Appendix G
Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts

This page is intentionally blank.

Table of Contents

List of Tables

List of Figures

Abbreviations and Acronyms

§	Section
°C	degrees Celsius
µg/L	micrograms per liter
µT	microtesla
AC	alternating current
ADLS	aircraft detection lighting system
BA	Biological Assessment
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
Btu	British thermal unit
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COP	Construction and Operations Plan
CRM	collision risk model
CTV	crew transfer vessel
CWA	Clean Water Act
DC	direct current
DOE	U.S. Department of Energy
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electric and magnetic fields
ESA	Endangered Species Act
ESP	electrical service platform
FAA	Federal Aviation Administration
FAD	fish aggregating device
FCC	Federal Communications Commission
Fed. Reg.	Federal Register
FMP	Fisheries Management Plan
G&G	geological and geophysical
GHG	greenhouse gas
HAP	hazardous air pollutant
HDD	horizontal directional drilling or drill
HDM	hydrodynamic model
HUC	hydrologic unit code
IHA	Incidental Harassment Authorization
IPF	impact-producing factor
LME	Large Marine Ecosystem
MARPOL	International Convention for the Prevention of Pollution from Ships
MassDEP	Massachusetts Department of Environmental Protection
MBTA	Migratory Bird Treaty Act
MCT	Marine Commerce Terminal
mg/L	milligrams per liter
MOU	Memorandum of Understanding
MW	megawatt
MWh	megawatt hour
NA	not applicable
NAAQS	National Ambient Air Quality Standards

NARW	North Atlantic right whale
ND	no data
NEPA	National Environmental Policy Act
NOA	Notice of Availability
NO_x	nitrogen oxide
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O_3	ozone
OCS	Outer Continental Shelf
OECC	offshore export cable corridor
OECR	onshore export cable route
OSRP	oil spill response plan
PDE	Project design envelope
$PM_{2.5}$	particulate matter smaller than 2.5 microns
PM_{10}	particulate matter smaller than 10 microns
ProvPort	Port of Providence
ppb	parts per billion
Project	New England Wind Project
psu	practical salinity unit
PTS	permanent threshold shift
RI/MA Lease Areas	Rhode Island and Massachusetts Lease Areas
RMS	root mean squared
ROW	right-of-way
SAR	search and rescue
SCV	South Coast Variant
SO_2	sulfur dioxide
SOC	standard operating condition
SOV	service operation vessel
SPL	sound pressure level
SWDA	Southern Wind Development Area
TCP	traditional cultural property
TMP	Traffic Management Plan
TSS	total suspended solids
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WNS	white nose syndrome
WTG	wind turbine generator

This page is intentionally blank.

G Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts

This appendix provides tables that discuss the individual impact-producing factors (IPF) that form the basis of the analyses in Chapter 3, Affected Environment and Environmental Consequences, of the Environmental Impact Statement (EIS). It also includes the assessment of resources for which the New England Wind Project (proposed Project) would generate no more than minor impacts.

G.1 Impact-Producing Factor Tables

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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	EIS Section G.2.2, Water Quality, discusses ongoing accidental releases. Accidental releases of hazardous materials 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. 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. 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. However, there does not appear to be evidence that ongoing releases have detectable impacts on benthic resources.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. EIS Section G.2.2 discusses water quality. No future activities related to invasive species or releases of trash and debris were identified within the geographic analysis area other than ongoing activities.
Anchoring and gear utilization	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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Cable emplacement and maintenance	Cable emplacement and 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 2019a for details). New cables are infrequently added near shore. Cable emplacement and 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. Ongoing sediment dredging for navigation purposes results in localized, short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations. 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 quick to recover from disturbance. Therefore, such impacts, while locally intense, have little impact on benthic resources in the geographic analysis area. 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 affect 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.	No future activities were identified within the geographic analysis area other than ongoing activities. 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.
Climate change	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. Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions and migration of benthic species and altering ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 30 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Discharges/intakes	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 on benthic resources are short term because spoils are typically recolonized naturally. In addition, the USEPA 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 potential impacts on the environment are minimized or mitigated.
EMF	EMF 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 EMF are infrequently installed in the geographic analysis area. Some benthic species can detect EMF, although EMF do not appear to present a barrier to movement. The extent of impacts (behavioral changes) is likely less than 50 feet from the cable, and the intensity of impacts on benthic resources is likely undetectable.	No future activities were identified within the geographic analysis area other than ongoing activities.
Noise	Detectable impacts of construction and G&G noise on benthic resources rarely, if ever, overlap from multiple sources. 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 the seabed can cause injury and/or mortality to benthic resources in a small area around each pile and short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions. 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.	Detectable impacts of construction and G&G noise on benthic resources would rarely, if ever, overlap from multiple sources. No future pile driving activities were identified within the geographic analysis area other than ongoing activities. 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.
Port utilization	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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
		Future channel-deepening activities will likely be undertaken. 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, impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.
Presence of structures	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 short-term and localized impacts. Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables, continuously create uncommon relief and uncommon hard-bottom habitat in a mostly sandy seascape and can affect natural hydrodynamic conditions. Structure-oriented fishes are attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes can affect populations and communities of benthic resources. These impacts are local and permanent. 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. The presence of transmission cable infrastructure, especially hard protection atop cables, causes impacts through entanglement/gear loss/damage, fish aggregation, and habitat conversion. 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).	Future new cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would present additional risk of gear loss, resulting in short-term and localized impacts (disturbance, injury). 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 cable emplacement and maintenance IPF in this table). Any new towers, buoy, or piers would also create uncommon relief in a mostly flat, sandy seascape and could alter hydrodynamic conditions. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could affect populations and communities of benthic resources. These impacts are expected to be local and permanent as long as the structures remain. 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). No future activities were identified within the geographic analysis area other than ongoing activities.

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; EFH = essential fish habitat; EIS = Environmental Impact Statement; EMF = electromagnetic fields; G&G = geological and geophysical; GHG = greenhouse gas; IPF = impact-producing factor; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; USACE = U.S. Army Corps of Engineers; USEPA = U.S. Environmental Protection Agency

Table G.1-2: Summary of Activities and the Associated Impact-Producing Factors for Coastal Habitats and Fauna

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Accidental releases of fuel, fluids, and hazardous materials have the potential to cause habitat contamination and harm to the species that build biogenic coastal habitats and fauna (e.g., eelgrass, oysters, mussels, snails, and cordgrass) from releases and/or cleanup activities. Only a portion of the ongoing releases contact coastal habitats and fauna in the geographic analysis area. Impacts are minimal, localized, and temporary. 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 and fauna.	No future activities were identified within the geographic analysis area other than ongoing activities.
Anchoring and gear utilization	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 and fauna. 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 other than ongoing activities.
Cable emplacement and maintenance	There are no existing cables in the geographic analysis area. Any cable emplacement and maintenance activities would infrequently disturb bottom sediments; these disturbances would be local and limited to the emplacement. Ongoing sediment dredging for navigation purposes results in fine sediment deposition within coastal habitats and fauna. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local and limited to the emplacement corridor. Ongoing sediment dredging for navigation purposes also results in localized and short-term impacts on coastal habitats and fauna through seabed profile alterations. For example, the Town of Barnstable and Barnstable County typically undertake multiple dredging projects each year (Barnstable County 2022; CapeCod.com 2019). Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and quick to recover from disturbance. Therefore, such impacts, while locally intense, have little effect on the general character of coastal habitats and fauna.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	No dredged material disposal sites were identified within the geographic analysis area.	
Climate change	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of reefs and other habitats formed by shells. Climate change, influenced in part by ongoing GHG 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.	No future activities were identified within the geographic analysis area other than ongoing activities.
EMF	EMF continuously emanate from existing telecommunication and electrical power transmission cables. There are no existing cables in the geographic analysis area for coastal habitats and fauna. New cables generating EMF are infrequently installed in the geographic analysis area. EIS Sections 3.4 and 3.6 discuss the nature of potential impacts on benthic resources and finfish, invertebrates, and EFH, respectively. The extent of impacts is likely less than 50 feet from the cable, and the intensity of impacts on coastal habitats and fauna is likely undetectable.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance	Ongoing development and construction of onshore properties, especially shoreline parcels, periodically causes short-term erosion and sedimentation of coastal habitats, short-term to permanent degradation of onshore coastal habitats, and the conversion of onshore coastal habitats to developed space.	No future activities were identified within the geographic analysis area other than ongoing activities.
Lighting	Navigation lights and deck lights on vessels are a source of ongoing light. EIS Sections 3.4 and 3.6 discuss the nature of potential impacts on benthic resources and finfish, invertebrates, and EFH, respectively. The extent of impacts is limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats and fauna is likely undetectable. Existing lights from navigational aids and other structures onshore and nearshore are a source of light. EIS 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 and fauna is likely undetectable.	Light is expected to continue to increase gradually with increasing vessel traffic over the next 30 years. EIS 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 and fauna would likely be undetectable.
Noise	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	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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	difficult to generalize, but impacts are local and temporary. 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. 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 the seabed can reach coastal habitats and fauna. The extent depends on pile size, hammer energy, and local acoustic conditions. Rare 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 and fauna are discountable compared to the impacts of the physical disturbance and sediment suspension.	echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary. 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 and fauna are discountable compared to the impacts of the physical disturbance and sediment suspension.
Presence of structures	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 geographic 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. 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 and infrastructure have no impact on coastal habitats and fauna. There are no existing cables in the geographic analysis area for coastal habitats and fauna.	Any new cable or pipeline installed in the geographic analysis area would likely require hard protection atop portions of the route (see cell 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 and fauna.

CO_2 = carbon dioxide; EFH = essential fish habitat; EIS = Environmental Impact Statement; EMF = electromagnetic fields; GHG = greenhouse gas; IPF = impact-producing factor; OCS = Outer Continental Shelf

Table G.1-3: Summary of Activities and the Associated Impact-Producing Factors for Finfish, Invertebrates, and Essential Fish Habitat

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Releases of fuels, fluids, and hazardous materials are frequent. Impacts, including mortality, decreased fitness, and contamination of habitat, are localized and temporary, and rarely affect populations. 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.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Impacts are unlikely to affect populations.
Anchoring and gear utilization	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; 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.
Cable emplacement and 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 2019a for details). New cables are infrequently added near shore. Cable emplacement and 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. Dredging 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 (BOEM 2019a). Sediment deposition could have impacts on eggs and larvae, particularly demersal eggs such as longfin squid (*Doryteuthis pealeii*), 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.	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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Climate change	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. 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 of various diseases, as well as migration and distributions of finfish, invertebrates, and EFH. This has been shown to affect the distribution of fish in the Northeast, with several species shifting their centers of biomass either northward or to deeper waters (Hare et al. 2016).	No future activities were identified within the geographic analysis area other than ongoing activities.
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; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison 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 affects commercially and recreationally important fish species within the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019).	During operations, future new cables would produce EMF. 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 (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.
Lighting	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. 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.
Noise	Noise from aircraft reaches the sea surface on a regular basis. However, aircraft noise is not likely to affect finfish, invertebrates, and EFH, as very little of the aircraft noise propagates through the water. 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. Ongoing site characterization surveys and scientific	Aircraft noise is likely to continue to increase as commercial air traffic increases. However, aircraft noise is not likely to affect finfish, invertebrates, and EFH. 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. Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	surveys produce noise around sites of investigation. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions. 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 from the WTG base. Based on the results of Thomsen et al. (2015), SPLs would be at or below ambient levels at relatively short distances (approximately 164 feet) 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 minimal and local impacts. 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 the seabed can 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. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality 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. 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. While ongoing 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 include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	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. 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 minimal and local. 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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Port utilization	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, 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, impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.
Presence of structures	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 minimal, localized, and short-term impacts. Human-made 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. 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 species are attracted to these locations and, thus, benefit on a constant basis (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 mussels and anemones (Degraer et al. 2019). 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. Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres), and species that rely on this habitat would not likely experience	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. New cables, installed incrementally in the geographic analysis area for finfish, invertebrates, and EFH over the next 20 to 30 years, would likely require hard protection atop portions of the route (see the cable emplacement and maintenance IPF in this table). The impacts of the presence of these structures described for ongoing activities would continue. 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, which could slow migrations. However, temperature would continue to be a bigger driver of habitat occupation and species movement.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	population-level impacts (Guida et al. 2017; Greene et al. 2010). 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, which could slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (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. 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).	

AC = alternating current; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; DC = direct current; EFH = essential fish habitat; EMF = electromagnetic fields; FCC = Federal Communications Commission; GHG = greenhouse gas; IPF = impact-producing factor; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = offshore export cable corridor; SPL = sound pressure level; WTG = wind turbine generator

Table G.1-4: Summary of Activities and the Associated Impact-Producing Factors for Marine Mammals

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Releases of fuel, fluids, and hazardous materials are frequent. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal impacts on the individual fitness, including adrenal impacts, hematological impacts, liver impacts, 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; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to impacts on prey species. 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; 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, 62 of 123 (50.4 percent) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data indicate potential debris induced	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases of fuel, fluids, hazardous materials, trash, and debris. The impacts described under ongoing activities would continue and increase along with increasing vessel traffic.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	mortality rates of 0 to 22 percent. 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 impacts on individuals to population-level impacts (Browne et al. 2015).	
Cable emplacement and 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 tolerance for increased turbidity. Similarly, McConnell et al. (1999) documented movements and foraging of gray seals (*Halichoerus grypus*) 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 gray 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 and short-term impacts on marine mammal prey species.	The FCC has two pending submarine telecommunication cable application in the North Atlantic. The impact on water quality from sediment suspension during cable emplacement would be 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, and any impacts would be temporary and short term.
Climate change	Increased storm frequency could result in increased energetic costs for marine mammals and reduced fitness, particularly for juveniles, calves, and pups. Ocean acidification has the potential to lead to long-term and high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells. Altered habitat/ecology has the potential to lead to long-term and high-consequence impacts on marine mammals as a result of changes in distribution, reduced breeding, and/or foraging habitat availability, and disruptions in migration. Altered migration patterns have the potential to lead to long-term and high-consequence impacts on marine mammals. For example, the NARW (*Eubalaena glacialis*) 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.) Climate change, influenced in part by GHG 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 influencing	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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 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). Increased erosion could impact seal haul outs, reducing their habitat availability, especially as things like sea walls are added, blocking seals access to shore.	
EMF	EMF 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 percent 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 EMF. Depending on the magnitude and persistence of the confounding magnetic field, such an impact could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an impact on marine mammals is more likely to occur with DC 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 operations, 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 (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 impacts from the numerous submarine cables have been observed. Further, EMF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to EMF would be low; as a result, impacts on marine mammals would not be expected.
Noise	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 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 U.S. Navy training operations could result in short-term responses of marine mammals to aircraft noise. If flights are at a sufficiently low altitude, marine mammals may respond with 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. 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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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 2018). 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 impacts, 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 2018). 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 from the WTG base. Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), SPLs would be at or below ambient levels at relatively short distances from the WTG foundations. 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 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 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. Ongoing activities that contribute to vessel noise include commercial shipping, recreational and fishing vessels, and 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 most oceanic regions. While vessel noise may have some impact on marine mammal behavior, it would be limited to brief	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. Cable-laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects. 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, these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals, and no stock or population-level impacts would be expected.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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 of the vessel by 26 percent (Jensen et al. 2009). Pilot whales, in a quieter, deep-water habitat, could experience a 50 percent reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther from the sound source compared to higher frequencies, low frequency cetaceans are at a greater risk of experiencing harassment from vessel traffic.	
Port utilization	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 and short-term impacts, if any, on marine mammals. Vessel noise may affect marine mammals, but the response would be temporary and short term. The impacts on water quality (and, thus, on marine mammals) from sediment suspension during port expansion activities is temporary, short term, and would be similar to those described under the cable emplacement and maintenance IPF in this table.	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 (and, thus, on 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.
Presence of structures	There are more than 130 artificial reefs in the Mid-Atlantic region. Entanglement or ingestion of lost fishing gear may result in long-term and 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 near shore where these structures are located. There are very few, if any, areas within the geographic analysis area for marine mammals that would serve to concentrate recreational	The presence of structures associated with non-offshore wind development in nearshore coastal waters have the potential to provide habitat for seals and small odontocetes, as well as preferred prey species. 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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	fishing and increase the likelihood that marine mammals would encounter lost fishing gear. 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. No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to avoidance/displacement, behavior disruption related to breeding and migration, or displacement into higher risk areas. There may be some impacts resulting from the existing Block Island Wind Facility but given that there are only five WTGs, no measurable impacts are occurring.	(Taormina et al. 2018), providing a potential increase in available forage items and shelter for marine mammals compared to the surrounding soft bottoms. This reef effect has the potential to result in long-term and low-intensity beneficial impacts.
Traffic	Current activities that are contributing to vessel traffic 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 percent of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the U.S. 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 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 impacts on most species unlikely (U.S. 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 impacts on the species.

μT = microtesla; AC = alternating current; BOEM = Bureau of Ocean Energy Management; DC = direct current; EMF = electromagnetic fields; ESP = electrical service platform; FCC = Federal Communications Commission; GHG = greenhouse gas; IHA = Incidental Harassment Authorization; IPF = impact-producing factor; mg/L = milligrams per liter; NARW = North Atlantic right whale; OCS = Outer Continental Shelf; PTS = permanent threshold shift; SPL = sound pressure level; TTS = temporary threshold shift; WTG = wind turbine generator

Table G.1-5: Summary of Activities and the Associated Impact-Producing Factors for Sea Turtles

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Releases of fuel, fluids, and hazardous materials occur frequently. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal impacts on individual fitness, including adrenal impacts, dehydration, hematological impacts, increased disease incidence, liver impacts, poor body condition, skin impacts, skeletomuscular impacts, and several other health impacts 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 impacts on prey species. 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; 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. 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 has also been documented (Tomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Tomás 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 impacts more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal impacts may include dietary dilution, chemical contamination, depressed immune system function, and poor body condition, as well as reduced growth rates, fecundity, and reproductive success. However, these impacts are cryptic, and clear causal links are difficult to identify (Nelms et al. 2016).	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases of fuel, fluids, hazardous materials, trash, and debris, as well as the associated impacts described for ongoing activities.
Cable emplacement and 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 impacts 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 (BOEM 2022a). 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 (BOEM 2022a). Turbidity	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. Any impacts would be short term and temporary. Turbidity associated with increased sedimentation may result in short-term and temporary impacts on some sea turtle prey species.

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	associated with increased sedimentation may result in short-term and temporary impacts on sea turtle prey species.	
Climate change	Increased storm frequency could lead to long-term and 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 and high-consequence changes to foraging habitat availability for green turtles (*Chelonia mydas*). Ocean acidification has the potential to lead to long-term and high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells. Altered habitat/ecology has the potential to lead to long-term and high-consequence impacts on sea turtles by influencing distributions of sea turtles and/or prey resources, as well as sea turtle breeding, foraging, and sheltering habitat use. Climate change, influenced in part by GHG 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. Climate change can also lead to long-term and high-consequence impacts on sea turtle habitat use and migratory patterns. The proliferation of coastline protections has the potential to result in long-term and high-consequence impacts on sea turtle nesting by eliminating or precluding access to potentially suitable nesting habitat or access to potentially suitable habitat. Sediment erosion and/or deposition in coastal waters have the potential to result in long-term and 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 other than ongoing activities.
EMF	EMF 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 (*Caretta caretta*), 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 in the water column above the cable. Juvenile and adult sea	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 (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. Further, EMF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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 sea turtle impacts from EMF 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 conditions and, thus, would be insignificant (Normandeau et al. 2011).	EMF would be low; as a result, impacts on sea turtles would not be expected.
Lighting	Ocean vessel, such as ongoing commercial vessel traffic, recreational and fishing activity, and 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. 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 impact. Decades of oil and gas platform operation in the Gulf of Mexico, with considerably more lighting than offshore WTGs, has not resulted in any known impacts on sea turtles (BOEM 2022a).	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. Non-offshore wind activities would not be expected to appreciably contribute to structure lighting. As such, no impact on sea turtles would be expected.
Noise	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. 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 (*Dermochelys coriacea*) and possibly loggerhead sea turtles, 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	Future low altitude aircraft activities such as survey activities and U.S. Navy training operations could result in short-term responses of sea turtles to aircraft noise, similar to those described for ongoing activities. Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Impacts of these activities would be similar to those described for ongoing activities. Cable-laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects (EIS Section 3.8, Sea Turtles). 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, these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles, and no stock or population-level impacts would be expected.

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	impacts are difficult to generalize but are likely local and temporary 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 from the WTG base (Miller and Potty 2017). Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), SPLs would be at or below ambient levels at relatively short distances from the WTG foundations. Furthermore, no information suggests that such noise would affect turtles. 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 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) • Behavioral disturbance: 166 dB referenced to 1 µPa RMS 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 1999) and would, therefore, be audible. However, Hazel et al. (2007) suggested 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 affect sea turtle behavior, especially their submergence patterns.	
Port utilization	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 and temporary impacts, if any, on sea turtles. Vessel noise may affect sea turtles, but response would likely be short term and temporary. 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 cable emplacement and maintenance IPF in this table.	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

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
		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.
Presence of structures	The Mid-Atlantic region has more than 130 artificial reefs. Entanglement or ingestion of lost fishing gear may result in long-term and 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 near shore, where these structures are located. There are very few, if any, areas in the 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. 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 (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. No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to avoidance/displacement. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only five WTGs, no measurable impacts are occurring. No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to behavioral disruption related to breeding and migration or displacement into higher risk areas.	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 and low-intensity beneficial impacts. Bridge foundations will continue to provide foraging opportunities for sea turtles with measurable benefits to some individuals.
Traffic	Current activities contributing to vessel collisions include port traffic levels, fairways, traffic separation schemes, commercial vessel traffic, recreational and fishing	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. Sea turtles are most

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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 percent in the 1980s to a record high of 20.5 percent 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.	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.

