
ballast tank	vessel compartment used to hold water to improve stability
ballast water	water carried by a ship in its ballast tank to improve stability
baleen whale	a cetacean with baleens (whalebones) instead of teeth
below grade	below ground level
benthic	related to the bottom of a body of water
benthic resources	the seafloor surface, the substrate itself, and the communities of bottom-dwelling organisms that live within these habitats
bilge	area where the bottom curve of a ship's hull meets the vertical sides
biogenic structure	structures generated by biological organisms
cetacea	order of aquatic mammals made up of whales, dolphins, porpoises, and related lifeforms
coastal habitat	coastal areas where flora and fauna live, including salt marshes and aquatic habitats
coastal waters	waters in nearshore areas where bottom depth is less than 98.4 feet (30 meters)
coastal zone	the lands and waters starting at 3 nautical miles from the land and ending at the first major land transportation route
commercial fisheries	areas or entities raising and/or catching fish for commercial profit
commercial-scale wind energy facility	wind energy facility usually greater than 1 MW that sells the produced electricity
cultural resource	historical districts, objects, places, sites, buildings, shipwrecks, and archeological sites on the American landscape, as well as sites of traditional, religious, or cultural significance to cultural groups, including Native American tribes
culvert	structure, usually a tunnel, allowing water to flow under an obstruction (e.g., road, trail)
planned actions	impacts that could result from the incremental impact of a specific action, such as the proposed Project, when combined with other past, present, or reasonably foreseeable future actions or other projects; can occur from individually minor, but collectively significant actions that take place over time
criteria pollutant	one of six common air pollutants for which the USEPA sets National Ambient Air Quality Standards: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, or sulfur dioxide
critical habitat	geographic area containing features essential to the conservation of threated or endangered species
delphinids	oceanic dolphins
demersal	living close to the ocean floor
project design envelope	the range of proposed Project characteristics defined by the applicant and used by BOEM for purposes of environmental review and permitting
dredging	removal of sediments and debris from the bottom of lakes, rivers, harbors, and other water bodies
duct bank	underground structure that houses the onshore export cables, which consists of polyvinyl chloride (PVC) pipes encased in concrete
ecosystem	community of interacting living organisms and nonliving components (such as air, water, soil)

Term	Definition
electrical service platform	the interconnection point between the wind turbine generators and the export cable; the necessary electrical equipment needed to connect the 66 kV inter-array cable to the 220 kV offshore export cables
electromagnetic field	a field of force produced by electrically charged objects and containing both electric and magnetic components
embayment	recessed part of a shoreline
endangered species	a species that is in danger of extinction in all or a significant portion of its range
ensonification	the process of filling with sound
environmental consequences	the potential direct, indirect, and cumulative impacts that the construction, operations, maintenance, and decommissioning of the proposed Project would have on the environment
environmental justice communities	minority and low-income populations affected by the proposed Project
epifauna	fauna that lives on the surface of a seabed (or riverbed), or is attached to underwater objects or aquatic plants or animals
ESA-listed species	species listed under the Endangered Species Act of 1973 (As Amended)
essential fish habitat	“those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (50 CFR § 600)
export cables	cables connecting the wind facility to the onshore electrical grid power
export cable corridor	area identified for routing the entire length of the onshore and offshore export cables
federal aids to navigation	visual references operated and maintained by the USCG, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation
finfish	vertebrate and cartilanginous fishery species, not including crustaceans, cephalopds, or other mollusks
for-hire commercial fishing	commercial fishing on a for-hire vessel (i.e., a vessel on which the passengers make a contribution to a person having an interest in the vessel in exchange for carriage)
geomagnetic	relating to the magnetism of the Earth
gillnet	a vertically hanging fishnet that traps fish by their gills
hard-bottom habitat	benthic habitats comprised of hard-bottom (e.g., cobble, rock, and ledge) substrates
historical resource	prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource
horizontal directional drilling	trenchless technique for installing underground cables, pipes, and conduits using a surface-launched drilling rig
hull	watertight frame or body of a ship
hypoxic event	event related to a lack of adequate oxygen supply
infauna	fauna living in the sediments of the ocean floor (or river or lake beds)
inter-array cables	cables connecting the wind turbine generators to the electrical service platforms
inter-link cables	cables connecting the electrical service platforms to one another
invertebrate	animal with no backbone
jacket foundation	latticed steel frame with three or four supporting piles driven into the seabed
jack-up vessel	mobile and self-elevating platform with buoyant hull
jet excavation	process of moving or removing soil with a jet
jet plowing	plowing in which the jet plow, with an adjustable blade, or plow rests on the seafloor and is towed by a surface vessel; the jet plow creates a narrow trench at the designated depth, while water jets fluidize the sediment within the trench; in the case of the proposed Project, the cables would then be feed through the plow and laid into the trench as it moves forward; the fluidized sediments then settle back down into the trench and bury the cable
knot	unit of speed equaling 1 nautical mile per hour
landfall site	the shoreline landing site at which the offshore cable transitions to onshore
marine mammal	aquatic vertebrate distinguished by the presence of mammary glands, hair, three middle ear bones, and a neocortex (a region of the brain)
marine waters	waters in offshore areas where bottom depth is more than 98.4 feet (30 meters)