µT = microtesla; AC = alternating current; BOEM = Bureau of Ocean Energy Management; dB = decibel; EIS = Environmental Impact Statement; EMF = electromagnetic fields; FCC = Federal Communications Commission; G&G = geological and geophysical; GHG = greenhouse gas; Hz = hertz; IPF = impact-producing factor; mg/L = milligrams per liter; NMFS = National Marine Fisheries Service; OCS = Outer Continental Shelf; PTS = permanent threshold shift; RMS = root mean squared; SPL = sound pressure level; TTS = temporary threshold shift; WTG = wind turbine generator

Table G.1-6: Summary of Activities and the Associated Impact-Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Anchoring and gear utilization	Impacts from anchoring occur due to ongoing military, survey, commercial, and recreational activities. The short-term and localized impact on 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 hundreds of feet of anchored vessel) navigational hazard to fishing vessels.
Cable emplacement and maintenance	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 2019a).	Future cable emplacement and 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 and 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.
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 potentially increase the cost of fishing if transiting time increases. Continuous CO_2 emissions causing ocean	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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.	
Noise	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. Noise is also created by operations and maintenance of marine minerals extraction, which has minimal and local impacts on fish but likely no impacts at a fishery level. 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 cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions. 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 the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile and 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. 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 vessel noise include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels (EIS Section 3.10, Commercial Fisheries and For-Hire Recreational Fishing).	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 minimal 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 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. 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. Planned new barge route and dredging disposal sites would generate vessel noise when implemented (EIS Section 3.10).
Port utilization	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 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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
		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.
Presence of structures	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 control their vessel movements or is distracted. 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 minimal, localized, short-term impacts on fish but likely no impacts at a fishery level. 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. 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. Current structures do not result in space use conflicts. 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	No known planned 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. New cables, installed incrementally in the geographic analysis area over the next 20 to 30 years, would likely require hard protection atop portions of the route (see cable emplacement and maintenance IPF in this table). 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. 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 slow species 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. Planned fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60 percent (McCreary and Brooks 2019). This would likely have a significant impact on fishing effort in the lobster and Jonah crab (*Cancer borealis)* fisheries in the geographic analysis area for this resource.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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. 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.	
Traffic	No substantial changes are anticipated to the vessel traffic volumes. The geographic analysis 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, 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.

BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; EIS = Environmental Impact Statement; FCC = Federal Communications Commission; FMP = Fisheries Management Plan; GHG = greenhouse gas; IPF = impact-producing factor; NARW = North Atlantic right whale; NOAA = National Oceanic and Atmospheric Administration; WTG = wind turbine generator

Table G.1-7: Summary of Activities and the Associated Impact-Producing Factors for Cultural Resources

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Accidental releases of fuel, fluids, hazardous materials, trash, and debris 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. 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	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 minimal, 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

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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 would continue to mitigate the impacts of small-scale accidental releases of trash.	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. 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.
Anchoring and gear utilization	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 affect 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.
Cable emplacement and 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. 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 operations 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.	Future activities with the potential to result in seafloor disturbances similar to offshore impacts include construction and operations 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. 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.
Climate change	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. Altered habitat/ecology and 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.	Sea level rise and storm severity/frequency would increase due to the impacts of climate change. The rate of change to habitats/ecology, migratory animal patterns, and property and infrastructure damage would increase as a result of climate change. Climate change would necessitate increased installation of coastal protective measures.

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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 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. 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. 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.	
Land disturbance	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.
Lighting	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. 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	Future activities with the potential to result in vessel lighting impacts include construction and operations 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. 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.

Associated IPF	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	hazard lighting to prevent aircraft collision can cause these types of impacts.	
Port utilization	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).
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.

BOEM = Bureau of Ocean Energy Management; IPF = impact-producing factor; MCT = Marine Commerce Terminal; OECR = onshore export cable route; TCP = traditional cultural property

Table G.1-8: Summary of Activities and the Associated Impact-Producing Factors for Demographics, Employment, and Economics

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Cable emplacement and 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.	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.
Climate change	Climate models predict climate change if current trends continue. Climate change has 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. In 2018, 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 2019).	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. 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.
Land disturbance	Onshore development activities support local population growth, employment, and economies. Disturbances can cause temporary, localized traffic delays and restricted access to adjacent properties. The	Onshore development projects would be ongoing in accordance with local government land use plans and regulations.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	rate of onshore land disturbance is expected to continue at or near current rates.	
Lighting	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis. Ocean vessels have an array of lights including navigational lights and deck lights.	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. Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
Noise	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. 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. Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to vessel noise include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Periodic trenching would be needed over the next 30 years for repair or installation of underground infrastructure. Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization	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, among other ports in the geographic analysis area, was upgraded by the port specifically to support the construction of offshore wind energy facilities. As ports expand, maintenance dredging of shipping channels is expected to increase.	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 are able to host larger deep draft vessels as they continue to increase in size.
Presence of structures	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. 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. 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 FADs. Recreational and commercial fishing can occur	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	near the FADs, although recreational fishing is more popular because commercial mobile fishing gear is more likely to snag on FADs. 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, as vessels need to avoid both the structure and each other. Current structures do not result in space use conflicts. No existing offshore structures are within the viewshed of the SWDA except buoys. 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.	
Traffic	Ports and marine traffic related to shipping, fishing, and recreation in the geographic analysis area are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes. 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.	New vessel traffic near the geographic analysis 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 geographic analysis area economy. No substantial changes anticipated.

Btu = British thermal unit; FAD = fish aggregating device; FCC = Federal Communications Commission; IPF = impact-producing factor; MCT = Marine Commerce Terminal; SWDA = Southern Wind Development Area

Table G.1-9: Summary of Activities and the Associated Impact-Producing Factors for Environmental Justice

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Air emissions	Ongoing population growth and new development within the geographic 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.
Cable emplacement and 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 geographic analysis area. Refer to EIS Appendix A, Required Environmental Permits and Consultations, 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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Land disturbance	Potential erosion and sedimentation from development and construction is controlled by local and state development regulations. Onshore development supports local population growth, employment, and economics. Onshore development would result in changes in land use in accordance with local government land use plans and regulations.	New development activities would be subject to erosion and sedimentation regulations. Onshore development would continue in accordance with local government land use plans and regulations. Development of onshore solar and wind energy would provide diversified, small-scale energy generation.
Lighting	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.
Noise	Offshore operations and maintenance of existing wind energy projects generates negligible amounts of noise. 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. 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. Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to vessel noise include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Periodic trenching would be needed over the next 30 years for repair or installation of underground infrastructure. Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization	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 are able to host larger deep draft vessels as they continue to increase in size.
Presence of structures	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. Vessels need to navigate around structures to avoid collisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, as vessels need to avoid both the structure and each other. Current structures do not result in space use conflicts. There are no existing offshore structures within the viewshed of the SWDA except buoys.	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. Existing cable operations and maintenance activities would continue within and offshore from the geographic analysis area.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	Two subsea cables 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.	
Traffic	Ports and marine traffic related to shipping, fishing, and recreation in the geographic analysis area are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis 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 geographic analysis area employment.

EIS = Environmental Impact Statement; FCC = Federal Communications Commission; IPF = impact-producing factor; MCT = Marine Commerce Terminal; SWDA = Southern Wind Development Area

Table G.1-10: Summary of Activities and the Associated Impact-Producing Factors for Navigation and Vessel Traffic

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Anchoring and gear utilization	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 and vessel traffic 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 also expected to increase, expanding 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 the same related to anchoring.
Cable emplacement and 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.	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 construction or operations, 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.
Port utilization	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 are 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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures	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. 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. Equipment in the ocean can create a substrate for mollusks to attach to, and fish eggs to settle nearby. This can create a reef-like habitat and benefit structure-oriented species on a constant basis. Noise-producing activities, such as pile driving and vessel traffic, may interfere and 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. Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, navigation is made more complex, as the vessels need to avoid both the structure and each other. 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 traffic separation scheme precautionary area and points north/east by way of the Nantucket-Ambrose Fairway and can cross through the southern portion of the RI/MA Lease Areas, particularly through OCS-A 0500 and 0501.	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. Fishing near artificial reefs is not expected to change meaningfully over the next 30 years. 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.
Traffic	Current vessel traffic includes commercial and other activity concentrated in designated navigation corridors, as well as commercial and recreational fishing activity, USCG maritime SAR, military vessel activity, and scientific and academic vessel traffic. The likelihood of collisions, allisions, and other incidents is expected to continue at or near current rates. No substantial changes are anticipated to existing air and vessel traffic volumes.	New vessel traffic, along with collisions, allisions, and other incidents in the geographic analysis area would be generated by increased overall commercial, SAR, and other vessel activity, as well as proposed barge routes and dredging demolition sites over the next 30 years.

BOEM = Bureau of Ocean Energy Management; FCC = Federal Communications Commission; IPF = impact-producing factor; RI/MA Lease Areas = Rhode Island and Massachusetts Lease Areas; SAR = search and rescue; USCG = U.S. Coast Guard

Table G.1-11: Summary of Activities and the Associated Impact-Producing Factors for Other Uses

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures	Existing stationary facilities within the geographic analysis area that present navigational hazards, including allision risks, 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. The Block Island Wind Farm WTGs also support fish aggregation. Eight existing submarine cables are in the geographic analysis area, including submarine power cables between the mainland and Nantucket and Martha's Vineyard, as well as two cables that cross the far western side of OCS-A 0487.	Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments. Submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future.
Traffic	Existing air traffic include commercial aviation, general aviation, USCG SAR activity, military training, and aircraft used for scientific and academic surveys in marine environments. Current vessel traffic includes commercial and other activity concentrated in designated navigation corridors, as well as commercial and recreational fishing activity, USCG maritime SAR, military vessel activity, and scientific and academic vessel traffic. The likelihood of collisions, allisions, and other incidents is expected to continue at or near current rates. No substantial changes are anticipated to existing air and vessel traffic volumes.	New vessel traffic in the geographic analysis area would be generated by increased overall commercial and other vessel activity, as well as proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy. No substantial changes anticipated.

IPF = impact-producing factor; SAR = search and rescue; USCG = U.S. Coast Guard; WTG = wind turbine generator

Table G.1-12: Summary of Activities and the Associated Impact-Producing Factors for Recreation and Tourism

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Anchoring and gear utilization	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 and localized impacts of navigational hazards, increased turbidity levels, and potential for direct contact causing mortality of benthic resources.
Cable emplacement and 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 generate short-term disturbances.
Lighting	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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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.
Noise	The Block Island Wind Farm is the only operating facility that could generate operational noise within the geographic analysis area for recreation and tourism. 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. Offshore trenching occurs periodically in connection with cable installation or sand and gravel mining. Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to vessel noise 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 routes and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization	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. Several ports (e.g., the MCT at the Port of New Bedford and the Port of Bridgeport) have been or are being upgraded specifically to support the construction of offshore wind energy facilities. Nearly all ports and harbors in the geographic analysis area for recreation and tourism require periodic maintenance dredging.	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 are able to host larger deep draft vessels as they continue to increase in size. Ongoing maintenance and dredging of harbors on Martha's Vineyard, Nantucket, and Cape Cod will continue as needed. No specific projects are known.
Presence of structures	The likelihood of allisions is expected to continue at or near current levels. Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. 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 and other species are attracted to these locations. Recreational and commercial fishing can occur near these aggregation locations, although recreational fishing is more popular, as commercial mobile fishing gear is more likely to snag on structures. 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, as vessels need to avoid both the structure and each other. Current structures do not result in space use conflicts.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion. 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. Non-offshore wind structures that could be viewed in conjunction with the offshore components of the proposed Project would be limited to meteorological towers. Marine activity would also occur within the marine viewshed.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	The only existing offshore structures within the viewshed of the proposed Project are minor features such as buoys.	
Traffic	Ports and marine traffic related to shipping, fishing, and recreation in the geographic analysis area are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes. 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.	New vessel traffic near the geographic analysis 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 geographic analysis area economy. An increased risk of collisions is not anticipated from future activities.

IPF = impact-producing factor; MCT = Marine Commerce Terminal

Table G.1-13: Summary of Activities and the Associated Impact-Producing Factors for Scenic and Visual Resources

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Cable emplacement and maintenance	Infrequent cable maintenance activities generate vessel traffic that may be visible to observers on shore and at sea.	Cable maintenance or replacement of existing cables in the geographic analysis area would occur infrequently.
Lighting	Ocean vessels have an array of lights including navigational lights and deck lights that may be visible from locations on land and at sea. The maximum theoretical distance at which lights near the surface may be visible is approximately 48 miles, reflecting curvature of the earth and the coefficient of refraction (COP Appendix III-H.a; Epsilon 2022). Actual viewing distances are typically significantly shorter, due to the presence of obstructions (i.e., topography, vegetation, structures, and waves), as well as weather and atmospheric conditions that restrict visibility (i.e., fog, haze, sea spray, clouds, precipitation, and sun angle and intensity). Offshore buoys and towers include vessel navigation safety lighting and may include aviation hazard lighting. Onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	The anticipated modest growth in regional vessel traffic would marginally increase the number of vessels operating at night with lighting. 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 number of offshore structures other than those from offshore wind projects is expected to remain relatively constant.
Presence of structures	The only existing offshore structures within the viewshed of the proposed Project are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components of the proposed Project would be limited to meteorological towers and buoys. The number of these offshore structures is expected to remain relatively constant.
Traffic	Vessel traffic related to shipping, fishing, and recreation are common, constant elements of seaward views.	Vessel traffic not associated with offshore wind is expected to increase along with increases in coastal population and marine-related economic activity.

COP = Construction and Operations Plan; IPF = impact-producing factor

Table G.1-14: Summary of Activities and the Associated Impact-Producing Factors for Air Quality

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	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. The DOE reports that 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Globally, approximately 43.8 million barrels of oil were lost as a result of tanker incidents from 1970 to 2021, although this includes only 175,000 barrels from 2010 to 2021, indicative of significant reductions in spills over time (ITOPF 2022).	Accidental releases of air toxics or HAPs would be due to potential chemical spills. 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.
Air emissions	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 improved over the last 30 years; however, some areas in the Northeast have experienced a recent decline in air quality. Some areas of the Atlantic coast remain in nonattainment for ozone, primarily from power generation. Many of these states (including Massachusetts and Connecticut, among others) have committed to clean energy goals to improve air quality and address climate change and have specifically included wind and solar energy generation as part of these 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.	The largest air quality impacts over the next 30 years would occur during the construction stage of any project; however, project construction would be required to comply with the CAA. During the construction and decommissioning stages, emissions above *de minimis* thresholds would require offsets and mitigation. Primary emission sources include increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. As wind, solar, and other non-fossil fuel energy projects come online, power generation emissions overall would decline and the industry as a whole would have a net benefit on air quality. Activities associated with operations and maintenance of onshore wind, solar, and other non-fossil fuel projects would have a proportionally minimal 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 minimal air quality impacts. Many Atlantic states (including Massachusetts and Connecticut, among others) have committed to clean energy goals, and have committed to wind, solar, and other non-fossil fuel sources to achieve these goals. In the absence of future offshore wind projects, power generation from non-fossil fuel sources would likely result in decreased air quality impacts regionally due to the avoidance or replacement of emissions from natural gas-, coal-, or oil-fired plants. Remaining fossil fuel facilities would likely have larger and continuous emissions and result in greater regional scale impacts on air quality.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Climate change	Activities that consume fossil fuels (such as construction, operations, and decommissioning of power generation and manufacturing facilities, as well as residential and commercial development) would produce GHG emissions (nearly all CO_2) that can contribute to climate change. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. As a result, the impact of GHG emissions does not depend upon the source location. Increasing energy production from clean energy projects (reflecting state and national commitments) would likely decrease GHG emissions by replacing energy from fossil fuels.	Development of future onshore wind, solar, and other non-fossil fuel projects marginally increase GHG emissions over the next 30 years. However, these contributions would be minimal compared to aggregate global emissions. The impact on climate change from these activities would be negligible. As more clean energy projects come online, some reduction in GHG emissions would occur. Overall, it is anticipated that there would be no collective adverse impact on global warming as a from onshore clean energy project activities.

CAA = Clean Air Act; CO_2 = carbon dioxide; DOE = U.S. Department of Energy; GHG = greenhouse gas; HAP = hazardous air pollutant; IPF = impact-producing factor

Table G.1-15: Summary of Activities and the Associated Impact-Producing Factors for Water Quality

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	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 of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Globally, approximately 43.8 million barrels of oil were lost as a result of tanker incidents from 1970 to 2021, although this includes only 175,000 barrels from 2010 to 2021, indicative of significant reductions in spills over time (ITOPF 2022). 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 limited spatial impact.	Future accidental releases of fuels and fluids from offshore vessel usage, spills, and consumption would likely continue on a similar trend. Impacts are unlikely to affect water quality. 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 affect water quality.
Anchoring and gear utilization	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.
Cable emplacement and 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 cable- and pipeline-laying activities disturb bottom sediments and cause temporary increases in suspended sediment; these	Suspension of sediments may continue to occur infrequently over the next 30 years due to survey activities, as well as 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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	disturbances would be short term, and either be limited to the emplacement corridor or localized.	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.
Discharges/intakes	Discharges affect 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 percent 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 would be minimized because the USEPA established dredge spoil criteria and regulates the disposal permits issued by the USACE. The impact on water quality from sediment suspension during future activities would be short term and localized.
Land disturbance	Ground-disturbing 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 impacts and subsequent increased turbidity. 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.	Ground disturbance associated with construction of onshore components could lead to unvegetated or unstable soils. Precipitation events could mobilize these soils, leading to erosion and sedimentation impacts and turbidity. Impacts from future offshore wind would be staggered in time and localized. The impacts would be short term and localized with an increased likelihood of impacts limited to onshore construction periods. The general trend along coastal regions is that port activity will likely 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.
Port utilization	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 affect 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	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 affect 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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	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.	increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.
Presence of structures	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 affect 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.

BOEM = Bureau of Ocean Energy Management; DOE = U.S. Department of Energy; FCC = Federal Communications Commission; IPF = impact-producing factor; mg/L = milligrams per liter; OCS = Outer Continental Shelf; USACE = U.S. Army Corps of Engineers; USEPA = U.S. Environmental Protection Agency

Table G.1-16: Summary of Activities and the Associated Impact-Producing Factors for Bats

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Climate change	Increased storm activity during breeding and roosting season can reduce productivity and increase mortality. Intensity of this impact is speculative. Disease can weaken, lower reproductive output, and/or kill individuals. Some tropical diseases could move northward due to climate change. Extent and intensity of this impact is highly speculative.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance	Onshore construction activities are expected to continue at current trends. Potential impacts 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 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 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.
Noise	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. This 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 TTS 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. Onshore construction occurs regularly for infrastructure projects in the geographic analysis area. There is a potential for displacement caused by equipment if construction occurs at night (Schaub et al. 2008). Displacement, if any, would be temporary. No individual or population-level impacts would be	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 and/or roosting 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 impacts would be expected. Onshore construction is expected to continue at current trends. Behavioral responses and avoidance of construction areas may occur (Schaub et al. 2008). However, no injury or mortality of individuals would be expected.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	expected. 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. No impacts would be expected, as frequent roost switching is a common component of a bat's life history (Hann et al. 2017; Whitaker 1998).	
Presence of structures	Few structures are scattered throughout the offshore portion of the geographic analysis area. There is an assortment of navigation and weather buoys and a handful of light towers (BOEM 2022b). 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 limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS, and no individual or population-level impacts would be expected. Few structures are in the offshore bat 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 turbine strikes would be expected.	The infrequent installation of future new structures in the marine environment over the next 30 years is expected to continue. These structures would not be expected to cause disturbance to migrating tree bats. The infrequent installation of future new structures in the marine environment of the next 30 years is expected to continue. These structures would not be expected to result in increased collision risk to migrating tree bats in the marine environment.

IPF = impact-producing factor; OCS = Outer Continental Shelf; TTS = temporary threshold shift

Table G.1-17: Summary of Activities and the Associated Impact-Producing Factors for Birds

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Ongoing releases of fuels and fluids 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 impacts 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. 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 ingest trash mistaken for prey. Mortality is typically a result of	Gradually increasing vessel traffic over the next 30 years would increase the potential risk of accidental releases of fuels and fluids and associated impacts, including mortality, decreased fitness, and health impacts on individuals. Impacts are unlikely to affect populations. 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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	blockages caused by both hard and soft plastic debris (Roman et al. 2019).	
Cable emplacement and maintenance	Cable emplacement and maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be temporary and generally limited to the emplacement corridor. In the geographic analysis area, there are six existing power cables (see BOEM 2019a 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 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.	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 and 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.
Climate change	Increased storm frequency and severity during the breeding season can reduce productivity of bird nesting colonies and kill adults, eggs, and chicks. 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. 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, as well as the distribution of bird prey resources. 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 (0.7 mile per hour; 9.6 percent) during spring migration by 2091, and wind assistance is projected to decrease within eastern portions of the continent (0.4 mile per hour; 6.6 percent) during autumn migration (La Sorte et al. 2019). The proliferation of coastline protections has the potential to result in long-term and high-consequence, impacts on bird nesting habitat.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance	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.
Lighting	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	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

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	may lead to accidental trash ingestion (see accidental releases). Population-level impacts would not be expected. 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.	collision with vessels but may lead to accidental trash ingestion (see accidental releases). No population-level impacts would be expected. 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.
Noise	Aircraft routinely travel in the geographic analysis area. 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. 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. 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, and 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. Onshore construction is routinely used in infrastructure projects. Equipment could potentially cause displacement. Any displacement would only be temporary, and no individual fitness or population-level impacts would be expected. Ongoing vessel noise activities that contribute to this IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Subsurface noise from vessels could disturb diving birds foraging for prey below the surface. The impact on birds would be similar to noise from G&G but likely less because noise levels are lower.	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. The impact of future site characterization surveys and pile driving would be the same as ongoing activities, with the addition of possible future oil and gas surveys. 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.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures	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. 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, beneficial impacts on some bird species due to increased prey species availability. Likewise, structures may attract recreational fishing. The area includes an assortment of navigation and weather buoys plus a handful of light towers (BOEM 2022b). Migrating birds can easily fly around or over these sparely distributed structures. 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.	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 cable emplacement and maintenance row). Any new towers, buoys, or piers would also create uncommon relief in a 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. 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 or an increase in collision risk or result in displacement. Some potential for attraction and opportunistic roosting exists but would be limited given the limited anticipated number of structures.
Traffic	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.

BOEM = Bureau of Ocean Energy Management; FCC = Federal Communications Commission; G&G = geological and geophysical; GHG = greenhouse gas; IPF = impact-producing factor

Table G.1-18: Summary of Activities and the Associated Impact-Producing Factors for Terrestrial Habitats and Fauna

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Climate change	Climate change, influenced in part by GHG 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.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Land disturbance	Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation but usually not to a degree that affects terrestrial habitats and fauna, assuming that industry standard BMPs are implemented. 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 localized, temporary impacts. 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.	No future activities were identified within the geographic analysis area other than ongoing activities.
Noise	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 minimal in the context of existing vehicle, commercial, and industrial noises in the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.