Term	Definition
Massachusetts Lease Areas	the lease areas that are comprised of the following projects: Bay State (portion of OCS-A 0500), Vineyard Wind 1 and Vineyard Wind South (OCS-A 0501), Equinor (OCS-A 0520), Mayflower (OCS-A 0521), and Liberty Wind (OCS-A 0522)
monopile or monopile foundation	a long steel tube driven into the seabed that supports a tower
nautical mile	a unit used to measure sea distances and equivalent to approximately 1.15 miles (1.85 kilometers)
odontocete	a kind of cetacean characterized by the presence of teeth, also called toothed whales
onshore substation	substation connecting the proposed Project to the existing bulk power grid system
operations and maintenance facilities	would include offices, control rooms, warehouses, shop space, and pier space
outer continental shelf	all submerged land, subsoil, and seabed belonging to the United States but outside of states’ jurisdiction
pile	a type a foundation akin to a pole
pile driving	installing foundation piles by driving them into the seafloor
pinnipeds	carnivorous, semiaquatic marine mammals with fin, also known as seals
pin pile	small-diameter pipe driven into the ground as foundation support
plume	column of fluid moving through another fluid
private aids to navigation	visual references on structures positioned in or near navigable waters of the United States, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation; permits for the aids are administered by the USCG
Project area	the combined onshore and offshore area where proposed Project components would be located
protected species	endangered or threatened species that receive federal protection under the Endangered Species Act of 1973 (As Amended)
Rhode Island Lease Areas	the lease areas that are comprised of the following projects: Revolution Wind (OCS-A 0486), Sunrise (parts of OCS-A 0487 and OCS-A 500), and South Fork (OCS-A 0517)
RI and MA Lease Areas	combination of all Rhode Island and Massachusetts lease areas
scour protection	protection consisting of rock and stone that would be placed around all foundations to stabilize the seabed near the foundations as well as the foundations themselves
scrublands	plant community dominated by shrubs and often also including grasses and herbs
sessile	attached directly by the base
silt substrate	substrate made of a granular material originating from quartz and feldspar, and whose size is between sand and clay
soft-bottom habitat	benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble, rock, and ledge) substrates, as well as biogenic habitat (e.g., eelgrass, mussel beds, and worm tubes) created by structure-forming species
splice vault	underground concrete transition vault that to be constructed at the landfall site and inside of which the 220 kV AC offshore export cables would be connected to the 220 kV onshore export cables
substrate	earthy material at the bottom of a marine habitat; the natural environment that an organism lives in
suspended sediments	very fine soil particles that remain in suspension in water for a considerable period of time without contact with the bottom; such material remains in suspension due to the upward components of turbulence and currents, and/or by suspension
threatened species	a species that is likely to become endangered within the foreseeable future
tidal energy project	project related to the conversion of the energy of tides into usable energy, usually electricity
tidal flushing	replacement of water in an estuary or bay because of tidal flow
trailing suction hopper dredge	a ship that is used to maintain waterways in navigable condition by virtue of being able to pump sand, clay, silt, and gravel; the ship trails its suction pipe, and a pump system sucks up a mixture of sand or soil and water, and discharges it in the hopper, or hold of the vessel; once fully loaded, the vessel sails to the unloading site
trawl	a large fishing net dragged by a vessel at the bottom or in the middle of sea or lake water
turbidity	a measure of water clarity

Term	Definition
utility right-of-way	registered easement on private land that allows utility companies to access the utilities or services located there
viewshed	area visible from a specific location
Vineyard Wind lease area	the full lease area compromised of 166,886 acres (675 km^2); the Vineyard Wind COP proposes to develop approximately 800 MW of wind energy capacity in the northern portion of the Vineyard Wind Lease Area OCS-A-0501
visual resource	the visible physical features on a landscape, including natural elements such as topography, landforms, water, vegetation, and manmade structures
wetland	land saturated with water; marshes; swamps
Wind Development Area	northern portion of the lease area measuring 75,614 acres (306 km^2)
wind energy	electricity from naturally occurring wind
wind turbine generator	component that puts out electricity in a structure that converts kinetic energy from wind into electricity

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APPENDIX J

Distribution List

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APPENDIX J. DISTRIBUTION LIST

Cooperating Federal Agencies

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Cheri Hunter, Sterling, Virginia

U.S. Coast Guard
George Detweiler, Washington, District of Columbia
Michele DesAutels, Boston, Massachusetts
Moon Youngmee, E. Providence, Rhode Island

U.S. Army Corps of Engineers
Christine Jacek, Concord, Massachusetts

U.S. Environmental Protection Agency
Tim Timmermann, Boston, Massachusetts

National Oceanic and Atmospheric Administration, National Marine Fisheries Service
Sue Tuxbury, Gloucester, Massachusetts

Narragansett Indian Tribe
John Brown, Charlestown, Rhode Island

Participating Federal Agencies

Federal Aviation Administration
Cindy Whitten, Kansas City, Missouri

National Park Service
Mary Krueger, Boston, Massachusetts

U.S. Fish and Wildlife Service
Tom Chapman, Concord, New Hampshire

Cooperating State Agencies

Massachusetts Coastal Zone Management
Bob Boeri, Boston, Massachusetts
Todd Callaghan, Beverly, Massachusetts

Rhode Island Coastal Resource Management Council
Jeffrey Willis, Wakefield, Rhode Island

Rhode Island Department of Environmental Management
Janet Coit, Providence, Rhode Island

Tribes and Native Organizations

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Mashantucket (Western) Pequot Tribal Nation
Mohegan Tribe of Indians of Connecticut

Massachusetts
Mashpee Wampanoag Tribe
Wampanoag Tribe of Gay Head (Aquinnah)

New York
Shinnecock Indian Nation

Rhode Island
Narraganset Indian Tribe

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Boston Public Library, Boston
Chilmark Free Public Library, Chilmark
Edgartown Public Library, Edgartown
Hyannis Public Library, Hyannis
New Bedford Free Public Library, New Bedford
Oak Bluffs Public Library, Oak Bluffs
Nantucket Atheneum, Nantucket
Vineyard Haven Public Library, Vineyard Haven
West Tisbury Free Public Library, Vineyard Haven
Woods Hole Public Library, Woods Hole

Rhode Island
Maury Loontjens Memorial Library, Narragansett

Other Interested Parties

Martha's Vineyard Commission, Oak Bluffs
Massachusetts Historic Commission
Town and County of Nantucket
Town of Barnstable
Town of Tisbury
Town of Yarmouth

Commenters on Draft EIS[1]

Al Eagles
Alan and Kristi Strahler
Alden Lenhart
Alessandro Bocconcelli
Alex Kithes
Alex Papali, Clean Water Action
Alice Berlow

[1] BOEM was not able to provide a copy of the EIS to commenters who did not provide a mailing address.