BMP = best management practice; GHG = greenhouse gas; IPF = impact-producing factor; ROW = right-of-way

Table G.1-19: Summary of Activities and the Associated Impact-Producing Factors for Wetlands and Other Waters of the United States

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Accidental releases of fuel, fluids, and hazardous materials have the potential to cause contamination and harm to water resources from releases and/or cleanup activities. Activities will not occur within 100 feet of wetlands, waterbodies, or known private or community potable wells. A spill prevention, control, and countermeasure plan, in accordance with applicable requirements, will outline spill prevention plans and measures to contain and clean up spills if they were to occur. Impacts are localized, temporary, and negligible.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to impacts on wetlands due to changes in temperature and in the frequency and amount of precipitation. Impacts are uncertain but expected to be minor.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Land disturbance	Ongoing development of onshore properties, especially the OECR and onshore substation, has the potential to cause an increase in sedimentation in the geographic analysis area. Impacts are localized, temporary, and negligible. This development could also degrade water quality in tidal and freshwater wetlands. Different crossing methods could be utilized to minimize impacts on the Centerville River or other wetlands. Impacts are localized, temporary, and negligible.	No future activities were identified within the geographic analysis area other than ongoing activities.

GHG = greenhouse gas; IPF = impact-producing factor; OECR = onshore export cable route

Table G.1-20: Summary of Activities and the Associated Impact-Producing Factors for Land Use and Coastal Infrastructure

Associated IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases	Various ongoing onshore and coastal construction projects include vehicles and equipment that contain fuel, fluids, and hazardous materials that could result in an accidental release.	Ongoing onshore construction projects involve vehicles and equipment that use fuel, fluids, or hazardous materials that could result in an accidental release. Intensity and extent would vary, depending on the size, location, and materials involved in the release.
Land disturbance	Onshore construction supports local population growth, employment, and economics, which, in turn, could lead to new development or redevelopment that disturbs land. New development or redevelopment would result in changes in land use in accordance with local government land use plans and regulations.	Onshore development would continue in accordance with local government land use plans and regulations and is, thus, anticipated to reinforce existing land use patterns, based on local government planning documents.
Lighting	Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles, which 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.
Port utilization	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 are able to host larger deep draft vessels as they continue to increase in size.
Presence of structures	The only existing offshore structures within the offshore viewshed of the proposed Project are minor features such as buoys. Onshore buried transmission cables are present in the area near the proposed 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.	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.

IPF = impact-producing factor; MCT = Marine Commerce Terminal

G.2 Assessment of Resources with Minor (or Lower) Impacts

G.2.1 Air Quality

The proposed Project's wind turbine generators (WTG), electrical service platforms (ESP), and offshore export cable corridor (OECC) would not generate air emissions during normal operations; however, air emissions from equipment used in the construction and installation (construction), operations and maintenance (operations), and conceptual decommissioning (decommissioning) stages 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 Southern Wind Development Area (SWDA), 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 proposed Project site. However, the proposed Project would provide beneficial impacts on air quality in comparison to fossil fuel power-generating stations (Volume III, Section 4.1; Epsilon 2022). Both Phase 1 and 2 of the proposed Project would contribute to a reduction of more than 3.93 million tons per year of carbon dioxide equivalent (CO_2e) from the electric grid, up to 2,103 tons of nitrogen oxides (NO_x), and up to 1,116 tons of sulfur dioxide (SO_2) per year, compared to power derived from fossil fuels.

G.2.1.1 Description of the Affected Environment

This section discusses the existing air quality in the geographic analysis area, as described in Table D-1 in EIS Appendix D, Geographical Analysis Areas, and shown on Figure G.2.1-1. The air quality geographic analysis area includes the airshed within 15.5 miles of each area potentially impacted by the proposed Project, including the lease area, onshore construction areas, and construction ports. Table G.1-14 describes existing conditions and the impacts, based on the impact-producing factors (IPF) 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) in U.S. Code, Title 42, Section 7409 (42 USC § 7409) for criteria pollutants to protect human health and welfare. The criteria pollutants are carbon monoxide (CO), SO_2, particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), nitrogen dioxide (NO_2), ozone (O_3), 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. An area can be in attainment for some pollutants and nonattainment for others.

The attainment status of an area can be found in the Code of Federal Regulations, Title 40, Section 81 (40 CFR § 81) and in the USEPA Green Book, which the agency revises periodically (USEPA 2022). Attainment status is determined through evaluation of air quality data from a network of monitors.

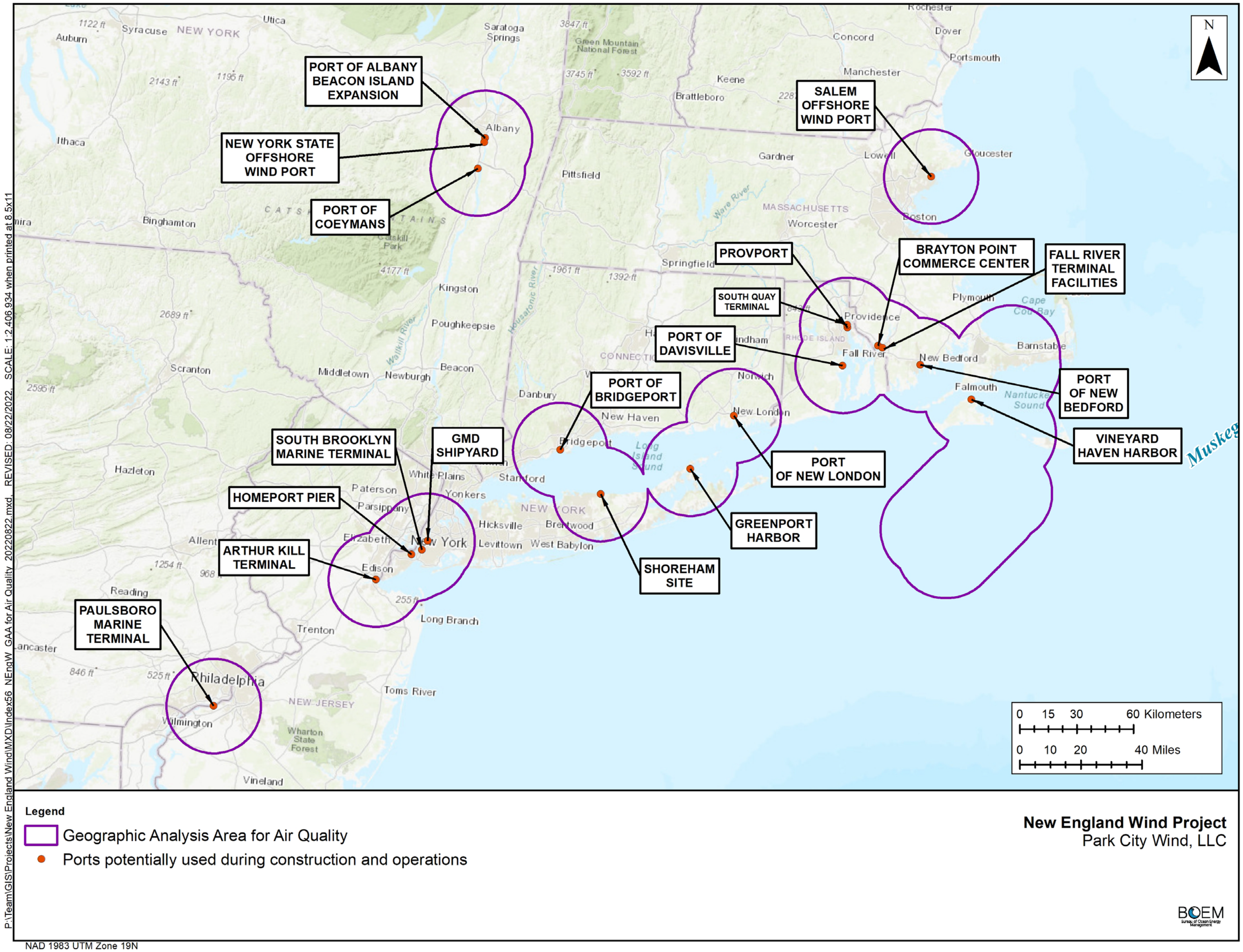


Figure G.2.1-1: Geographic Analysis Area for Air Quality

The CAA amendments directed the USEPA to establish requirements to control air pollution from Outer Continental Shelf (OCS) oil- and gas-related activities along the Pacific, Arctic, and Atlantic coasts, and along the U.S. Gulf Coast of Florida, eastward of 87º 30′ 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 within 25 nautical miles (28.8 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 stage of the proposed Project. Emissions from the proposed Project would exceed USEPA major source thresholds under the Prevention of Significant Deterioration and New Source Review programs, which evaluate the emissions from new or expanded projects in the context of air quality standards. 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, which includes a detailed emissions inventory for the proposed Project design activities, such as engine sizes and activity durations.

The proposed Project may generate air emissions within Massachusetts, Rhode Island, New York, New Jersey, Connecticut, and Pennsylvania. The proposed Project has identified several port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey that may be used for major Phase 1 construction staging activities; however, the proposed Project may need to stage certain activities at other commercial seaports. If a port in one of the aforementioned states is used during construction, proposed Project-related air emissions could potentially occur in the counties discussed below. For Phase 1, the proposed Project has proposed operations facilities in Bridgeport, Connecticut, and Vineyard Haven, Massachusetts (EIS Section G.2.7, Land Use and Coastal Infrastructure).

All southeastern Massachusetts is presently designated as unclassifiable or in attainment for all criteria pollutants (Construction and Operations Plan [COP] Volume III, Section 5.1; Epsilon 2022), except for Dukes County (which includes Martha's Vineyard), which is designated as marginally in nonattainment for the 2008 O_3 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 remain in effect, Dukes County was designated in attainment in August 2018 against the more stringent 2015 O_3 NAAQS of 70 ppb; as noted in the Federal Register, Volume 80, Issue 206 (October 26, 2015), pp. 65121–65603 (80 Fed. Reg. 206 pp. 65121–65603); 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. The USEPA has administrative responsibility for changing this designation to attainment but has not yet done so.

Emissions from the proposed Project may occur within the New York Metropolitan Area, including Fairfield, Middlesex, and New Haven counties in Connecticut; Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, and Westchester counties in New York; and Bergen, Hudson, Middlesex, and Monmouth counties in New Jersey. The New York Metropolitan Area is classified as being in serious nonattainment with the 2008 8-hour O_3 standard and moderate nonattainment for the revised 2015 O_3 standard (USEPA 2022). The region is also in maintenance for CO (since 1971) and $PM_{2.5}$ (since 2006).

Outside of the New York Metropolitan Area, the Greater Connecticut area is designated as being in serious nonattainment for the 2008 O_3 NAAQS but in marginal nonattainment with the 2015 O_3 standard (USEPA 2022). The entire State of Rhode Island is currently in attainment for all criteria pollutants. Use of ports on the Hudson River in the New York Capital Region could generate emissions in Putnam, Orange, Dutchess, Ulster, Columbia, Greene, Rensselaer, and Albany counties, each of which is in attainment for all criteria pollutants, with the exception of Orange County, which is in nonattainment for $PM_{2.5}$ (USEPA 2022).

The proposed Project may cause emissions along the Delaware River within Cape May, Cumberland, Gloucester, and Salem counties in New Jersey; Kent, New Castle, and Sussex counties in Delaware; and Delaware County in Pennsylvania. Each of these counties is in attainment with NAAQS for lead, CO, NO_2, $PM_{2.5}$ and PM_{10}, and SO_2. Sussex County is in marginal nonattainment with the 2008 O_3 standard but is in attainment with the more stringent 2015 O_3 standard, and Kent County is in attainment for O_3. The Philadelphia-Wilmington-Atlantic City region includes Cape May, Cumberland, Gloucester, Salem, New Castle, and Delaware counties and is in marginal nonattainment for both the 2008 and 2015 O_3 standards.

G.2.1.2 Environmental Consequences

Definitions of impact levels for air quality are described in Table G.2.1-1. Impact levels are intended to serve National Environmental Policy Act (NEPA) purposes only and are not intended to establish thresholds or other requirements with respect to permitting under the CAA.

Table G.2.1-1: Impact Level Definitions for Air Quality

Impact Level	Impact Type	Definition
Negligible	Adverse	Increases in ambient pollutant concentrations due to proposed Project emissions would not be detectable.
	Beneficial	Decreases in ambient pollutant concentrations due to proposed Project emissions would not be detectable.
Minor to Moderate	Adverse	Increases in ambient pollutant concentrations due to proposed Project emissions would be detectable but would not lead to exceedance of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to proposed Project emissions would be detectable.
Major	Adverse	Changes in ambient pollutant concentrations due to proposed Project emissions would lead to exceedance of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to proposed Project emissions would be larger than for minor to moderate impacts.

NAAQS = National Ambient Air Quality Standards

Impacts of Alternative A – No Action Alternative on Air Quality

When analyzing the impacts of Alternative A on air quality, the Bureau of Ocean Energy Management (BOEM) considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for air quality infrastructure (Table G.1-14). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in EIS Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for air quality described in Section G.2.1.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on air quality include the need to construct and operate new energy generation facilities to meet future power demands. Reflecting market forces and state energy policies, these 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. Under Alternative A, emissions and impacts from future fossil fuel facilities would be partially mitigated 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.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on air quality include construction, operation, and decommissioning of the Vineyard Wind 1 project in Lease Area OCS-A 0501, as well as other ongoing offshore wind projects that use the ports listed in Table 2.1-4 in EIS Chapter 2, Alternatives. Ongoing and planned activities (including offshore wind) would affect land use and coastal infrastructure through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind activities would affect air quality through the following primary IPFs.

Accidental releases: Future offshore wind activities could release air toxics or hazardous air pollutants (HAP) because of accidental chemical spills within the air quality geographic analysis area. EIS Section G.2.2, Water Quality, includes a discussion of the nature of releases anticipated. As shown in Table E-1, up to about 528,331 gallons of coolants, 2,959,716 gallons of oils and lubricants, and 434,680 gallons of diesel fuel would be contained in the 570 WTG and ESP foundations (other than the proposed Project) constructed 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. HAP emissions would consist of volatile organic compounds (VOC), which may be important for O_3 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. As described in EIS Section G.2.2, tankers are relatively common in these waters, and the total WTG and ESP chemical storage capacity within the air quality geographic analysis area is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). Air quality impacts from accidental releases would be short term and limited to the area near the accidental release location. Accidental releases 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 the entirety of projects within lease areas OCS-A 0487 (Revolution Wind), OCS-A 0500 (Bay State Wind), OCS-A 0501 (Vineyard Wind 1), OCS-A 0520 (Beacon Wind), and OCS-A 0521 (Mayflower Wind), and a portion of OCS-A 0486 (Sunrise Wind) (Table E-1). Based on the planned activities assumptions in Table E-1, the portions of these projects within the geographic analysis area would produce approximately 5,751 megawatts (MW) of renewable power from the installation of up to 570 WTG and ESP foundations. Based on the assumed offshore foundation construction schedule in Table E-1, those projects within the geographic analysis area would have overlapping construction periods beginning in 2022 and continuing through 2030. The total construction emissions of criteria pollutants (CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, and VOCs) are shown in Table G.2.1-2.

Table G.2.1-2: 2022–2030 Construction Emissions, Future Offshore Wind Projects, Geographic Analysis Area

	Total Emissions (tons)[a]						
Project	**NO_x**	**VOCs**	**CO**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2e**
Sunrise Wind (OCS-A 0486)	1,378	32	573	25	25	1	149,639
Revolution Wind (OCS-A 0487)	4,124	85	1,008	135	130	13	278,696
Vineyard Wind 1 (OCS-A 0501)	4,961	122	1,116	172	166	38	318,660
Bay State Wind (OCS-A 0500)[b]	9,167	200	2,259	346	335	56	631,707
Beacon Wind (OCS-A 0520)[b]	8,723	191	2,150	329	318	54	601,077
Mayflower Wind (OCS-A 0521)[b]	8,278	181	2,040	312	302	51	570,450
Total	**36,631**	**811**	**9,146**	**1,319**	**1,276**	**213**	**2,550,331**

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; RI/MA Lease Areas = Rhode Island/Massachusetts Lease Areas; SO_2 = sulfur dioxide; VOC = volatile organic compound

[a] This includes only the portion of other offshore wind projects within the geographic analysis area for air quality. Emissions from projects partially within the geographic analysis area (e.g., Sunrise Wind) were pro-rated based on the share of potential foundations from that project within the geographic analysis area.

[b] Emissions data for the Bay State Wind (OCS-A 0500), Beacon Wind (OCS-A 0520), and Mayflower Wind (OCS-A 0521) are not publicly available and were estimated based on the ratio of total combined emissions (by pollutant) to total combined foundations constructed for the other offshore wind projects in the RI/MA Lease Areas.

The carbon dioxide (CO_2) construction emissions make up the largest percentage of total construction-stage emissions, resulting in about 2.5 million tons of CO_2 emissions for the projects within the air quality geographic analysis area (other than the proposed Project). Overall, construction and decommissioning stages would have the largest emissions. The largest emissions of criteria pollutants would be NO_x (36,631 tons) and CO (9,146 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 stages even for overlapping projects. This spatial and temporal variability assumes that construction activity would occur at different locations and 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. Using the assumptions in Table E-1, Alternative A could generate up to approximately 4,000 tons per year of operations emissions in the air quality geographic analysis area beginning in 2030 and continuing for the life of the projects. The largest emissions would be NO_x (2,983 tons per year) and CO (780 tons per year). The other criteria pollutants would each account for approximately 50 to 100 tons per year of operations emissions. Operations air emissions would overall be short term, intermittent, widely dispersed, and generally contribute to small and localized air quality impacts.

Operations of future offshore wind projects would result in 241,595 tons of CO_2e emissions per year. Greenhouse gases (GHG) are important for assessing climate change impacts. However, they are not criteria pollutants and are not included in air quality impact analyses. Common GHGs include CO_2, methane, and nitrous oxide. GHG emissions are calculated as CO2e to express their warming influences in a common metric.

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, compared to health trends from equivalent amounts of fossil fuel energy development, 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; Buonocore et al. 2016). An evaluation of health and climate benefits of offshore wind projects in the Mid-Atlantic United States, compared to health trends from comparable amounts of fossil fuel energy development, examined a range of project sizes and connecting states (Buonocore et al. 2016). While the air emissions profile for a particular grid region will affect the level of benefits (compared to health impacts from equivalent amounts of fossil fuel energy) experienced, a representative range of potential annual health benefits (in dollars) and annual premature deaths avoided with 22 gigawatts of future offshore wind development is presented in Table G.2.1-3. These ranges were created by converting the scenarios analyzed in Buonocore et al. (2016) to dollars and annual premature deaths avoided per megawatt hour (MWh), and assuming a conservative 45 percent average net capacity factor across all future offshore wind development in the Atlantic Ocean. Net capacity factor refers to the proportion of actual energy generation over time over the maximum generation capacity over time.

Table G.2.1-3: Representative Range of Annual Health and Climate Benefits and Annual Premature Deaths Avoided from 22 Gigawatts of Offshore Wind Development

Planned Action Estimate Range Level	Annual Air Quality Health Benefit	Annual Premature Deaths Avoided	Notes
Low	$4.64 billion	463	This range includes the smallest financial impacts per MWh and number of deaths avoided.
Medium	$7.42 billion	571	This range includes the mean financial impact per MWh and number of deaths avoided.
High	$10.32 billion	971	This range includes the largest financial impact per MWh and number of deaths avoided.

Source: Buonocore et al. 2016

MWh = megawatt hour

Climate change: Construction and operations 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 limited GHG emissions from offshore wind projects. U.S. offshore wind projects would likely 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.

Conclusions

Impacts of Alternative A. Under Alternative A, 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, online 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 Alternative A, ongoing activities would have continuing regional air quality impacts primarily through air emissions, accidental releases, and climate change. The impacts of ongoing activities, such as those from air emissions and GHGs, would be **moderate**.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on air quality. Planned activities other than offshore wind include increasing air emission and GHG through construction and operations of new energy generation facilities to meet future power demands (Table G.1-14). These facilities may consist of new natural gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. The impacts of planned activities other than offshore wind would be **moderate**. The combination of ongoing and planned activities would result in **moderate** cumulative 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, ongoing and planned activities in the geographic analysis area would result in **minor** cumulative 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 temporary, 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 stages from 2023 through 2027 (Table E-1). Overall, air quality impacts from future offshore wind projects are expected to be relatively small and temporary. Other future offshore wind projects would likely lead to reduced emissions from fossil-fuel power-generating facilities and **minor** to **moderate** beneficial impacts on air quality.

Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (EIS Appendix C, Project Design Envelope and Maximum-Case Scenario) 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 SWDA and OECC;
- Soil characteristics at excavation areas for fugitive emissions determination; and
- 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 Alternative B because the maximum-case scenario involved the maximum number of WTGs (62 for Phase 1, up to 88 for Phase 2) allowed in the proposed-Project design envelope (PDE).

Impacts of Alternative B – Proposed Action on Air Quality

This section identifies potential impacts of Alternative B on air quality.

Impacts of Phase 1

Air emissions during construction of Phase 1 would primarily come from the main propulsion engines, auxiliary engines, and auxiliary equipment on marine vessels used during construction activities. Emissions from vessel engines would occur while vessels install offshore facilities within the SWDA, during installation of the offshore export cables, during vessel transits to and from port, and while vessels are in port (COP Volume I, Sections 3.2.2.5 and 4.2.2.5; Epsilon 2022).

Primary emission sources would be increased commercial vessel traffic, air traffic, public vehicular traffic, combustion emissions from construction equipment, and some fugitive emissions. 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. Reduced levels of emissions and lower magnitude air quality impacts would occur during the decommissioning stage. As Alternative B and other future offshore wind projects come online, power generation emissions in the region would reduce emissions over time, and this would contribute to a net benefit on air quality regionally. Most air quality impacts would remain offshore because the highest emissions would occur in this region, and the westward prevailing winds would result in most plumes remaining offshore. Phase 1 activities would be required to comply with the CAA, and emissions may exceed *de minimis* thresholds, requiring offsets and mitigation.

During the construction stage, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses could result in impacts on air quality. 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, CO_2e or GHG emissions, O_3, and total HAPs. The COP provides a complete description of all emission points associated with the construction and operations stages of Phase 1, 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, Appendix B; Epsilon 2022). The total construction emissions of each pollutant for Phase 1 are summarized Table E-1, as well as in the COP (Volume III, Table 5.1-6 and Volume III, Appendix B, Table 3.2-1; Epsilon 2022). Construction equipment would use appropriate fuel-efficient engines and comply with all applicable air emission standards to keep combustion emissions and associated air quality impacts to a minimum.

Phase 1 would affect air quality through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: Proposed Project construction could release air toxics or HAPs due to accidental chemical spills. Phase 1 would have up to about 373,426 gallons of coolants, 591,542 gallons of oils and lubricants, and 114,638 gallons of diesel fuel in its 62 WTG foundations; and about 6,340 gallons of coolants, 355,506 gallons of oils and lubricants, and 16,402 gallons of diesel fuel in its two ESP foundations within the air quality geographic analysis area (COP Volume I, Table 3.3-6; Epsilon 2022). 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 O_3 formation. Air quality impacts would be short term and limited to the local area at and around the accidental release location. These activities would have a **negligible** air quality impact from Phase 1.