Amanda Braga, Marion Institute
Amber Hewett, National Wildlife Federation
Andrew Grande, Massachusetts Climate Action Network
Ann Howe
Ann Rosenkranz, 350 Martha's Vineyard Island
Anne Hawkins, Responsible Offshore Development Alliance
Annie Hayes
Ara Charder
Audra Parker
Audrey Ciochetto
Ben Hellerstein, Environment Massachusetts Research and Policy Center
Beth Casoni, Massachusetts Lobstermen's Association
Bethia Brehmer
Bill Lake
Bill Ravanesi
Bonnie Brady, Long Island Commercial Fishing Association
Brendan O'Neill, Vineyard Conservation Society
Brent Loftes, Scandinavian Fisheries, Inc.
Brian Chmielecki
Brian Loftes, Rhode Island Fishermen's Alliance
Brian Thibeault, Rhode Island Lobstermen's Association
Britt Beedenbender
Bruce Mandel
Burt Hamner
Cam Gammill, Bill Fisher Trade
Candace Rufleth
Carl Borchert
Carol (Mary Caroline) Magenau
Carol Lampson
Carol Shweder
Caroline Karp, Emerita Faculty, Brown University
Caroline Ochs, MASSPIRG
Catherine Bowes, Environmental NGOs
Charles Borkoski, Cape Cod Commercial Fisherman's Alliance
Charles Mayo, North Atlantic Right Whale Program at the Center for Coastal Studies
Charles Stott
Chris Adams, Cape Cod Chamber of Commerce
Chris Clander, U.S. Coast Guard
Chris Lee, Sea Fresh
Chris Powicki
Christine Gault
Christine Greeley
Christopher Brown
Christopher Lanctot
Colin Wyatt Leddy
Cynthia M. Erickson
Dan Mallison
Dan Masoud, United Brotherhood of Carpenters and Joiners of America
Dan Pronk, Hannibal Fish/Lobster Co
Dan Seidman
Daniel LaVecchia
Daniel Webb
Dave Monti, Rhode Island Saltwater Anglers
David Charles
David Dow
David Frulla
David Hubbard, ACK Residents Against Turbines
David Knapik, Town of Yarmouth
David Monti, RI Saltwater Anglers Association
David Wallace, Wallace & Associates
David Wallace, Surf Clam and Ocean Quahog Fishery
Dean Pesante
Dennis Ingram
Dennis Maltais
Deven Robitaille
Don DeBerardino II, F/V UMIAK
Don Keeran, Association to Preserve Cape Cod
Dorothy McIver, Greening Greenfield
Ed Barrett
Ed Zeitz
Edmund Janiunas
Edward Barrett, Northeast Fishery Sector X
Edward Barrett, Massachusetts Fishermen's Partnership
Edward Barrett
Edwin Zeitz
Eli Schwartz
Elias Lieberman
Elizabeth Barminski, Business Network for Offshore Wind
Elizabeth Rodio
Emlyn Addison
Eric Reid
Eric Wilkinson, Environmental League of Massachusetts
Erica Fuller, Conservation Law Foundation
Erik Peckar, Vineyard Power Cooperative
Eva Jellison
Fran Schofield
Frank Haggerty
Fred Mattera, Commercial Fishery Center of Rhode Island

Fred Murphy
Fred Unger
Gary Harcourt
Genna Duplisea
George and Susan Oleyer
George Maynard, Cape Cod Commercial Fisherman's Alliance
Gordon Starr
Greer Thornton
Gregory Garrison, Northeast Solar Design Associates,
Gus Santos
Haskell Werlin
Hoffman
Holly Goyert, American Bird Conservancy
Hugh Dunn, SouthCoast Development Partnership
Hunter Major
Hunter Moorman, Massachusetts Chapter of Elders Climate Action
Ingold Ingold
James Boyd, Rhode Island Coastal Resources Management Council
James Jacquart
James Spellman, Spellman Energy Associates LLC
James Violet
Jan Galkowski
Janet M. Hively
Janet Rochon
Janice Kubiac
Jarrett Drake
Jason Bridges, Town of Nantucket
Jason Jarvis, Old Jake Fisheries
Jason McNamee, RI DEM Marine Fisheries Division
Jay LaFrance
Jeffrey Kominers
Jerald Katch
Jim Wolf, Cape Air
Jo-Ann Taylor, Martha's Vineyard Commission
Joel Gates
John Buddy Andrade, New Bedford Minority Action Committee
John Ellersick, Next Rung Technology
John Haran
John Pappalardo, Cape Cod Commercial Fishermen's Alliance
Jon Hartzband
Jon Mitchell, City of New Bedford
Jonathan Ryder
Joseph Huckemeyer
Josiah Dodge
Joyce Flynn, Yarmouth Energy Committee
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Julius Lowe
Kai Salem, Green Energy Consumers Alliance
Karin Kugel
Kate Warner
Katherine Davis
Katie Almeida, The Town Dock
Katie Ruppel
Keith Roberts, Falmouth Fishermen's Association
Kendra Anderson
Kisha Santiago-Martinez, New York State Department of State
Kristin Daley, KD Consulting
Larry Cronin
Laura Messier
Lauren Sinatra, Town of Nantucket
Lauri Murphy
Leanne Bell
Linda Ziegler
Lindsay Crouch
Lisa Coedy
Lisa Engler, Massachusetts Office of Coastal Zone Management
Liz Argo
M. E. Sinkiewicz
Maggie Downey, Cape Light Compact
Manuela Barrett
Marc Rosenbaum
Mark Wirtanen
Mary Chalke
Matt Lord
Matthew Cannon
Maureen Condon
Maureen Phillips, Madaket Residents Association
Max Ciarlone
Megan Amsler, Falmouth Energy Committee
Megan Ottens-Sargent, Aquinnah Rep, BOEM Task Force
Meghan Lapp, Seafreeze Ltd.
Melinda Loberg, Board of Selectmen in the Town of Tisbury
Michael Cornish
Michael Davey, United Brotherhood of Carpenters
Michael Jacobs
Michael Pentony, National Marine Fisheries Service
Michael Pierdinock, Recreational Fishing Alliance
Michael Waine, American Sportfishing Association
Michael Warner
Michael Dunbar
Michelle Cote

Moncrieff Cochran, Cape Cod Climate Change Collaborative
Mr. Cronin
Mr. Keene
Mr. Mallinson
Mr. Minkiewicz
Mr. Morris
Mr. Parente
Mr. Strahler
Nathan Davis
Nick Schulz
Nicola Blake
Nicole Dipaolo
Nicole Morris-McLaughlin, Marion Institute—Southcoast Energy Challenge
Nicole Morris-McLaughlin, Southcoast Energy Challenge
Nina Wolff Landau
Noli Taylor
Patricia Hinkey
Patrick Paquette
Patti Rego, Marion Institute
Paul Cove
Paul Eidman
Paul Pimentel
Paul Vigeant
Pete Kaizer
Pete Meerbergen
Peter Anthony, Nordic Fisheries
Peter Bachant
Peter D'Angelo
Peter Neronha, Rhode Island Office of the Attorney General
Peter Rufleth
Peter Wakeman
Randi Allfather
Raysel Martinez
Reno Mastrocola
Rep. William Straus
Rex Jarrell
Rich Lodge, F/V Select
Richard Toole
Rick Bellavance, RI Coastal Resources Management Council Fishermen's Advisory Board
Rick Kidder, SouthCoast Chamber
Rob Hannemann
Robert Mason
Robert Michaud
Robert Myers
Robert Stuyt, Brabers
Roger Schaefer
Ron Dagostino
Ronald Dagostino
Ronald Gagnon, Rhode Island Department of Environmental Management
Rosemary Carey
Rudy Whelan
Sam Hart, Adult Continuing Education Program on Martha's Vineyard
Sandra Pimentel, Vineyard Power
Seth Handy
Shannon Donovan
Sharon Gold, Citizen's Climate Lobby
Sheila Place
Stephanie Thompson
Stephen Perrault
Stephen Tom
Steve Chinetti
Steven Anderson, Rhode Island Party and Charter Boat Association
Steven Carvalho
Stuart Sheehan
Sue Hruby
Susan Feller
Susan Starkey
Tamara Grenier, Nantucket Eco Group
Thomas Dameron, Surfside Food, LLC.
Thomas Melone, Allco Renewable Energy Limited
Thomas Nies, New England Fishery Management Council
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Thomas Sullivan
Tim Boland
Timmons Roberts
Timothy Field
Tobias Glidden
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Troy Huiser
Vida Morris
Warren Adams
Wayne Kurker
Wendy Northcross, Cape Cod Chamber of Commerce
Wesley Brighton
Will Stark
William Bridwell
William Lake
William Smith III
Zachary Dusseau

Commenters on the Supplement to the Draft EIS[2]

Aaron Ott
Alan Nogee
Alexander Elvin
Allen Burgenson
Allison Pistolessi
Amber Hamlett
Anna Gooding-Call
Anthony Garcia
Anthony Speelman
Arthur Cruz
Arthur Warren
Barbara Gaba
Barbara Hafner
Barbara Stone
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Ben Hellerstein
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George Detweiler
George Hagerman
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[2] BOEM was not able to provide a copy of the EIS to commenters who did not provide a mailing address.

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Victoria Esserry
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William Lake
William Leavenworth
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William Vachon
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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.