Accidental releases would occur infrequently over the 30-year period of operations 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; 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. As a result, the Phase 1 operations would have **negligible** impacts on air quality due to accidental releases.

Air emissions: Emission-producing onshore activities of Phase 1 would consist of horizontal directional drilling (HDD), duct bank construction, cable-pulling operations, and substation construction. HDD emissions would be generated by operations 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 8 months spread across an 18-month period (COP Volume III, Figure 3.1-3; Epsilon 2022). The applicant's voluntarily committed emission-reduction measures include 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; complying with International Maritime Organization energy-efficiency regulations; complying 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 SWDA and OECC; and other emission-reducing measures to further reduce air quality impacts (Epsilon 2022). It is anticipated that emissions and the corresponding air quality impacts of Phase 1 onshore construction activities would be limited to approximately 2 years (COP Volume III, Figure 3.1-3; Epsilon 2022). Because such activities for Phase 1 would occur for short periods and be limited to combustion emissions, they would 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 temporary, **minor** impacts. 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 spraying water for dust control, when possible, thereby resulting in **minor** impacts. There would be **minor** impacts from onshore construction from Phase 1.

The overall air quality impacts of offshore construction activities would continue for approximately 2 years (COP Volume III, Figure 3.1-3; Epsilon 2022). Specific emissions from potential sources or construction activities would vary throughout construction of offshore components. For pollutants such as NO_2, $PM_{2.5}$, and SO_2, the USEPA bases NAAQS attainment status on monitored 3-year pollutant concentrations. Because the construction stage of the offshore components would likely not extend past 2 years and because the emissions would vary throughout the stage, BOEM does not expect projected air quality impacts to exceed the NAAQS for these pollutants. Construction emissions from Phase 1 are shown in Table G.2.1-4 (COP Volume III, Appendix B; Epsilon 2022).

Table G.2.1-4: Estimated Construction Emissions, Phase 1

	Total Emissions (tons)							
Activity	**NO_x**	**VOCs**	**CO**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**HAPs**	**CO_2e**
Phase 1 construction emissions	5,917	124	1,406	238	230	41	18	393,627

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxide; $PM_{2.5}$ = articulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound

Both NO_x and VOC are O_3 precursors, and these emissions may contribute to some increase in O_3 production during construction. There would be **minor** air quality impacts due to construction of Phase 1.

Emissions from Phase 1 offshore activities would 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. The proposed Project may require emergency generators at times, potentially resulting in increased emissions for limited periods.

Emissions from onshore operations activities would be limited to periodic use of construction vehicles and equipment. Onshore operations 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. Phase 1 intends to use port facilities at both Craigville Public Beach Landfall Site and/or Covell's Beach Landfall Site to support operations activities. Air quality impacts due to onshore operations from Phase 1 would be **minor**, occurring for short periods and temporary.

During operations, air quality impacts are anticipated to be smaller in magnitude than during construction and decommissioning. The operations stage of Phase 1 would generate fewer emissions than construction, as it would involve limited vessel and commercial traffic, and operations of emergency equipment would occur infrequently.

Operations activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance. The WTGs operating under Phase 1 would have no pollutant emissions. Emergency generators located on the WTGs and the ESPs would operate during emergencies or testing, so emissions from these sources would be temporary and **negligible**. Pollutant emissions from operations 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 SWDA for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would infrequently travel to the SWDA for significant maintenance and repairs. Table G.2.1-5 shows the estimated operations emissions for Phase 1 (COP Volume III, Appendix B; Epsilon 2022).

Table G.2.1-5: Estimated Operations Emissions, Phase 1

	Annual Emissions (tons per year)							
Activity	**NO_x**	**VOCs**	**CO**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**HAPs**	**CO_2e**
Phase 1 operations emissions, typical year	178	3.2	45	6.0	5.8	0.5	0.5	20,259
Phase 1 operations emissions, maximum year	266	4.8	65	8.9	8.6	0.8	0.7	26,039

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound

Increases in renewable energy can result in significant reductions in fossil-fuel-type emissions. Once operational, Phase 1 would result in annual avoided emissions of 1,585,878 tons of CO_2e, 848 tons of NO_x, and 450 tons of SO_2 (COP Volume III, Appendix B; Epsilon 2022). Accounting for construction emissions and assuming decommissioning emissions would be similar to construction emissions, the proposed Project would offset CO_2e emissions related to its development and eventual decommissioning within the first year of operations; from that point, the proposed Project would offset emissions that would otherwise be generated from another source. Offshore operations activities would have a **minor** beneficial air quality impact as a result of Phase 1.

For onshore decommissioning activities, the proposed Project would remove onshore export cables from the duct bank using truck-mounted winches, cable reels, and cable reel transport trucks. The proposed Project 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. There would be **minor** and temporary air quality impacts from Phase 1 due to decommissioning.

Climate change: Phase 1 and other future offshore wind projects would produce GHG emissions (nearly all CO_2) that contribute to climate change; however, these contributions would be minimal compared to aggregate global emissions and less than the emissions offset during operations 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. Increasing energy production from offshore wind projects could reduce regional GHG emissions by displacing energy from fossil fuels. This reduction could more than offset the relatively small GHG emissions from offshore wind projects. This reduction in regional GHG emissions would be noticeable in the regional context, would contribute incrementally to reducing climate change, and would represent a moderate beneficial impact in the regional context but a negligible beneficial impact in the global context. The additional GHG emissions anticipated from the planned activities, including Phase 1, over the next 30-year period would have a negligible incremental contribution to climate change. Therefore, Phase 1 would have **negligible** impacts on climate change during these activities and an overall **minor** beneficial impact on both GHG emissions and criteria pollutants, including O_3 precursors like NO_x, compared to a similarly sized fossil-fuel power-generating station or 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.

As shown in Table G.2.1-5, operations of Phase 1 would produce CO_2e emissions that that contribute to climate change, although these contributions would be minuscule compared to aggregate global emissions. Operations of Phase 1 would also reduce or avoid CO_2e emissions from fossil-fuel power generation. As a result, Phase 1 operations would have **negligible** impacts with respect to climate change due to CO_2e emissions, as well as **negligible** beneficial impacts due to fossil fuel CO_2e emissions avoided or prevented.

Impacts of Phase 2

The air emission sources during construction of Phase 2 would be similar to those in Phase 1 of the proposed Project. If the applicant includes the South Coast Variant (SCV) as part of the final proposed Project design, some or all of the impacts on air quality from the Phase 2 OECC through Muskeget Channel would not occur. [1] BOEM will provide a more detailed analysis of the SCV impacts and the Phase 2 OECC on air quality in a supplemental NEPA analysis. The volumes and impacts of Phase 2 emissions are discussed below.

[1] The applicant would be required to notify BOEM of a COP revision pursuant to 30 CFR § 585.634 if the applicant determines the SCV is necessary.

The COP provides a complete description of all emission points associated with the construction and operations stages of Phase 2, 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, Appendix B; Epsilon 2022). The total construction emissions of each pollutant for Phase 2 are summarized Table G.2.1-6, as well as in the COP (Volume III, Table 5.1-7 and Volume III, Appendix B, Table 3.3-1; Epsilon 2022).

Accidental releases: Phase 2 could release HAPs because of accidental chemical spills. Phase 2 would have up to about 409,564 gallons of coolants, 648,788 gallons of oils and lubricants, and 125,732 gallons of diesel fuel in its 68 WTG foundations; and about 9,510 gallons of coolants, 533,334 gallons of oils and lubricants, and 24,608 gallons of diesel fuel in its three ESP foundations within the air quality geographic analysis area (COP Volume I, Table 4.3-7; Epsilon 2022). Air quality impacts would be short term and limited to the local area at and around the accidental release location. These activities would have a **negligible** air quality impact as a result of Phase 2. The change in risk to, or impact on, air quality in the air quality geographic analysis area due to offshore wind development is small. The frequency of accidental release events would be small. If an accidental release occurs, it is anticipated that the overall air quality impact would be short term and spatially limited. Collectively, there would be about 1.3 million gallons of coolants, 5.1 million gallons of oils and lubricants, and 715,955 gallons of diesel fuel contained within the 700 foundations from Phase 2 and future planned activities in the air quality geographic analysis area. Impacts from accidental releases during construction from the SCV would be similar to those impacts discussed for Phase 1 but would occur in Bristol County, Massachusetts.

Air emissions: Onshore activities of Phase 2 would be similar to those of Phase 1 and consist of HDD, duct bank construction, cable-pulling operations, and substation construction. The applicant would commit to the same emission-reducing measures as described for Phase 1. It is anticipated that emissions and the corresponding air quality impacts of onshore construction activities would be limited to approximately 2 years. Because such activities for Phase 2 would occur for short periods and be limited to combustion emissions, they would have a **negligible** impact on air quality. Fugitive emissions could be partially mitigated by imposing limits on the surface area of exposed soils in a specific area and spraying water for dust control, when possible, thereby resulting in **minor** impacts. There would be **minor** impacts from onshore construction from Phase 2.

Phase 2 would contribute up to 531,441 tons of construction emissions, which would be additive with the impacts of 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. Table G.2.1-6 shows the estimated construction emissions for Phase 2 (COP Volume III, Appendix B; Epsilon 2022).

Table G.2.1-6: Estimated Construction Emissions, Phase 2

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

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound

Both NO_x and VOC are O_3 precursors, and these emissions may contribute to some increase in O_3 production during construction. There would be **minor** air quality impacts due to the construction of Phase 2. The emission sources for Phase 2 offshore activities would be the same sources as for Phase 1.

Emissions from operations activities would be similar to those in Phase 1 and limited to periodic use of construction vehicles and equipment. During operations, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. Operations of Phase 2 would generate fewer emissions than construction since they would involve limited vessel and commercial traffic, and operations of emergency equipment would occur infrequently. Air quality impacts due to onshore operations from Phase 2 would be temporary and **minor**, occurring only when maintenance vessels or vehicles are used.

The change in risk to, or impact on, air quality in the geographic analysis area due to offshore wind development is small, and the frequency of accidental release events would also be small. If a release were to occur, it is anticipated that the overall air quality impact would be short term and spatially limited.

The COP provides a more detailed description of offshore and onshore operations activities for Phase 2 (Volume I; Epsilon 2022) and summarizes emissions during operations (COP Volume III, Appendix B, Table 3.3-2; Epsilon 2022). Operations activities would be similar to those in Phase 1 and include WTG operations, planned maintenance, and unplanned emergency maintenance.
Table G.2.1-7 shows the estimated operations emissions for Phase 2 (COP Volume III, Appendix B; Epsilon 2022).

Table G.2.1-7: Estimated Operations Emissions, Phase 2

Activity	Annual Emissions (tons per year)							
	NO_x	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
Phase 2 operations emissions, typical year	179	3.2	45	6.0	5.8	0.5	0.5	27,594
Phase 2 operations emissions, maximum year	270	4.9	67	9.0	8.7	0.9	0.7	33,606

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound

Increases in renewable energy can result in significant reductions in fossil-fuel-type emissions. Once operational, Phase 2 would result in annual avoided emissions of 2,345,191 tons of CO_2e, 1,255 tons of NO_x, and 666 tons of SO_2 (COP Volume III, Appendix B; Epsilon 2022). Accounting for construction emissions, and assuming decommissioning emissions would be similar to the construction stage, the proposed Project would offset CO_2e emissions related to its development and eventual decommissioning within the first year of operation; from that point, offsetting emissions would be otherwise generated from another source.

Similar to Phase 1, onshore decommissioning activities of Phase 2 would have substantially lower emissions than onshore construction. There would be **minor** and temporary air quality impacts from Phase 2 due to decommissioning. Air emission impacts from operations and decommissioning of the SCV would be similar to those impacts discussed under Phase 1.

Climate change: Impacts on climate change from Phase 2 construction would be similar to those in Phase 1. Therefore, Phase 2 construction would have **negligible** impacts on climate change and an overall **minor** beneficial impact on GHG emissions and criteria pollutants compared to a similarly sized fossil-fuel power-generating station or the generation of the same amount of energy by the existing grids. Impacts on climate change from construction of the SCV would be similar to those in Phase 1.

Cumulative Impacts

Offshore construction overlap between Phase 1 and planned offshore wind projects would begin in 2023 based on the lease areas within the air quality geographic analysis area (Table E-1). As Alternative B and other future offshore wind projects come online, power generation emissions in the region 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 westward prevailing winds would result in most plumes remaining offshore.

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-14 in Appendix G would contribute to impacts on air quality through the primary IPFs of air emissions and climate change. These impacts would primarily occur through changes emissions of air pollutants and CO_2e. Cumulative impacts on air quality would range from **negligible** to **minor**, as well as **minor** beneficial. Adverse impacts would occur due to increased emissions, while beneficial impacts would occur due to the offset of GHG emissions from fossil-fuel power plants due to the use of offshore wind energy.

Conclusions

Impacts of Alternative B. Alternative B would have **minor** impacts and **minor** beneficial impacts on air quality within the geographic analysis area based on all IPFs. Air quality in the geographic analysis area may be impacted by the emission of criteria pollutants from sources involved in construction or operations of the proposed Project. 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 SWDA or at any of the onshore construction or support sites. Additionally, O_3 levels in the region could potentially be impacted.

The majority of air emissions from Alternative B would come from vessels, engines on construction equipment, aircraft (e.g., helicopters), generators, on-road vehicles, and some fugitive emissions during the construction, operations, and decommissioning stages. Fugitive emissions would occur from excavation and hauling soil. A net benefit in air quality is expected as Alternative B comes online and offsets emissions from fossil-fuel-type sources. Because 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.

Although Alternative B would generate 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 dust control plans for onshore construction areas as a condition of COP approval (EIS Appendix H, Mitigation and Monitoring). The potential impacts from construction activities and the operations of the various vehicles, sea vessels, and temporary power-generating and maintenance equipment would be further reduced if the potential mitigation and monitoring measures related to dust control plans outlined in EIS Appendix H became a condition of COP approval.

Cumulative Impacts of Alternative B. The cumulative impacts on air quality in the geographic analysis area would be **minor** and **moderate** beneficial**.** 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 B would contribute to the overall impact rating primarily through short-term construction emissions from construction vessels. Overall, Alternative B would result in a net decrease in overall emissions over the region compared to the installation of a traditional fossil-fuel power-generating station.

Impacts of Alternative C – Habitat Impact Minimization Alternative on Air Quality

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project, and could, thus, affect the exact length of cable installed and area of ocean floor disturbed or the exact location of construction or maintenance vessel activity. These differences would not result in meaningfully different impacts compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on air quality would be the same as those for Alternative B.

G.2.2 Water Quality

G.2.2.1 Description of the Affected Environment

This section discusses existing water quality in the geographic analysis area, as described in Table D-1 in EIS Appendix D, Geographical Analysis Areas, and shown on Figure G.2.2-1. This is defined as a 10-mile radius around the SWDA, the OECC, and vessel routes to/from the port facilities. Table G.1-15 describes existing conditions and, based on IPFs assessed, the impacts on water quality of ongoing and planned activities other than offshore wind, which is discussed below.

Detailed descriptions of existing conditions for onshore and offshore water quality can be found in the COP (Section 5.2, Volume III; Epsilon 2022), as well as the *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement* (BOEM 2021a), for which the analysis area overlaps with much of the geographic analysis area for the proposed Project. These regional descriptions remain valid and are briefly summarized in this section. Key water quality parameters are presented in Table G.2.2-1, including mean observed values from 2010 to 2020 in Nantucket Sound for three data buoys from the available data in Center for Coastal Studies (2020) dataset.

Table G.2.2-1: Water Quality Parameters with Characterizing Descriptions and Mean Ranges from Three Data Buoys in Nantucket Sound (2010 to 2020)

Parameter	Characterizing Description	Mean Ranges
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).	18.0–20.3°C
Salinity	Salinity, or salt concentration, also affects species distribution. Seasonal variation is smaller than year-to-year variation and less predictable than temperature changes (Kaplan 2011).	31.5–31.7 practical salinity units
Dissolved oxygen	Dissolved oxygen concentrations should be above 5 mg/L to maintain a stable environment; lower levels may affect sensitive organisms (USEPA 2000).	7.3–8.0 mg/L
Chlorophyll a	Chlorophyll a is an indicator of primary productivity. The USEPA considers estuarine and marine levels of chlorophyll a under 5 µg/L to be good, 5 to 20 µg/L to be fair, and over 20 µg/L to be poor (USEPA 2021a).	2.0–2.3 mg/L
Turbidity	Turbidity is a measure of water clarity. High turbidity reduces light penetration, reduces ecological productivity, and provides attachment places for other pollutants (USGS 2018).	0.6–0.8 nephelometric turbidity units
Total nitrogen and Total phosphorous	Phytoplankton (the foundation of the marine food chain) growth rates depend on nutrient availability in the water. Nutrient sources within the geographic analysis area include recycling or resuspension from sediments, river and stream discharges, transport into the area from offshore waters, atmospheric deposition, and upwelling from deeper waters (COP Section 5.2.1, Volume III; Epsilon 2022).	10.2–12.7 µM 0.7–0.9 µM

Source: Center for Coastal Studies 2020

°C = degrees Celsius; µg/L = micrograms per liter; COP = Construction and Operations Plan; mg/L = milligrams per liter; USEPA = U.S. Environmental Protection Agency

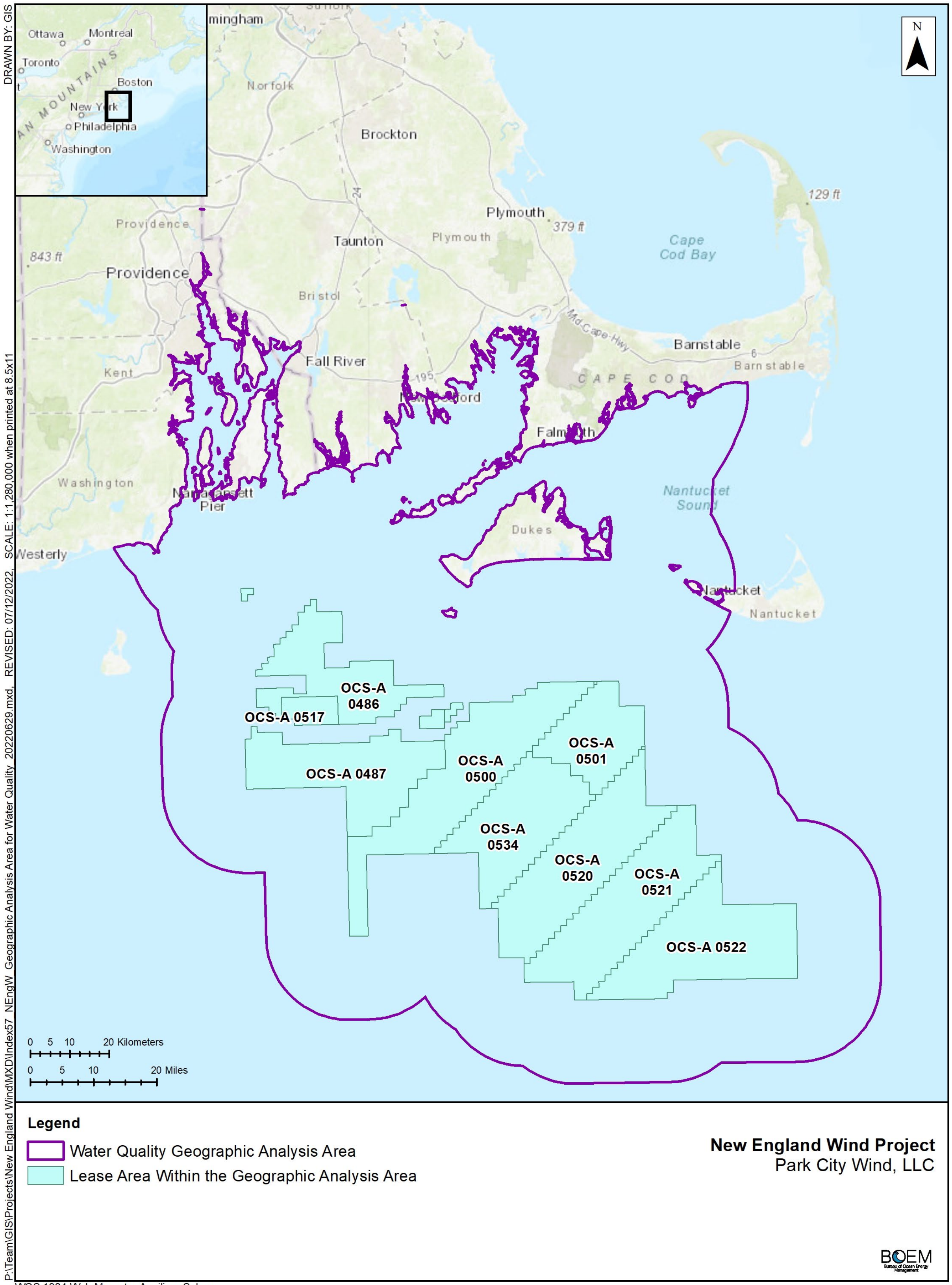


Figure G.2.2-1: Geographic Analysis Area for Water Quality

Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011) with large-scale regional water circulation (clockwise movement from Georges Bank toward the equator) being the strongest in the late spring and summer (Gulf of Maine Census 2018).

The proposed Project may use the following ports: the Port of New Bedford, Brayton Point Commerce Center, Fall River terminal facilities, Vineyard Haven Harbor, and the Salem Offshore Wind Port in Massachusetts; the Port of Bridgeport and Port of New London in Connecticut; the Paulsboro Marine Terminal in New Jersey; the Port of Albany Beacon Island expansion, Port of Coeymans, GMD Shipyard, South Brooklyn Marine Terminal, New York State Offshore Wind Port, Homeport Pier, Arthur Kill Terminal, Shoreham site, and Greenport Harbor in New York; and the Port of Providence (ProvPort), South Quay Terminal, and Port of Davisville in Rhode Island (EIS Section G.2.7, Land Use and Coastal Infrastructure). These ports are located within protected embayments and urban estuaries. These nearshore and inshore bodies of water 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. Inner New Bedford Harbor was given a score of 43 (Fair) out of 100 in the Buzzards Bay Coalition's Bay Health Index score, which combines water turbidity, nitrogen levels, dissolved oxygen concentration, and algae content. Outer New Bedford Harbor had a score of 56 (Fair) (Buzzards Bay Coalition 2021). Nutrient overloading in estuaries and coastal waters goes back several decades with increases in coastal development (approximately 80 percent of which is due to groundwater contamination by septic systems) and boat traffic (Cape Cod Commission 2013). Both development and increased boat traffic contribute to other contaminant levels, and these would continue regardless of the offshore development.

Additionally, climate change (warming sea temperatures, rising sea levels, ocean acidification, etc.) can affect water quality, causing variability within the ecosystem. Regional ocean temperatures have warmed faster than the global ocean over the last 2 decades, especially in the Gulf of Maine (NOAA 2021). This long-term temperature change is forced by the warming of source waters flowing into the region rather than by local atmospheric forcing (Shearman and Lentz 2010).

The USEPA monitors water quality trends over time through a national coastal condition assessment. This assessment establishes a water quality index to describe the water quality of various coastal areas by assigning three condition levels (good, fair, and poor) for several water quality parameters. Table G.2.2-2 lists the USEPA Region 1 condition levels per parameter from 2005, 2010, and 2015 (USEPA 2021b); Region 1 includes the coastal waters in the geographic analysis area. Overall, coastal water quality is in good condition. Since 2005, the percentage of "good" ratings has increased for all of the parameters analyzed, although dissolved phosphorus "good" ratings dipped in 2010 before increasing in 2015.

Table G.2.2-2: Water Quality Index for the U.S. Environmental Protection Agency Region 1 Stations based on Data Collected in 2005, 2010, and 2015

	2005			2010			2015		
Parameter	**Other[a]**	**Good**	**Fair**	**Other[a]**	**Good**	**Fair**	**Other[a]**	**Good**	**Fair**
Dissolved oxygen	62.1 %	8.0%	29.9%	86.6%	7.6%	5.8%	88.4%	4.8%	6.8%
Chlorophyll a	65.7%	9.4%	24.9%	86.7%	10.0%	3.3%	94.2%	5.8%	0%
Water clarity	66.9%	1.0%	32.1%	97.6%	0%	2.4%	99.6%	0.2%	0.2%
Dissolved nitrogen	74.2%	2.3%	23.5%	94.0%	5.8%	0.2%	99.7%	0.3%	0%
Dissolved phosphorous	17.4%	52.3%	30.3%	14.7%	82.3%	3.0%	40%	51.9%	8.1%

Source: USEPA 2021b
[a] This includes water quality stations that recorded "poor" values, or for which data were not available.

G.2.2.2 Environmental Consequences

Definitions of impact levels for water quality are described in Table G.2.2-3. There are no beneficial impacts on water quality.

Table G.2.2-3: Impact Level Definitions for Water Quality

Impact Level	Impact Level	Definition
Negligible	Adverse	Changes would be undetectable.
Minor	Adverse	Changes would be detectable but would not result in degradation of water quality in exceedance of water quality standards.
Moderate	Adverse	Changes would be detectable and would result in localized, short-term degradation of water quality in exceedance of water quality standards.
Major	Adverse	Changes would be detectable and would result in extensive, long-term degradation of water quality in exceedance of water quality standards.

Impacts of Alternative A – No Action Alternative on Water Quality

When analyzing the impacts of Alternative A on water quality, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for air quality infrastructure (Table G.1-15). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in EIS Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for water quality described in Section G.2.2.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing and planned activities within the geographic analysis area that affect water quality include onshore development activities (including urbanization, forestry practices, municipal waste discharges, and agriculture), marine transportation-related discharges, dredging and port improvement projects, commercial fishing, military use, new submarine cables and pipelines, and climate change. These activities would continue regardless of the offshore development over the proposed 30-year Project period and are expected to continue on existing trends based on the current regulations in place. Impacts on water quality from ongoing and planned non-offshore wind actions would still occur, but the exact impact depends on the temporal and geographical nature of activities and associated IPFs.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on water quality include construction, operation, and decommissioning of the Vineyard Wind 1 project in Lease Area OCS-A 0501 and the South Fork Wind project in Lease Area OCS-A 0517, as well as other ongoing offshore wind projects that use Massachusetts ports in and near New Bedford, Brayton Point, Fall River, and Vineyard Haven. Ongoing and planned activities (including offshore wind) would affect land use and coastal infrastructure through the primary IPFs described below.

Cumulative Impacts

The nature, extent, frequency, duration, and intensity of various IPFs and their associated impacts from future offshore wind activities other than the proposed Project have been detailed in the Final EIS for Vineyard Wind 1 Project (Vineyard Wind 1) (BOEM 2021a). That analysis is also applicable to the present assessment. The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). The following section summarizes BOEM's findings (2021a) and updates them to the extent that new information is available. Future offshore wind activities would affect water quality through the following primary IPFs.

Accidental releases: Future offshore wind activities could expose coastal and 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, collisions and allisions, or equipment failure of a WTG or ESP. All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by the U.S. Coast Guard (USCG) and Bureau of Safety and Environmental Enforcement (BSEE). Oil spill response plans (OSRP) are required for every project and would provide for rapid spill response, clean-up, and other measures that would help to minimize potential impacts on affected resources from spills. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases.

Vessel activity would increase during construction, and, thus, would increase the potential for vessel allisions/collisions and fuel spills. The probability of a fuel spill would be minimized by preventative measures, such as onboard containment measures and OSRPs, during routine vessel operations, including fuel transfer. The extent and persistence of water quality impacts from a fuel spill would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures.

Using the assumptions in Table E-1, approximately 1.0 million gallons of coolants, 4.6 million gallons of oils and lubricants, and 703,850 gallons of diesel fuel would be contained in the 724 foundations (WTGs and ESPs) for the wind energy projects (other than the proposed Project) within the water quality geographic analysis. Other chemicals, including grease, paints, and sulfur hexafluoride, would also be used at the offshore wind projects, and black and gray water may be stored on facilities. BOEM has conducted extensive modeling to determine the likelihood and impacts of a chemical spill at offshore wind facilities (Bejarano et al. 2013). The modeling effort revealed the most likely type of spill to occur is from the WTGs at a volume of 90 to 440 gallons, at a rate of one time in 1 to 5 years, or a diesel fuel spill of up to 2,000 gallons 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 are largely discountable. The likelihood of a catastrophic, or maximum-case scenario, release of all oils and chemicals would be very low (Bejarano et al. 2013).

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

Trash and debris accidently released into the marine environment can harm marine animals through entanglement and ingestion. Vessel operators will adhere to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements, USEPA and USCG regulations, and BSEE regulations.

An accidental release would generally be localized, short term, and result in little change to water quality. In the unlikely event a large spill occurred, impacts on water quality would be 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 spill location, as well as the effectiveness of spill response measures. Due to the low likelihood of a spill occurring and the expected size of the most likely spill, the overall impact of accidental releases would be short term and localized, resulting in little change to water quality (BOEM 2021a). As such, accidental releases from future offshore wind development would not contribute appreciably to overall impacts on water quality.

Anchoring and gear utilization: Anchoring associated with future wind development could contribute to changes in water quality through resuspension of sediments during construction, operations, and decommissioning. Disturbances to the seabed during anchoring would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to the anchorage area. 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 would be localized and short term, resulting in little change to ambient water quality (BOEM 2021a). Therefore, anchoring and gear utilization would not appreciably contribute to overall impacts on water quality.

Cable emplacement and maintenance: Using the assumptions in Table E-1, cable emplacement from future offshore wind development other than the proposed Project would result in seabed disturbance of about 7,510 acres. This would result in increased suspended sediments and turbidity. The sediment dispersion model for the proposed Project used several simulations for possible cable installation methods and predicted the sediment plume would be located in approximately the bottom 20 feet of the water column. Above-ambient total suspended solids (TSS) was predicted to stay within 656 feet of the cable but could possibly extend 1.3 to 1.4 miles; elevated TSS persisted for less than 4 hours. Future offshore wind projects would use dredging only when necessary and rely on other cable laying methods for reduced impacts (i.e., jet or mechanical plow), where feasible. 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 would be localized and short term, resulting in little change to ambient water quality. The impacts of periodic cable maintenance on water quality would be similar to those described for cable emplacement but would be more localized (i.e., affecting only the segment of cable being maintained). Cable emplacement and maintenance activities would not appreciably contribute to overall impacts on water quality.

Discharges/intakes: WTGs and ESPs are typically self-contained and do not generate discharges under normal operating conditions. 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 Rhode Island and Massachusetts Lease Areas (RI/MA Lease Areas) beginning in 2022 and continuing through 2030 and then lessen to near-existing condition levels during operations. 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/facilities operating in the same area will comply with federal and state regulations on effluent discharge including the requirement of a USEPA National Pollutant Discharge Elimination System (NPDES) permit. 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 non-indigenous species. All vessels would need to comply with USCG ballast water management requirements outlined in 33 Code of Federal Regulations, Title 33, Part 151 (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, impacts on water quality resulting from vessel discharges would be minimal and to not exceed background levels over time.

Due to the staggered increase in vessels from various projects; the current regulatory requirements administered by the USEPA, the U.S. Army Corps of Engineers (USACE), USCG, and BSEE; and the restricted allowable discharges; the overall impacts of discharges from vessels would 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 appreciably contribute to overall impacts on water quality.

Other offshore wind projects in the RI/MA Lease Areas may include high-voltage direct current (DC) export cables. The process of converting alternating current (AC) to DC generates substantial amounts of heat, and the conversion equipment requires cooling systems (often installed as stand-alone structures similar to an ESP) to avoid overheating (BOEM 2022c). Where high-voltage DC closed loop cooling systems are installed, sea water may be used for heat exchange. Ambient-temperature seawater is pumped into and absorbs heat from the high-voltage DC conversion process before being discharged into the ocean, where that heat is absorbed and dissipated (BOEM 2022c). The warmer outflow from high-voltage DC is "generally accepted as a minimal effect" (BOEM 2022c), and any such discharges must be permitted through the USEPA's NPDES (BOEM 2022c). These impacts would be long term and localized to the area around high-voltage DC conversion systems and would not appreciably contribute to overall impacts on water quality.

Land disturbance: Future wind development could include onshore components that could contribute to water quality impacts through sedimentation and accidental spills of fuels and lubricants during construction. BOEM assumes that each project would avoid and minimize water quality impacts through best management practices (BMP); spill prevention, control, and countermeasure plans; stormwater pollution prevention plans; and compliance with applicable permit requirements. Overall, the impacts from onshore activities that occur near waterbodies could result in temporary introduction of sediments or pollutants fluids into coastal waters in small amounts where erosion and sediment controls fail. Land disturbance for future offshore wind developments that are at a distance from waterbodies and that implement erosion and sediment control measures would be less likely to affect water quality. Impacts on water quality would be localized, short term, and limited to periods of onshore construction and periodic maintenance over the life of each project. Land disturbance from future offshore wind development would not appreciably contribute to overall impacts on water quality.

Port utilization: Future wind development could increase port utilization, possibly including port expansion/modification, resulting in increased potential for increased turbidity, sedimentation, and accidental releases (fuel spills, trash/debris, etc.). However, any port expansions/modifications would comply with all applicable permit requirements, and vessels would adhere to all USCG and MARPOL 73/78 Annex V requirements and, as applicable, the NPDES vessel general permit. Due to construction timeframes and decreased vessel traffic during operations, the overall impact of accidental spills and sedimentation during port utilization would be localized and short to long term, resulting in little change to water quality. Port utilization would not appreciably contribute to overall impacts on water quality.

Presence of structures: Using the assumptions in Table E-1, future offshore wind development other than the proposed Project would result in 724 structures in the water, 6,981 acres of impact from installation of foundations and scour protection, and 1,095 acres of impact from hard protection for the offshore export, inter-array, and inter-link cables. These structures would result in some alteration of local water current leading to increased movement, suspension, and deposition of sediments, but significant scour is not expected in deep water locations (areas without tidally dominated currents), where most of the structures would be located. Scouring that leads to impacts on water quality through the formation of sediment plumes generally occurs in shallow areas with tidally dominated currents (Harris et al. 2011). Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing. Results from a recent BOEM (2021b) hydrodynamic model (HDM) of four different WTG buildout scenarios of the offshore RI/MA Lease Areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind. The results of the HDM study show that introduction of the offshore wind structures into the offshore area modifies the oceanic responses of current magnitude, temperature, and wave heights by reducing the current magnitude through added flow resistance, influencing the temperature stratification by introducing additional mixing, and reducing current magnitude and wave height by extracting of energy from the wind by the turbines. The changes in currents and mixing would fluctuate seasonally and regionally and affect water quality parameters (e.g., temperature, dissolved oxygen, and salinity).

Without protective measures, the exposure of offshore wind structures, which are mainly made of steel, to the marine environment can result in corrosion. Corrosion is a general problem for offshore infrastructure, and corrosion protection systems are necessary to maintain structural integrity. Protective measures for corrosion (e.g., coatings, cathodic protection systems) are often in direct contact with seawater and have different potentials for emissions. For example, galvanic anodes can emit metals such as aluminum, zinc, and indium, and organic coatings can release organic compounds due to weathering and/or leaching. The current understanding of chemical emissions for offshore wind structures is that emissions appear to be small, suggesting a low environmental impact, especially compared to other offshore activities. These emissions may become more relevant for the marine environment with increased numbers of offshore wind projects (Kirchgeorg et al. 2018).

Overall impacts on water quality from future offshore wind activities would be localized and could be recurring for the life of the structures. Presence of structures would not appreciably contribute to overall impacts on water quality.

Conclusions

Impacts of Alternative A. Under Alternative A, 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 under Alternative A, ongoing activities would have continuing impacts primarily through accidental releases and discharges/intakes. Considering all the IPFs together, the water quality impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing activities would be **minor** to **moderate**. BOEM has considered the possibility of impacts resulting from accidental releases. A **moderate** impact could occur if there was a large-volume, catastrophic release; however, the probability of this occurring is very low.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities may also contribute to impacts on water quality, primarily through accidental releases and discharges/intakes. The combination of ongoing activities and planned activities other than offshore wind would result in **minor** to **moderate** impacts on water quality. Considering all the IPFs together, the overall impacts of Alternative A would result in **minor** impacts on water quality due primarily to accidental releases and discharges/intakes. A **moderate** impact could occur if there was a large-volume, catastrophic release; however, the probability of this occurring is very low.

Relevant Design Parameters and Potential Variances in Impacts

The primary proposed Project design parameters that would influence the magnitude of the impacts on water quality include the following:

- The extent of vessel use during construction, operations, and decommissioning;
- The number of WTGs and ESPs and the amount of cable laid, which determines the area of seafloor and volume of sediment disturbed by installation;
- Installation methods and installation duration;
- Proximity to sensitive groundwater or surface water sources and mitigation and monitoring measures used for onshore proposed Project activities; and
- The quantity and type of oil, lubricants, chemicals, or other trash/debris contained in the WTGs, vessels, and other proposed Project equipment in the event of a non-routine event, such as a spill.

Impacts of Alternative B – Proposed Action on Water Quality

This section identifies potential impacts of Alternative B on water quality.

Impacts of Phase 1

Phase 1 would affect water quality through the following primary IPFs during construction, operations, and decommissioning.

The water quality impacts from the presence of structures during Phase 1 operations are discussed below. Phase 1 operations would be similar to, but less extensive than, construction for IPFs related to accidental releases, anchoring and gear utilization, cable emplacement and maintenance, discharges, and port utilization. Vessel activity would be significantly less during operations than construction, decreasing the frequency of anchoring and port utilization, and reducing the likelihood of accidental releases and discharges. Cable maintenance impacts for operations would be similar to those described for construction but would be limited to individual cable sections being maintained or repaired. The WTGs and ESPs are self-contained and do not generate discharges under normal operating conditions. The mitigation and monitoring measures listed for Phase 1 construction (EIS Appendix H, Mitigation and Monitoring) would be followed during Phase 1 operations, limiting the impacts on water quality. Phase 1 operations would not generate any land disturbance under normal operating conditions.

Accidental releases: Accidental releases during construction could involve fuel, oil, and lubricants. Each Phase 1 WTG would store up to 6,023 gallons of coolant, 9,547 gallons of oils and lubricants, and 1,849 gallons of diesel fuel, while each ESP would store 2,113 gallons of coolant, 118,616 gallons of oils and lubricants, and 5,468 gallons of diesel fuels (COP Volume I, Table 3.3-6; Epsilon 2022). The risk of a spill from any single offshore structure would be low, and any impacts would likely be localized. Increased vessel activity during construction would increase the potential for vessel allisions/collisions and fuel spills. However, collisions and allisions would be unlikely based on USCG requirement for lighting on proposed Project vessels, vessel speed restrictions, the proposed spacing of WTGs and the ESPs, the implementation of a USCG-approved lighting and marking plan, and the inclusion of proposed Project components on navigation charts (EIS Appendix H). The applicant would implement and adhere to its OSRP (COP Appendix I-F, Volume I; Epsilon 2022), which would provide for rapid spill response, cleanup, 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 Phase 1 vessels or components resulted in a large spill, impacts from Phase 1 on water quality would be 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. Overall, the probability of an oil or chemical spill occurring that is large enough to affect water quality is very low, and the degree of impact on water quality would depend on the spill volume. This risk and impact would be similar to that evaluated in BOEM (2021a) and would be localized, short term, and **minor,** with the unlikely event of a large accidental release potentially causing a **moderate** and short-term impact.

All onshore vehicle fueling and major equipment maintenance would be performed off site at commercial service stations or a contractor's yard. A few pieces of large, less mobile equipment (e.g., excavators, paving equipment, and generators) would be refueled, as necessary, on site. Any such field refueling would not be performed within 100 feet of wetlands or waterways (EIS Section G.2.6, Wetlands and Other Waters of the United States), within 100 feet of known private or community potable wells, or within any Town of Barnstable water supply Zone I area. Proper spill containment gear and absorption materials would be maintained for immediate use in the event of any inadvertent spills or leaks. Any proposed Project substation equipment would be equipped with full containment for any components containing dielectric fluid. As a result, Phase 1 would result in **negligible** impacts (including 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.

Phase 1 could also result in accidental releases of trash and debris; however, these releases would be infrequent and **negligible** because operators would comply with federal and international requirements for management of shipboard trash, and the extent of an accidental release would be limited to the localized area.

Anchoring and gear utilization: Under the maximum-case scenario, the applicant would use a nine-point anchoring system for installation of offshore export cables or the inter-link cables within the SWDA. This system would be equipped with spud legs that are deployed to secure the cable laying vessel while its anchors are being repositioned (COP Sections 3.3.1.3.6 and 4.3.1.3.6, Volume I; Epsilon 2022). To install the cable close to shore using tools that are best optimized to achieve sufficient cable burial, the cable laying vessel may temporarily ground nearshore, and a jack-up vessel may be used to facilitate pulling the offshore export cables through HDD conduits installed at the landfall site. Overall, anchoring from Phase 1 construction would affect 177 acres, while offshore wind construction activities within the geographic analysis area for water quality (including Phase 1) would affect 2,267 acres between 2022 and 2030. Although up to seven offshore wind projects (including Phase 1) would be under construction simultaneously in 2025, only a portion of this acreage would be impacted at any single time.

Anchoring can cause resuspension and deposition of sediments in the immediate area of disturbance. Disturbed sediments would be limited to a localized area and would settle shortly (several hours) thereafter (COP Section 5.2.2.1.2, Volume III; Epsilon 2022). Therefore, impacts from Phase 1 on water quality from anchoring and gear utilization would be **negligible**.

Cable emplacement and maintenance: Cable emplacement for the proposed Project may disturb up to 52 acres of seabed through dredging in the OECC. The sediment dispersion model for the proposed Project predicted that, with the use of a trailing suction hopper dredge, above-ambient TSS greater than 10 milligrams per liter (mg/L) could persist for 4 to 6 hours throughout the entire water column (COP Section 5.2.2.1.2, Volume III; Epsilon 2022). Phase 1 would disturb up to 200 acres of seabed for offshore cable emplacement, and 242 acres during inter-array and inter-link cable installation. The sediment dispersion model used several simulations for possible cable installation methods and predicted the sediment plume would be located in the bottom, approximately 20 feet of the water column. Above-ambient TSS was predicted to stay within 656 feet of the cable but could possibly extend 1.3 to 1.4 miles; elevated TSS persisted for less than 4 hours. Sediment deposition greater than 1 millimeter is generally confined within 328 to 492 feet of the installation alignment with maximum deposition usually less than 5 millimeters (COP Appendix A, Volume III; Epsilon 2022). Impacts on water quality from construction of Phase 1 due to cable emplacement and resulting suspension of sediment and turbidity would be short term and **minor**.

Discharges/intakes: During the proposed 18-month construction stage, approximately 30 to 60 proposed Project vessels would be operating in the geographic analysis area, undertaking an estimated total of 3,000 round trips at an average of 6 round trips per day (COP Section 3.3.1.12.1, Volume I; Epsilon 2022). Vessels are permitted to routinely discharge certain liquid wastes to marine waters, including domestic water, uncontaminated bilge water, treated deck drainage and sumps, uncontaminated ballast water, and uncontaminated fresh or seawater from vessel air conditioning. Other waste such as sewage; solid waste or chemicals; solvents; oils and greases from equipment, vessels, or facilities would be stored and properly disposed of on land or incinerated offshore. The proposed Project would require all vessels to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental releases. All vessels would need to comply with USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162, USCG bilge water regulations in 33 CFR Part 151, and the NPDES vessel general permit (as applicable). Allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids.

Based on the BMPs proposed by the proposed Project and compliance with applicable vessel requirements, the impacts on water quality from the Phase 1 discharges would be short term and **minor** during construction.

Land disturbance: Onshore components would include construction of a substation, concrete transition vaults, and buried concrete duct banks through which the onshore export or grid interconnection cables would run. The onshore export cable and grid interconnection routes would be primarily located within existing public roadway layouts or utility rights-of-way (ROW), and construction involves standard inert materials such as concrete, polyvinyl chloride conduit, and solid dielectric cable. Proper erosion and sedimentation controls would be maintained to avoid and minimize unstable soils that could potentially be moved by wind and runoff into surface waters and increase turbidity. HDD is expected to be used at the Phase 1 landfall site to minimize land disturbance near the shoreline. It is possible that potential, limited sediment releases could occur during the HDD, but impacts would be localized and short term. As such, impacts from construction of Phase 1 on water quality from land disturbance would be **negligible**.

Port utilization: The applicant has identified several port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey for the proposed Project construction staging activities, although not all ports would be used. No port expansions are included in Alternative B. Each port facility under consideration already has sufficient existing infrastructure or has an area where other entities intend to develop infrastructure with the capacity to support offshore wind activity, including the proposed Project. The increase in vessel activity during construction would be small, and multiple authorities regulate water quality impacts from port activities. Therefore, impacts of Phase 1 construction on water quality from port utilization would be **negligible**.

Presence of structures: Phase 1 impacts on water quality due to the presence of structures would be additive with the impacts of structures associated with offshore wind activities and activities other than offshore wind that occur within the water quality geographic analysis area that would remain in place during the life of the proposed Project. Impacts on water quality due to the presence of structures would begin during construction immediately after the structures are installed; however, most impacts under this IPF would occur during Phase 1 operations are discussed in the Operations and Maintenance and Conceptual Decommissioning section.

Phase 1 would add up to 63 stationary structures to the SWDA during construction, involving 74 acres of foundation and scour protection and up to 35 acres of hard protection for offshore, inter-array, and inter-link cables. Results from a recent BOEM (2021b) HDM study found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind. These disturbances would be localized but, depending on the hydrologic conditions, have the potential to affect water quality through altering mixing patterns and the formation of sediment plumes. Significant scour is not expected due to anticipated low current speeds and low seabed mobility in the SWDA (COP Section 3.2.2, Volume II, and Section 5.2.2.2.1, Volume III; Epsilon 2022). The addition of scour protection would further minimize impacts on local sediment transport. Furthermore, limited scour is anticipated around each cable due to the target cable burial depths.

In addition, the exposure of offshore wind structures to the marine environment can result in emissions of metals and organic compounds from corrosion protection systems. However, the current understanding of chemical emissions for offshore wind structures is that emissions appear to be small, suggesting a low environmental impact (Kirchgeorg et al. 2018).

The presence of structures during operations could continue to disrupt bottom current patterns, leading to the increased movement, suspension, and deposition of sediments, although significant scour is not expected (COP Volume II, Section 3.2.2 and Volume III Section 5.2.2.2.1; Epsilon 2022). Scour protection for WTGs, ESPs, and cables would limit local sediment transport. The extent of the changes in the currents and mixing would fluctuate seasonally and regionally and affect water quality parameters (e.g., temperature, dissolved oxygen, and salinity). Changes to water quality would be detectable but would not result in degradation of water quality that would exceed water quality standards. Therefore, the impact on water quality from Phase 1 operations would be temporary and **minor**.

Decommissioning of the proposed Project would include removing or retiring onshore and offshore Phase 1 components in place. The impacts of Phase 1 decommissioning would be similar to construction impacts and could include short-term and localized sediment resuspension and deposition. Over the life of the proposed Project, technological advances in methods and equipment may result in increased efficiency and reduction of impacts at the time of decommissioning. As a result, Phase 1 decommissioning impacts on water quality would be **minor**.

Impacts of Phase 2

Phase 2 would affect water quality through the following primary IPFs during construction, operations, and decommissioning. If the applicant includes the SCV as part of the final proposed Project design, some or all of the impacts on water quality from the Phase 2 OECC through Muskeget Channel may not occur and would instead occur along the SCV OECC route. BOEM will provide a more detailed analysis of the SCV in a supplemental NEPA analysis. Except where specified, the impacts of SCV construction and operations would be similar to the Phase 2 OECC through Muskeget Channel but would occur in a different location.

The impacts of Phase 2 operations (with or without the SCV) would be the same as Phase 1 operations, and would, thus, be **negligible** to **minor**, with the unlikely event of a large accidental release potentially causing a **moderate** impact.

The SCV would include up to 41 acres of hard protection for offshore export cables. This additional area of hard protection would not change the overall impacts of Phase 2 water quality due to the presence of structures.

The impacts resulting from Phase 2 decommissioning (with or without the SCV) would be similar to, but slightly larger than, those described for Phase 1, due to the increased number of foundations and increased inter-array cable length. The decommissioning impacts from Phase 2 would still, however, be **negligible** to **minor.**

Accidental releases: The Phase 2 WTGs and ESPs would store the same volume of coolant, oils, and fuel as the Phase 1 WTGs and ESPs. The potential for collisions/allisions during Phase 2 construction is similar to Phase 1 due to similar vessel traffic volumes. Construction (COP Table 4.3-7, Volume I; Epsilon 2022) of Phase 2 would have similar impacts as Phase 1: infrequent and **negligible.** An allision or collision involving proposed Project vessels or components resulting in a small oil or chemical spill would have **minor** and temporary impacts, while a larger spill would have potentially **moderate** and temporary impacts.

Anchoring and gear utilization: Anchoring for Phase 2 construction would affect 245 acres of seafloor and result in the same type and level of anchoring as Phase 1. As a result, Phase 2 anchoring and gear utilization would have **negligible** impacts on water quality.

Cable emplacement and maintenance: Phase 2 would affect 67 acres of seabed due to dredging in the OECC, 352 acres of seabed for offshore cable emplacement, and 380 acres of seabed for inter-array and inter-link cable installation. The same sediment dispersion model discussed in Phase 1 can be applied to Phase 2. Impacts on water quality would decrease as the sediment settles in the high turbidity areas. Impacts on water quality from Phase 2 cable emplacement and maintenance due to increased suspension of sediment and turbidity would be short term and **minor**.

The SCV would affect up to 379 acres of seafloor. A dispersion model for the SCV found that TSS concentrations greater than 10 mg/L could extend up to 0.6 mile but would typically extend less than 500 feet from the cable centerline with most of the sediment settling out within 2 to 3 hours and all within 6 hours. A deposition of 1 millimeter remained within 656 feet of the cable centerline, and no deposition would reach 5 millimeters thickness (Epsilon 2022). As a result, the impacts on water quality from the SCV would be short term and **minor.**

Discharges/intakes: Phase 2 would have the same level of vessel traffic (approximately 30 to a maximum of 60 vessels) during the 18-month construction stage as Phase 1 (COP Section 4.3.1.12, Volume I; Epsilon 2022). Therefore, the impacts of discharges on water quality during construction of Phase 2 would be similar to those for Phase 1: short term and **minor**.

Land disturbance: Phase 2 onshore components would largely be separate from the Phase 1 onshore components, although the Phase 1 and Phase 2 OECR could be collocated near the West Barnstable Substation and along the grid interconnection route. The applicant may identify one or more separate Phase 2 substation sites within the Town of Barnstable. The Phase 2 OECR could also be longer than the Phase 1 OECR (up to 10.6 miles for Phase 2, compared to up to 6.5 miles for Phase 1); however, the Phase 2 construction impacts on water quality from land disturbance would be similar in type and extent to those for Phase 1: localized, short term, and **negligible**.

The SCV would include a cable landing site, OECR, substation, and grid interconnection point in Bristol County, Massachusetts. The land disturbance impacts of the SCV will be evaluated in a supplemental NEPA analysis if the applicant determines that the SCV will be used.

Presence of structures: As with Phase 1, the impacts on water quality due to the presence of structures would begin during construction, but most impacts under this IPF would occur during operations. The impacts of Phase 2 construction on water quality due to the presence of structures would be similar to Phase 1: short term and **minor**.

Port utilization: Phase 2 (with or without the SCV) would utilize the same ports and involve the same level of vessel traffic as Phase 1. Therefore, the impacts of port utilization on water quality during construction of Phase 2 would be the same as Phase 1: **negligible**.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-15 would contribute to impact on water quality through the primary IPFs of accidental releases, cable emplacement and maintenance, discharges and intakes, and presence of structures. These impacts would primarily occur through release of materials and sedimentation. Cumulative impacts on water quality would range from **negligible** to **minor**.

Conclusions

Impacts of Alternative B. Construction, operations, and decommissioning of Alternative B would result in sediment resuspension and deposition, an increased potential for accidental releases, and changes to water mixing patterns that could affect water quality. Operational impacts would be smaller than construction and decommissioning impacts. The impacts resulting from Phase 1 and Phase 2 would be **negligible** to **minor**, although the impact of the unlikely event of a large accidental release could be **moderate**. Therefore, the overall impact on water quality from Alternative B would be **minor** because the impact would be small, and the resource would recover completely without remedial or mitigating action after decommissioning.

Cumulative Impacts of Alternative B. In the context of ongoing and planned activities, the incremental impacts of Alternative B resulting from individual IPFs would range from **negligible** to **moderate**. Considering all the IPFs, the overall impacts associated with Alternative B when combined with past, present, and future actions would be localized and **negligible** to **moderate** and would not alter the overall character of water quality in the geographic analysis area. The main drivers for this impact rating are the short-term, localized impacts from increased turbidity and sedimentation due to anchoring and gear utilization and cable emplacement and maintenance during construction and alteration of water currents and increased sedimentation during operations due to the presence of structures. A **moderate** impact resulting from accidental releases could occur; however, this level of impact would be unlikely and occur only in the event of a large-volume, catastrophic release.

As a result, the likely overall impacts of Alternative B on water quality would qualify as **minor** because measurable impacts are anticipated, but the impacts would be small, and the resource would recover completely after decommissioning without remedial or mitigating action.

Impacts of Alternative C – Habitat Impact Minimization Alternative on Water Quality

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project, and could, thus, affect the exact length of cable installed and area of ocean floor disturbed or the exact location of construction or maintenance vessel activity. These differences would not result in meaningfully different impacts compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on water quality would be the same as those for Alternative B.

G.2.3 Bats

G.2.3.1 Description of the Affected Environment

This section discusses existing bat resources in the bat geographic analysis area, as described in Table D-1 in EIS Appendix D, Geographical Analysis Areas, and shown on Figure G.2.3-1. Specifically, the geographic analysis area for bats includes the U.S. East Coast, from Maine to Florida, and extends 100 miles offshore and 5 miles inland to capture the movement range for species in this group. Table G.2.3-1 describes existing conditions and impacts, based on IPFs assessed, of ongoing and planned activities other than offshore wind, which is discussed below.

Table G.2.3-1: Bat Species Potentially Present in Massachusetts

Common Name	Scientific Name	State Status	Federal Status
Cave Bats			
Big brown bat	*Eptesicus fuscus*	Not listed	Not listed
Eastern small-footed bat	*Myotis leibii*	Endangered	Not listed
Little brown bat	*Myotis lucifugus*	Endangered	Not listed
Northern long-eared bat	*Myotis septentrionalis*	Endangered	Threatened[a]
Indiana bat[b]	*Myotis sodalis*	Endangered	Endangered
Tri-colored bat	*Perimyotis subflavus*	Endangered	Not listed[c]
Tree Bats			
Silver-haired bat	*Lasionycteris noctivagans*	Not listed	Not listed
Eastern red bat	*Lasiurus borealis*	Not listed	Not listed
Hoary bat	*Lasiurus cinereus*	Not listed	Not listed

Source: BOEM 2012; USFWS 2022

USFWS = U.S. Fish and Wildlife Service
a The USFWS has proposed to list the northern long-eared bat as Endangered.
b This species does not occur in eastern Massachusetts.
c The USFWS has proposed to list the tri-colored bat as Endangered.

Nine species of bats occur within Massachusetts, eight of which may be present in the onshore portions of the proposed Project area (Table G.2.3-1). Bat species consist of two distinct groups based on their overwintering strategy: cave-hibernating bats (cave bats) and migratory tree bats (tree bats). Bats are terrestrial species that spend their lives on or over land. On occasion, tree bats may potentially occur offshore during spring and fall migration and under specific conditions like low wind and high temperatures. Recent studies, combined with historical anecdotal accounts, indicate 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 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 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 SWDA. Pre-construction studies at the Block Island Wind Farm indicate that bat use off Block Island is largely limited to the island and nearshore waters, with limited acoustic detections in offshore habitats (TetraTech 2012). 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 Group, Inc. 2014).

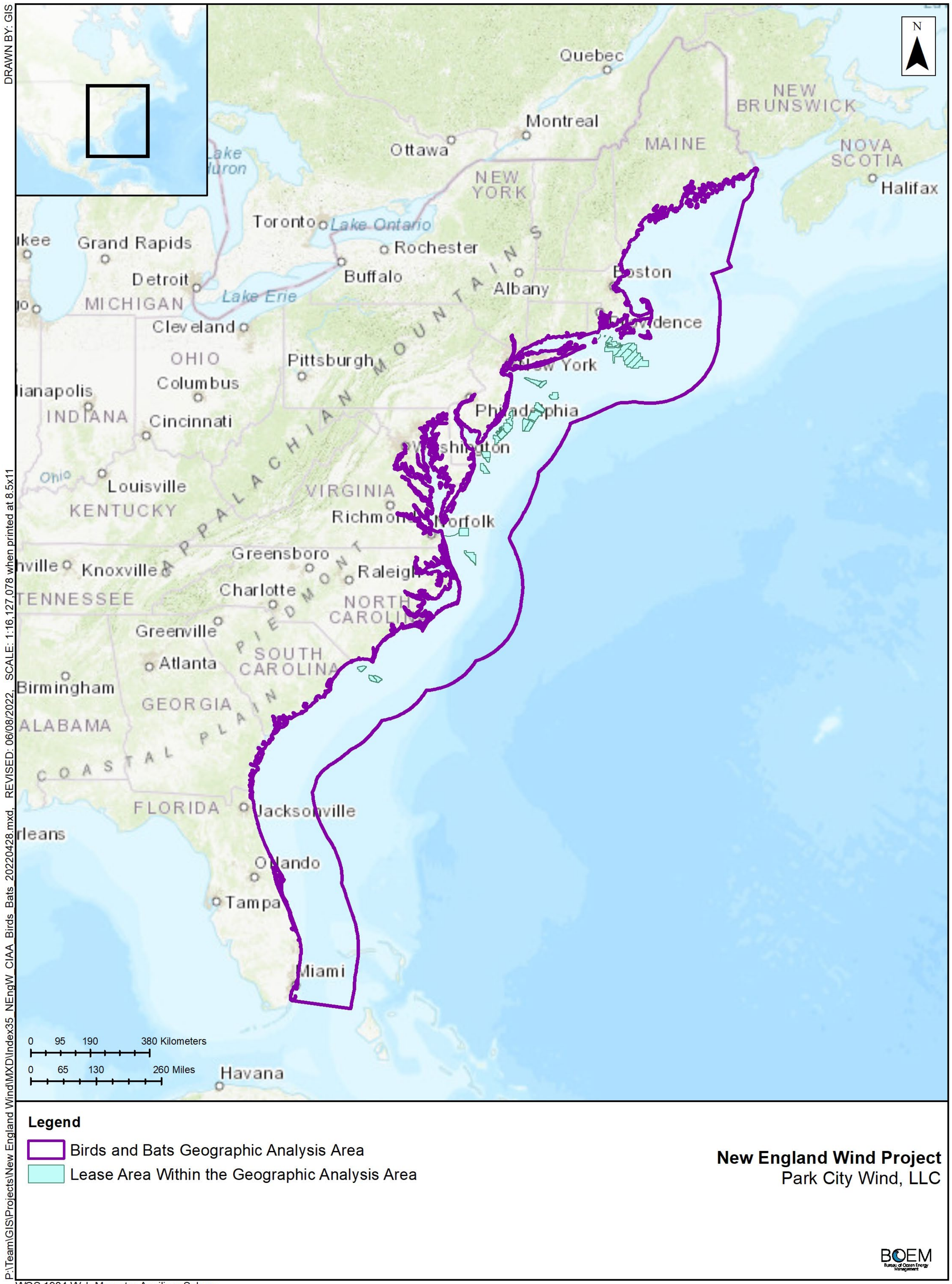


Figure G.2.3-1: Geographic Analysis Area for Bats

Existing data from meteorological buoys provide the best opportunity to further define bat use of open-water habitat far from shore where the applicant would site the proposed Project WTGs. Despite significant distance from any suitable terrestrial habitat, 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 limited use of open water habitats by cave bats. Acoustic detectors in the Gulf of Maine and Great Lakes documented higher than expected proportions of Myotis calls, suggesting that individuals of this genus are capable of, and may frequently make, long-distance, offshore flights (Stantec 2016). The same study reported very little offshore activity of Myotis species in the mid-Atlantic. In a separate mid-Atlantic study, the maximum distance Myotis bats were detected offshore was 7.2 miles (Sjollema et al. 2014). Results from a recent publication show a negative relationship between bat activity and distance from the coast. Specifically, at the nearshore survey location, the number of detections was up to 24 times higher compared to the offshore locations (Brabant et al. 2021). Data from New York State Energy Research and Development Authority metocean buoys deployed within the New York Bight indicate that only ten calls were recorded (nine identified silver-haired bats [*Lasionycteris noctivagans*] and one unknown low-frequency [i.e., non-*mytois*] species) from August 2019 to June 2022, all of which occurred in August, September, and October (Normandeau 2022). Given these data, the potential exists for some migratory tree bats to encounter offshore facilities during spring and fall migration. This exposure risk would be limited to very few individual tree bats and would occur, if at all, during migration. Given the distance of the SWDA from shore, BOEM does not expect foraging bats to encounter operating WTGs outside spring and fall migration.

The onshore areas in the region of Alternative B include forested habitats that provide features suitable for use by roosting and/or foraging bats (COP Section 6.3.1, Volume III; Epsilon 2021), 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 on Cape Cod, Martha's Vineyard, and Nantucket. See the Biological Assessment (BA) for further details on this species (BOEM 2022b). The federally endangered Indiana bat (*Myotis sodalis*) is not known to occur in the greater Cape Cod region and is not discussed further. Several state endangered species—the eastern small-footed bat (*Myotis 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 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 illustrates that the species can cross open water habitats, there are no records of northern long-eared bats migrating to and from islands (BOEM 2015; Dowling et al. 2017; Pelletier et al. 2013). Therefore, it is unlikely that northern long-eared bats would fly over the open ocean near the SWDA. For the same reason, it is unlikely that state-endangered eastern small-footed, little brown, or tri-colored bats would encounter offshore facilities during migration (BOEM 2015; Pelletier et al. 2013).

On March 22, 2022, the U.S. Fish and Wildlife Service (USFWS) published a proposed rule to reclassify the northern long-eared bat as endangered. A final decision on the proposed rule is expected in November 2022. If reclassified, the full suite of prohibitions and exceptions to take of endangered species would be applied to the northern long-eared bat, and exemptions for incidental take of the species, as described under the current 4(d) Rule, would no longer apply (87 Fed. Reg. 56 [March 23,2022]). BOEM assumes the applicant would conduct tree-clearing activities during the seasonal clearing window of

November 1 through March 31, and impacts, if any, would not rise to the level of take. Should tree-clearing activities occur outside of this timeframe, species-specific presence/probable absence surveys would be required for Endangered Species Act (ESA) compliance. Further details regarding potential impacts on northern long-eared bats is provided in the proposed Project-specific BA (BOEM 2022b).

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, would 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 from WNS (Mass Wildlife 2015b). Likewise, WNS has devastated the tri-colored bat in the last 10 years (Mass Wildlife 2015c). Proposed Project-related activities have the potential to result in impacts on cave bat populations already affected by WNS. The unprecedented mortality of millions of bats in North America as of 2015 reduces the likelihood of many individuals being present within the onshore portions of the proposed Project area (USFWS 2022).

G.2.3.2 Environmental Consequences

Definitions of impact levels for bats are described in Table G.2.3-2. There are no beneficial impacts on bats.

Table G.2.3-2: Impact Level Definitions for Bats

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
Moderate	Adverse	Impacts are unavoidable but would not result in population-level impacts or threaten overall habitat function.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level impacts on species.

Impacts of Alternative A – No Action Alternative on Bats

When analyzing the impacts of Alternative A on bats, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for bats (Table G.1-16). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for bats described in Section G.2.3.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities (generally onshore activities) within the geographic analysis area that contribute to impacts on bats would include onshore construction and climate change. Impacts associated with climate change have the potential to reduce reproductive output, increase individual mortality, and increase disease occurrence (Table G.1-16). In the case of most cave bat species, WNS would continue to strain populations. Ongoing impacts from onshore construction activities have the potential to result in impacts on bats and would continue regardless of the offshore wind industry. For several tree bat species, expansion of terrestrial wind energy development in the geographic analysis area to meet current demand would continue to result in some incidental take each year during migration and would also result in a slight increase in forest fragmentation and habitat loss.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on bats include continued operation of the Block Island Wind Farm, as well as ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and South Fork Wind Project, along with planned offshore wind activities, would affect bats through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind development activities would affect bats through the following primary IPFs.

Climate change: In addition to increasing storm severity and frequency, climate change can increase disease frequency. Storms during breeding and roosting season can reduce productivity and increase mortality. Intensity of this impact is speculative. Disease can weaken individuals, lower reproductive output, and/or kill individuals, and some tropical diseases could move northward. The extent and intensity of this impact is highly speculative.

Land disturbance: A small amount of infrequent construction impacts associated with onshore power infrastructure would be required between 2022 and 2030 and beyond to tie future offshore wind energy projects to the electric grid. Typically, this would require only insignificant 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 appreciably contribute to overall impacts on bats.

In addition to electrical infrastructure, some 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 would increase modestly and require some conversion of undeveloped land to meet port demand. This conversion could 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 all increased commercial, industrial, and recreational demand (BOEM 2019a).

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

Construction of up to 2,955 offshore structures within the geographic analysis area (EIS Appendix E) would create noise and may temporarily affect some migrating tree bats, if conducted at night during spring or fall migration. The greatest noise impact 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 from 2022 through 2030 and beyond. Construction activity would be short term, temporary, and highly localized. Auditory impacts are not expected, 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 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 because bats are expected to make little use of the OCS and would only use the OCS 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. 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 would 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 biologically significant. Some bats roosting in the vicinity of construction activities may be disturbed during construction but would move to a different roost farther from construction noise. This would not 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 during 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 as a result of onshore or offshore noise associated with future offshore wind development.

Presence of structures: The presence of up to 2,955 WTGs and ESPs on the OCS could affect 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 would be limited (BOEM 2015; Pelletier et al. 2013). Tree bats, however, may pass through the offshore wind development areas during the fall migration. There is 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 SWDA. Several authors 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 bat attraction to WTGs in the Atlantic OCS 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 2008; Kunz et al. 2007). However, there is 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 potential 2,955 structures to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects 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 (*Lasiurus cinereus*), and the silver-haired bat. Offshore operations would present a seasonal risk factor to migratory tree bats that may use 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 low (Stantec 2016). Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would encounter operating WTGs or other structures associated with future offshore wind development. With the proposed 1 nautical mile (1.9 kilometers, 1.15 miles) 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 proposed 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 WTG 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 (e.g., 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).

Other considerations: Ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the proposed Project may affect the currently federally threatened northern long-eared bat and the proposed federally endangered tri-colored bat. As described above and discussed further in the BA (BOEM 2022b), the possibility of impacts on these species would be limited to onshore impacts, generally during onshore facilities construction.

Conclusions

Impacts of Alternative A. Under Alternative A, 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 Alternative A, ongoing activities would 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. The potential impacts of ongoing activities would be **negligible.**

Cumulative Impacts of Alternative A. In addition to ongoing activities, the impacts of planned activities other than offshore wind development may also contribute to impacts on bats, including increasing onshore construction (Table G.1-16), but these impacts would be **negligible**. The combination of ongoing and planned activities other than offshore wind development would result in **negligible** impacts on bats.

Considering all the IPFs together, the overall impacts associated with future offshore wind activities in the geographic analysis area, not including the proposed Project, would result in **negligible** impacts, notwithstanding 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 since cave bats do not typically occur on the OCS, none of the IPFs associated with future offshore wind activities that occur offshore would 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, onshore habitat removal is anticipated to be minimal when compared to other ongoing and planned activities, and any impacts resulting from habitat loss or disturbance would not result in individual fitness or population-level impacts within the bat geographic analysis area.

Relevant Design Parameters and Potential Variances in Impacts

The bat geographic analysis area was established to capture most of the movement range for migratory species. Northern long-eared bats and other cave bats do not typically occur on the OCS. Tree bats are long-distance migrants; their range includes most of the East Coast from Florida to Maine. Although 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 most of the onshore habitat used by those species that may encounter the proposed Project during most of their life cycles.

The following proposed Project design parameters (EIS Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on bats:

- One or two new onshore substations, which could 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.

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.

Impacts of Alternative B – Proposed Action on Bats

This section identifies potential impacts of Alternative B on bats. BOEM prepared a BA for the potential impacts on USFWS federally listed species, which found that Alternative B was not likely to affect, or had no effect, on listed species and/or designated critical habitat (BOEM 2022b).

Impacts of Phase 1

Phase 1 would affect bats through the following primary IPFs during construction, operations, and decommissioning. Except where otherwise stated, the impacts of Phase 1 decommissioning would be similar to those for Phase 1 construction for all of the IPFs described below.

Land disturbance: Impacts associated with construction of Phase 1 onshore elements 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. BOEM assumes that tree-clearing activities would occur during the hibernation period (November 1 through March 31), thus limiting the potential for direct injury or mortality from the removal of occupied roost trees). Should tree clearing be required during the period when bats may be using trees within the geographic analysis area for bats, species-specific presence/probable absence surveys would be conducted to determine if the species is present, and additional consultation with USFWS would occur. 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, the proposed Project would only remove 6.7 acres of marginal quality habitat that is characterized by a cluttered understory, which limits its suitability. Further, contiguous blocks of potentially suitable habitat are located near the site where forested habitat would be removed. **Negligible** impacts, if any, would occur with adherence to USFWS northern long-eared bat conservation measures and, these impacts would not result in individual fitness or population-level impacts given the limited amount of habitat removal and the presence of contiguous blocks of potentially suitable habitat in the vicinity. These impacts can also result in long-term to permanent impacts that would be **negligible**. The applicant would likely leave onshore facilities in place for future use (EIS Chapter 2, Alternatives). There are no plans to disturb the land surface or terrestrial habitat during decommissioning. Therefore, onshore temporary impacts of decommissioning would be **negligible**.

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on bats, as described in detail in Table H-2 of EIS Appendix H, Mitigation and Monitoring. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Require that trees (greater than 3-inch-diameter at breast height) not be cleared from April 1 to October 31. Should presence/probable absence surveys be conducted pursuant to current USFWS protocols and no northern long-eared bats be documented, this measure may not be necessary for ESA compliance relative to this species.

Noise: Pile-driving noise and onshore and offshore construction noise associated with Phase 1 would result in **negligible** impacts. Construction activity would be short term, temporary, and highly localized. Auditory impacts are not expected, 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, would 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).

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 under Alternative A. Using the assumptions in Table E-1, there could be up to 3,031 new WTGs in the geographic analysis area for bats where few currently exist, of which up to 62 (2.0 percent of the total) would be for Phase 1. The structures associated with Phase 1, 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 population-level consequences of individual mortality, if any, associated with operating WTGs. Given the drastic reduction in cave bat populations in the region, the biological significance of mortality resulting from Alternative B, if any, may be increased. However, as described in Section G.2.3.1, existing data from meteorological buoys provide the best opportunity to further define bat use of open-water habitat far from shore where the applicant would site the proposed Project WTGs. Relatively few (372) bat passes were detected at meteorological buoy sites in the Gulf of Maine and in the Mid-Atlantic and use was sporadic when compared to sites on offshore islands (Stantec 2016). While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on bats, as described in detail in Table H-2 of EIS Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

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

Impacts of Phase 2

Phase 2 would affect bats through the following primary IPFs during construction, operations, and decommissioning. If the SCV is chosen, Phase 2 impacts would be the same as those described under Phase 1.

Land disturbance: Impacts resulting from onshore land disturbance associated with construction of Phase 2 onshore elements would be similar to those described under Phase 1: **negligible** impacts, if any, with adherence to USFWS northern long-eared bat conservation measures. These impacts would not result in individual fitness or population-level impacts. While the site(s) for up to two onshore substations for Phase 2 have not been selected, the largest parcel, or combination of parcels currently under consideration, totals 38 acres in size. While the total acreage of forested habitat to be removed is greater than described under Phase 1 and could result in habitat loss and increased forest fragmentation, population or individual impacts would not be expected. While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on bats, as described in detail in Table H-2 of EIS Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Require that trees (greater than 3-inch-diameter at breast height) not be cleared from April 1 to October 31. Should presence/probable absence surveys be conducted pursuant to current USFWS protocols and no northern long-eared bats be documented, this measure may not be necessary for ESA compliance relative to this species.

Noise: Impacts of pile-driving noise and onshore and offshore construction noise associated with Phase 2 would be similar to those described under Phase 1: **negligible**. While pile-driving noise associated with the installation of Phase 2 WTGs would occur over a longer period due to the larger number of turbines to be installed, construction activity would be short term, temporary, and highly localized. Impacts, if any, would 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).

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 under Alternative A. Using the assumptions in Table E-1, there could be up to 3,031 new WTGs and ESPs in the geographic analysis area where few currently exist, of which up to 88 (2.9 percent of the total) would be for Phase 2. The structures associated with Phase 2, and the consequential **negligible** impacts, would remain at least until decommissioning of the proposed Project is complete. While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on bats, as described in detail in Table H-2 of EIS Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

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

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-16 would contribute to impacts on bats through the primary IPFs of land disturbance and the presence of structures. These impacts would primarily occur through habitat loss and potential interactions with operating WTGs. The cumulative impacts of all IPFs from ongoing and planned activities, including Alternative B, would be **negligible**.

Conclusions

Impacts of Alternative B. In summary, construction and decommissioning of Alternative B 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 this would be rare. The impact conclusions for ongoing and future non-offshore wind activities are presented under Alternative A.

Cumulative Impacts of Alternative B. The cumulative impacts on bats within the geographic analysis area would be **negligible**. Considering all the IPFs together, the impacts from ongoing and planned activities, including Alternative B, would result in **negligible** impacts on bats in the geographic analysis area, primarily due to ongoing climate change and onshore habitat loss. Alternative B would contribute to the overall impact rating primarily through the permanent impacts due to onshore habitat loss. Thus, the overall impacts on bats would be **negligible** because no measurable impacts are expected due to the expected absence of bats within the SWDA.

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measures to address impacts on bats, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

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

Impacts of Alternative C – Habitat Impact Minimization Alternative on Bats

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. While Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project—and could, thus, affect the exact length of cable installed and area of seafloor disturbed—these changes would not result in meaningfully different impacts on bats compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on bats would the same as those for Alternative B.

G.2.4 Birds

G.2.4.1 Description of the Affected Environment

Geographic Analysis Area

This section addresses potential impacts on bird species that use marine, coastal, and/or offshore habitats, including both resident individuals that use the proposed Project area during all (or portions of) the year and migrating individuals with the potential to pass through the proposed Project area during fall and/or spring migration. The geographic analysis area for birds includes the East Coast from Maine to Florida in order to cover migratory species that may encounter the proposed Project and that use habitats along these states, as described in Table D-1 in EIS Appendix D, Geographic Analysis Areas, and shown on Figure G.2.4-1. The geographic analysis area extends 100 miles offshore from the Atlantic Ocean shore to capture the migratory movements of most species and 0.5 mile inland to cover onshore habitats used by birds that could be affected by proposed onshore Project components.

Detailed information regarding species potentially present can be found in the COP and is incorporated by reference (Volume III, Sections 6.1, 6.2, Appendix III-C, and Appendix III-D; Epsilon 2022). A general overview of that information is included below, as well as federally listed threatened and endangered species. Further information on threatened and endangered bird species is provided in the BA for the proposed Project (BOEM 2022b).

Overview of Birds

The SWDA is located between two Large Marine Ecosystems (LME[2]): the Scotian Shelf to the north (the Gulf of Maine) and the Northeast United States Continental Shelf to the south (the Mid-Atlantic Bight) (LMEHub 2022). This region is important to birds because it is used by a suite of breeding birds from both oceanographic regions. In addition, non-breeding summer migrants (e.g., shearwaters and storm-petrels) constitute a significant portion of the marine birds present (Nisbet et al. 2013). The SWDA is no exception, with an influx of southern hemisphere breeding species present during the boreal summer/austral winter (Veit et al. 2016).

While the terrestrial and coastal avifauna of the geographic analysis area is rich and diverse with, for example, around 450 species recorded in Massachusetts alone (Blodget 2002). Many of these species are rarities or unlikely to occur in the offshore portion of the proposed Project area. Breeding and wintering birds that are likely to use or pass through the offshore proposed Project area include primarily marine birds such as seabirds and sea ducks. Numerous shorebirds, waterfowl, wading birds, raptors, and songbirds are also expected to occur, although more typically in the coastal and onshore portions of the proposed Project area. The most likely of these to occur in the SWDA are waterfowl, loons and grebes, shearwaters and petrels, gannet and cormorants, shorebirds, gulls, terns, jaegers, and auks (BOEM 2014). Bird use of the SWDA and surrounding area is well-documented with multiple studies providing important information on avian presence and abundances at a series of useful scales (Veit et al. 2016; Curtice et al. 2019; COP Appendix III-C; Epsilon 2022).

[2] 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.

Threatened and Endangered Species

At least three federally listed birds have the potential to occur within the proposed Project area: Roseate Tern (*Sterna dougallii*), Piping Plover (*Charadrius melodus*), and Red Knot (*Calidris canutus rufa*). The BA provides a detailed description and analysis of potential impacts on ESA-listed species and potential impacts on these species as a result of the proposed Project (BOEM 2022b).

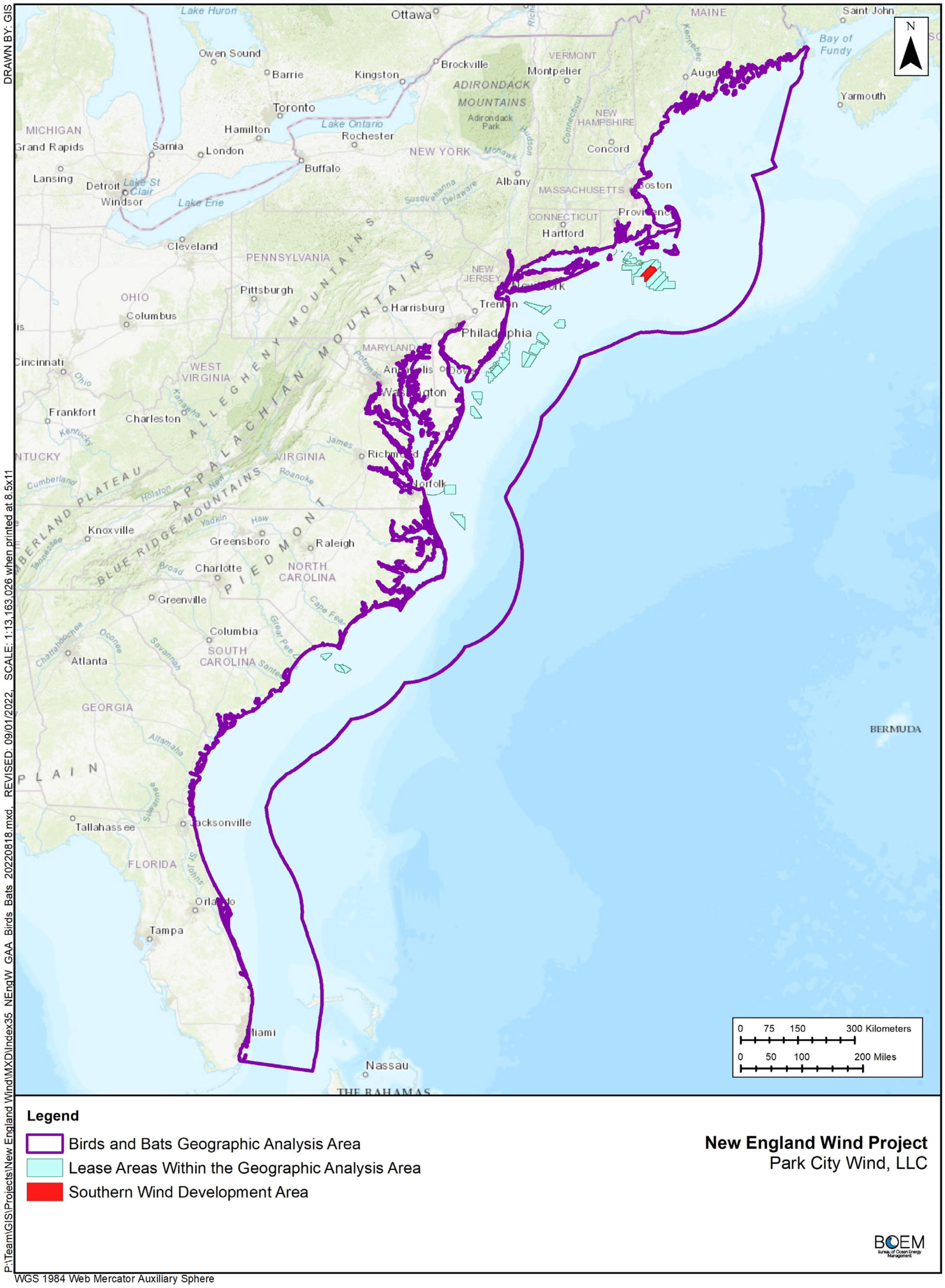


Figure G.2.4-1: Geographic Analysis Area for Birds

Any future proposed project in the RI/MA Lease Areas would be required to address ESA-listed species at the individual project scale and cumulatively. Additionally, BOEM is currently developing a programmatic ESA consultation with the USFWS to address the potential impacts of future Atlantic OCS offshore wind energy facilities on ESA-listed species.

Bald Eagles (*Haliaeetus leucocephalus*), which are listed as threatened in Massachusetts, are also 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 2022). Bald and Golden Eagles typically migrate over land, well inland of all proposed Project facilities (BOEM 2012).

Bald and Golden Eagles are not expected to occur in the offshore portion of the proposed Project area, but some potential exists for impacts (displacement due to noise, habitat loss/modification, and injury/mortality due to contact with construction equipment) resulting from construction, operations, and decommissioning of the onshore facilities. More information on Bald and Golden Eagles use of the proposed Project area is available in the COP (Volume III, Section 6.2.1.5.5; Epsilon 2022).

Migrating Birds

Many bird species do not normally reside along the Atlantic coast of North America but pass through during spring migration to more northern breeding habitats and/or fall migration to wintering areas. 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 Project 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. Migrating birds are protected under the Migratory Bird Treaty Act of 1918 (MBTA). Chapter 4 of the Atlantic Final Programmatic EIS (BOEM 2014) 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 the 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. One of the underlying tenets identified in the MOU is to evaluate potential impacts on migratory birds and design or implement measures to avoid, minimize, and mitigate such impacts as appropriate (MMS-USFWS 2009; BOEM Undated).

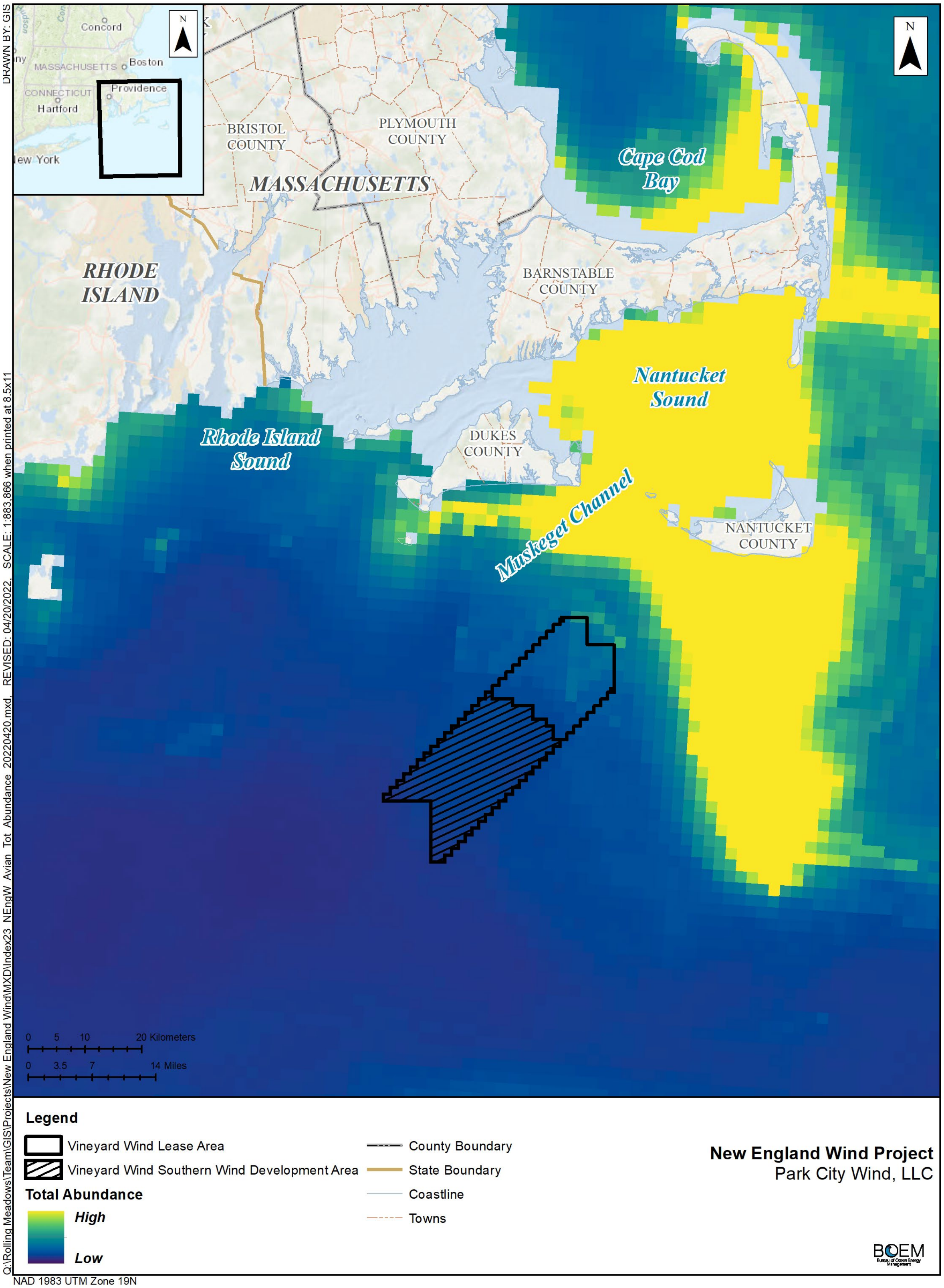
BOEM funds scientific studies and partners with the USFWS to better understand how migratory birds use the Atlantic OCS and refine the understanding of the risks from development to migratory species (BOEM Undated). BOEM uses information from these studies, coordination with the USFWS, and the scientific 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 Wind Energy Area resulted in the exclusion of 14 OCS blocks that overlapped with high value sea duck habitat (BOEM 2012).

BOEM worked with the USFWS to develop standard operating conditions (SOC) for commercial leases as terms and conditions of plan approval. These SOC are intended to ensure that the potential for impacts on birds is minimized. The SOCs have been analyzed in recent environmental assessments and consultations for lease issuance and site assessment activities, as well as BOEM's approval of the Coastal Virginia Offshore Wind Technology Advancement Project (BOEM 2015). Some of the SOCs originated from BMPs 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). Finally, BOEM and the USFWS work with the lessees to develop post-construction plans aimed at monitoring the effectiveness of measures considered necessary to minimize impacts on migratory birds with the flexibility to consider the need for modifications or additions to the measures.

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 as a movement corridor during annual migrations between wintering and breeding grounds (Watts 2010). Within the Atlantic Flyway in North America, 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 extend considerable distances from shore, the highest 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 from 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 Hüppop (2004), Furness and Wade (2012), and Furness et al. (2013), Atlantic OCS avian species with high scores for sensitivity for collision include gulls, jaegers, and the Northern Gannet (*Morus bassanus*). In many cases, high collision sensitivity ratings were 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) that 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 of potential overlap with the SWDA and could potentially encounter operating WTGs on the Atlantic OCS. In general, the abundance of bird species that overlap with future wind energy facilities on the Atlantic OCS is relatively small. Figure G.2.4-2 illustrates that areas modeled for highest marine bird abundances are primarily outside the SWDA.

As described above, of the 177 species that may occur along the Atlantic coast, 55 have some potential to encounter WTGs associated with offshore wind development. Of these, 47 marine bird species have sufficient survey data to calculate the modeled percentage of a species population that would overlap with future 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 G.2.4-1). 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.



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

Figure G.2.4-2: Total Avian Relative Abundance Distribution Map

Table G.2.4-1: Percentage of Each Atlantic Seabird Population that Overlaps with Planned Offshore Wind Energy Development on the Outer Continental Shelf 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 (*Phalacrocorax 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: These data were calculated from Winship et al. 2018.

NA = not applicable

[a] This includes species used in collision risk modeling.

Offshore Birds

Along the Atlantic coast, bird species abundance and species diversity generally decrease as distance from shore increases (Petersen et al. 2006; Paton et al. 2010; Watts 2010). The closest WTG for the proposed Project would be approximately 21 miles from shore in an area that has been part of a detailed resource assessment, including a review of bird resources (BOEM 2012, 2015); the RI/MA Lease Areas excludes 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 Project 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). The COP describes each bird species likely to occur offshore Massachusetts (Volume III, Tables 6.2-6; Epsilon 2022).

Birds in the geographic analysis area are subject to pressure from ongoing activities, particularly accidental releases, cable emplacement and maintenance, presence of structures, 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 affect bird species. Inland birds are discussed in EIS Section G.2.5, Terrestrial Habitats and Fauna.

G.2.4.2 Environmental Consequences

Definitions of impact levels for birds are described in Table G.2.4-2.

Table G.2.4-2: Impact Level Definitions for Birds

Impact Level	Impact Level	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
	Beneficial	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
	Beneficial	Impacts would be localized to a small area but with some measurable effect on one or a few individuals or habitat.
Moderate	Adverse	Impacts would be unavoidable but would not result in population-level impacts or threaten overall habitat function.
	Beneficial	Impacts would affect more than a few individuals in a broad area but not regionally and would not result in population-level impacts.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level impacts on species.
	Beneficial	Long-term beneficial population-level impacts would occur.

Impacts of Alternative A – No Action Alternative on Birds

When analyzing the impacts of Alternative A on birds, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for birds resources (Table G.1-17). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in EIS Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for birds described in Section G.2.4.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on birds include ongoing activities on the OCS that have the potential to result in continuing temporary to permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on birds using the offshore portions of the OCS regardless of the offshore wind industry. Ongoing activities, especially interactions with commercial fisheries, anthropogenic light in the coastal and offshore environment, and climate change would continue. In addition to ongoing activities, the impacts of planned activities 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 G.1-18).

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on birds include continued operation of the Block Island Wind Farm, as well as ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and South Fork Wind Project, along with planned offshore wind activities, would affect commercial fisheries and for-hire recreational fishing through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind development activities would affect birds through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazardous materials, sediment, and/or trash and debris may increase as a result of future offshore wind activities. EIS Section G.2.2, Water Quality, discusses the amount and nature of substances in WTGs and ESPs that could be released. The risk of any type of accidental release would be increased primarily during construction but also during operations and decommissioning of offshore wind facilities.

Ingestion of hazardous materials could have 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 feathers can lead to sublethal impacts 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 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 individual vessels within wind development areas. 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), although accidental trash releases from Project vessels would be rare events.

Because the overall impact of accidental releases on birds is anticipated to be localized and short term, accidental releases of trash and debris would not appreciably contribute to overall impacts on birds. Further, while future offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazardous materials exposure, the contribution from future offshore wind activities would be a low percentage of the overall spill risk from ongoing activities that occur on the OCS.

Cable emplacement and maintenance: Emplacement of submarine cables would generally 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 E-1, the total area of seafloor disturbed by offshore export, inter-array, and inter-link cables for offshore wind facilities (excluding the proposed Project) in the geographic analysis area would be up to 63,846 acres (of the roughly 193 million acres of seafloor habitat potentially available in the geographic analysis area for birds), although only a fraction of this total area would be actively disturbed at any single time. All habitat impacts associated with cable emplacement and maintenance 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 Alternative A 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 planned for the proposed Project, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance (EIS Section 3.4, Benthic Resources, and EIS Section 3.6, Finfish, Invertebrates, and Essential Fish Habitat, provide more information). Given that impacts would be temporary and generally localized to the emplacement corridor, no population-level impacts on birds would be expected. The offshore wind projects included in Alternative A (Table E-1) would primarily be constructed between 2022 and 2030 (and possibly beyond, in the case of some projects in the New York Bight and Carolina Long Bay areas), and construction impacts from multiple projects could overlap in time and space and could potentially result in greater impacts. No population-level impacts would be anticipated because birds would 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 by this IPF.

Climate change: Several sub-IPFs are related to climate change, including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures (e.g., barriers and seawalls), and increased erosion and sediment deposition. These factors have the potential to result in long-term, potentially high-consequence, risks to birds via, for example, changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing. EIS Section G.2.1, Air Quality, provides more details on the expected contribution of offshore wind on climate change.

Lighting: Offshore wind development would result in additional light from vessels and offshore structures at night. Ocean vessels have an array of lights including navigational lights and deck lights. Such lights can attract nocturnal migrant 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 given the distance from shore and the expected limited use of the SWDA. The resulting vessel-related lighting impacts would be localized around individual vessels 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 accidental releases associated with construction activities.

Up to 2,955 WTGs and ESPs with navigational and Federal Aviation Administration (FAA) hazard lighting would be constructed within the geographic analysis area for birds (excluding the proposed Project), where few lighted structures currently exist. This lighting has some potential to result in long-term impacts on species that have potential to encounter operating WTGs and may pose an increased collision risk to migrating birds (Hüppop et al. 2006), although this risk would be minimized through the use of red flashing FAA lighting (BOEM 2019b; Kerlinger et al. 2010). WTG lighting could result in new incremental collision risk for birds, particularly to night flying migrants during low-visibility weather conditions where few lighted structures currently exist on the OCS. Other offshore wind projects will use an aircraft detection light system (ADLS), which will only activate FAA lighting when an aircraft approaches, and these impacts would be substantially reduced.

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 impact birds on the OCS. Additionally, onshore construction noise has the potential to impact birds. These impacts would be localized and temporary. Potential impacts associated with greater energy expenditure could be greater if avoidance behavior and displacement of birds occurs during seasonal migration periods but would not be expected to be biologically significant.

Fixed and rotary wing aircraft may be used to transport construction and operations crews and would continue to be used for ongoing inland bird monitoring surveys, although 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 impacts would be expected.

Noise from construction of WTGs and ESPs may temporarily affect diving birds. The greatest impact of noise is likely to be caused by pile-driving activities, which would occur during construction for up to 4 to 6 hours at a time from 2022 through 2030 and possibly beyond. 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, impacts on prey species may affect foraging success (Table G.1-5). 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.

Noise associated with project vessels could disturb some individual diving birds, although these individuals 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 dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level impacts would be expected.

Noise associated with construction of onshore project components may also have localized and temporary impacts, including avoidance and displacement, although no individual fitness or population-level impacts would be expected.

Presence of structures: The presence of structures under Alternative A could have both beneficial and adverse impacts 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. Up to 2,955 WTG and ESP foundations, which would entail 43,526 acres of new scour protection for foundations and hard protection atop cables, would be constructed in the geographic analysis area for birds (compared to more than 193 million acres in the geographic analysis area) where few such structures exist. Structures would be added intermittently between 2022 and 2030 and beyond and that these structures would remain until decommissioning of each facility is complete, approximately 30 years following construction.

In the northeast and mid-Atlantic waters, there are approximately 2,570 seabird fatalities through interaction with commercial fishing gear each year, of which 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 if left to drift until sinking or washing ashore. A reduction in drifting derelict fishing gear (in this case by entanglement with foundations) would have a beneficial impact on bird populations (Regular et al. 2013). In contrast, the presence of structures could also increase recreational fishing activity (EIS Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing), thus exposing 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 increase 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, new structures 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 few years 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 (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. 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.

The uniform 1-nautical-mile (1.9-kilometer, 1.15-mile) WTG spacing in the RI/MA Lease Areas would provide ample space between WTGs for birds that are not flying above WTGs to fly through the wind array without changing course or by making minor course corrections to avoid operating WTGs. Course corrections made by migratory birds to avoid a project or individual WTG would result in miniscule additional flight distances compared to the distances traveled during seasonal long-distance migrations. Impacts of additional energy expenditure due to minor course corrections or complete avoidance of wind development areas would not be expected to be biologically significant, and no individual fitness or population-level impacts would be expected.

The greatest risk to birds associated with future offshore wind development would be fatal interactions with spinning WTGs. There could be additional collision risk to birds if non-operational WTGs are lighted. In the contiguous United States, bird collisions with operating WTGs are a relatively rare event, with an estimated 140,000 to 328,000 (with a mean of 234,000) birds reported killed annually by 44,577 onshore turbines (Loss et al. 2013, Erickson et al. 2014). Actual mortality rates are likely higher because of (inadequate) strike detection methods, variable scavenger rates, and other challenges in survey ; nevertheless, these studies represent the best available science in estimating collision mortality of North American bird species. Estimating avian mortality at an onshore wind facility is relatively straightforward and is based on counts of bodies discovered during ground searches, statistically adjusted upward to account for searcher efficiency and scavenging rates.

It is extremely difficult to record fatality events in the offshore environment; further, in these events, the victim was rarely identified to species. Siting projects away from areas with high concentrations of birds and vulnerable populations is the most effective way to minimize impacts on 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 on these species (BOEM 2012, 2014b). Based solely on a minimum estimated 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 by Alternative A WTGs. This estimate likely significantly overstates the actual mortality rate of Alternative A for several reasons. Approximately 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. In addition, factors such as landscape features and weather patterns that influence collision risk are different on the OCS than at onshore wind facilities.

Empirical studies also suggest that bird fatalities due to collision with offshore turbines are rare. For instance, unlike the planned development on the 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 closer proximity to some nesting colonies. In addition, the European wind energy facilities that are further from shore (e.g., North Sea) are usually between large land masses, thus creating more opportunities for birds to move between land masses. Using data from radar and thermal imaging to inform a stochastic collision risk model (CRM), 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. The area studied has approximately 3 to 10 times more gulls than the SWDA (Royal Haskoning 2013; COP Appendix III-C, Table 3-2; Epsilon 2022).

Another approach to estimate collision fatalities uses a CRM. Collision modeling is used at the project level to predict the number of fatalities of marine bird species in Europe and the United States (BOEM 2015, 2019b). 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 Alternative A. This analysis is not intended to quantify the exact number of fatalities associated with Alternative A or with Atlantic offshore wind energy facilities, but rather to explore the relative number of fatalities using species that have sufficient information to run CRMs.

Modeling of the collision risk associated with Alternative A for Vineyard Wind 1 used the Avian Stochastic CRM (v 2.3.2) model (BOEM 2019c).[3] Twelve seabird species were identified as occurring on the Atlantic OCS with modeled flight height distributions from Johnston et al. (2014). This wide range of marine bird species spans five taxonomic orders: Anseriformes, Charadriiformes, Gaviiformes, Procellariiformes, and Suliformes. Selected key model inputs for each species are provided in Table G.2.4-3. 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 G.2.4-4. 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 G.2.4-5) was calculated across regions.

Table G.2.4-3: Model Inputs for Each Species[a]

Species	Avoidance[x]	Body Length (inches)	Wingspan (inches)	Flight Speed (miles per hour)	Nocturnal Activity[i]
Black-legged Kittiwake (*Rissa tridactyla*)	0.967 (0.002)	15.4 (0.2)	42.5 (1.6)	16.2 (3.4)	0.033 (0.0045)
Common Eider (*Somateria mollissima*)	0.98	23.8	38.2	42.5 (3.6)	0
Northern Fulmar (*Fulmarus glacialis*)	0.98	17.7 (1.0)	42.1 (1.0)	29.1 (6.3)	0.7
Razorbill (*Alca torda*)	0.98	15.0 (0.2)	26.0 (0.5)	35.8 (5.6)	0.1
Red-throated Loon (*Gavia stellate*)	0.98	24.0 (1.6)	43.7 (1.0)	46.1 (3.3)	0.1
Common Tern (*Sterna hirundo*)	0.98	13.0 (0.4)	34.6 (2.1)	24.6 (4.1)[b]	0.28 (0.07)[c]
Great Black-backed Gull (*Larus marinus*)	0.996 (0.011)[d]	28.0 (1.4)	62.2 (1.5)	21.9 (8.1)[d]	0.5[e]
Herring Gull (*Larus argentatus*)	0.999 (0.005)[d]	23.4 (0.9)	56.7 (1.2)	21.9 (8.1)[d]	0.5[e]
Northern Gannet (*Morus bassanus*)	0.999 (0.003)[d]	36.8 (1.3)	68.1 (1.5)	29.8 (9.5)[d]	0.03[f]
Lesser Black-backed Gull (*Larus fuscus*)	99.8[d]	22.8	52.8[b]	19.5[d]	3.0[g]
Atlantic Puffin (*Fratercula arctica*)	0.98	10.8 (0.3)	21.7 (1.6)	39.4 (7.2)[h]	0.10[e]
Manx Shearwater (*Puffinus puffinus*)	0.98	13.4 (0.1)	32.7 (1.3)	25.3	0.5[e]

[x] This is the conditional probability of avoiding a turbine blade for the extended model.
[a] Mean (1 Standard Deviation) values in parentheses: Avoidance extended, 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
i This is the proportion of time spent flying at night.

[3] Although some of the assumed characteristics of offshore wind projects in Alternative A have changed since publication of the Vineyard Wind 1 EIS (BOEM 2021a), these differences are relatively small in context of the entire array, and the findings of the EIS are assumed to be broadly relevant to this analysis.

Table G.2.4-4: 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 Existing Boat Surveys	Mid-Atlantic Boat Surveys
Common Eider (*Somateria mollissima)*	0.759	0.047	ND	ND	ND
Red-throated Loon (*Gavia stellate*)	0.891	ND	0.423	0.820	0.876
Northern Fulmar (*Fulmarus glacialis*)	0.000[b]	0.692	0.667	ND	ND
Manx Shearwater (*Puffinus puffinus*)	0.200[b]	ND	ND	ND	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	ND
Lesser Black-backed Gull (*Larus fuscus*)	ND	ND	0.395	ND	ND
Herring Gull (*Larus argentatus*)	0.904	ND	0.297	0.813	0.840
Great Black-backed Gull (*Larus marinus*)	0.780	ND	0.312	0.670	0.696
Common Tern (*Sterna hirundo*)	0.947	ND	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]	ND	0.010	ND	ND

ND = no data
[a] O'Connell et al. 2009; only observations that were identified to species were used.
[b] This indicates fewer than ten observations.

Table G.2.4-5: Mean Density per Square Kilometer (1 Standard Deviation) of Flying Birds by Month across Regional Surveys That Were Used as Model Inputs

Species	January	February	March	April	May	June	July	August	September	October	November	December
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: Data calculated from O’Connell et al. 2009
“-”= not calculated

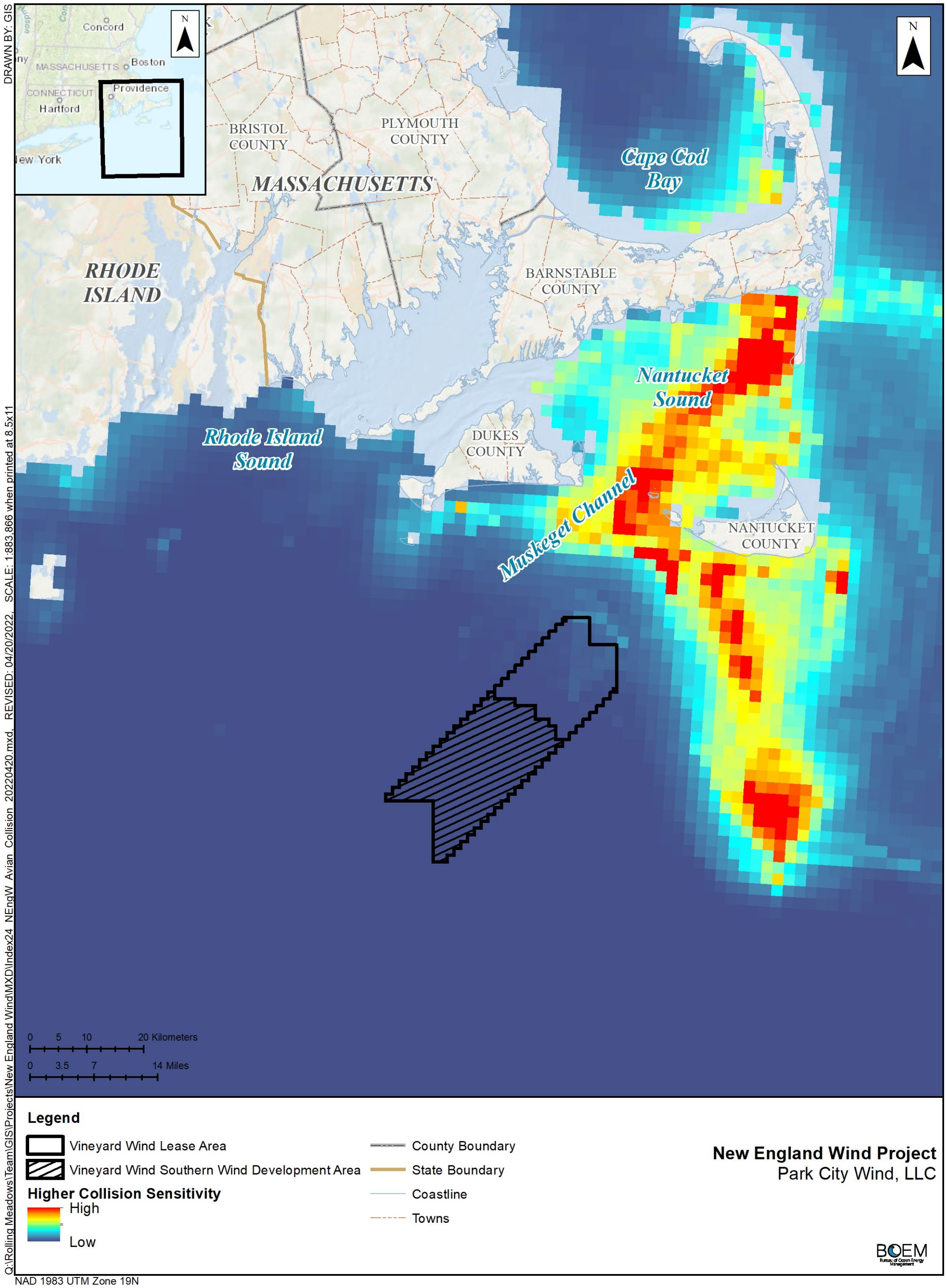
For Alternative A, the collision models predicted that 75 marine birds across the 12 modeled species would be killed each year. However, due to uncertainty in the data inputs (Table G.2.4-6), the modeled fatalities could be as high as 3,481 birds. Most of the variation in estimated fatalities is likely due to the relatively large amount of variation in monthly bird densities. Fatalities of Common Eider (*Somateria mollissima*) were predicted to be relatively greater than Common Tern (*Sterna hirundo*) and Red-throated Loon (*Gavia stellate*) (Table G.2.4-6). 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 131 feet above the sea surface). The Avian Stochastic CRM was not valid for Lesser Black-backed Gulls (*Larus fuscus*), so the Band (2012) model was used instead; no fatalities were predicted for Lesser Black-backed Gulls by the Band model.

Table G.2.4-6: Predicted Annual Number of Hypothetical Collision Fatalities on the Atlantic Outer Continental Shelf[a]

Species	Median[b]	95% Confidence Interval
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

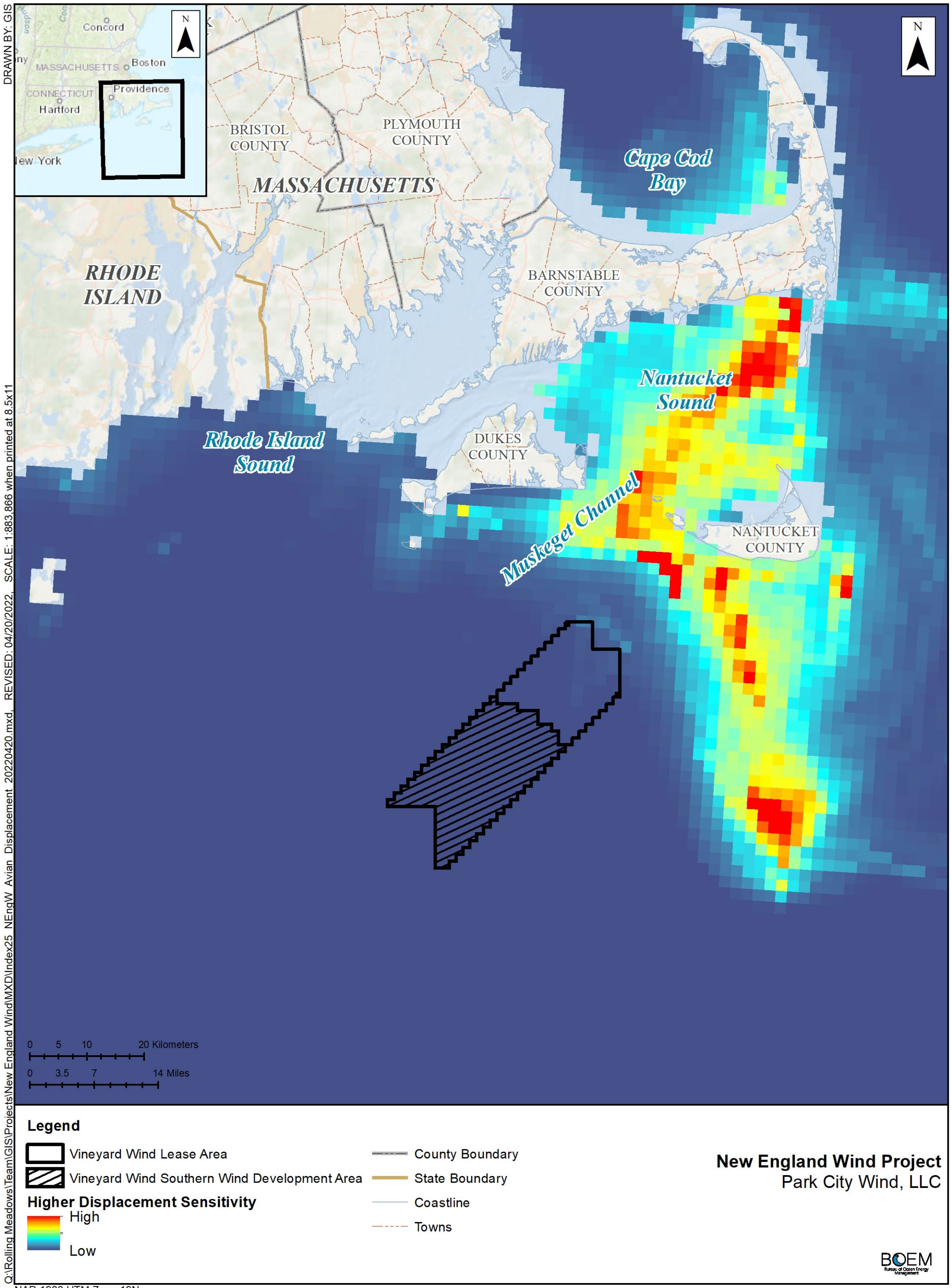
NA = not applicable
[a] This was calculated from the Avian Stochastic CRM (v2.3.2), using 12-MW turbines with 40-meter (131.2 foot) air gap. Output is from the Extended Model (Option 3). Monthly mean densities of flying birds were calculated across regional survey efforts.
[b] Fatality estimates are 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] The species flies below rotor swept zone and is, therefore, not at risk of collision with rotating turbine blades.
[d] When the stochastic model was not valid, the traditional Band model was used.

Due to inherent data limitations (e.g., species-specific data needed to complete Tables G.2.4-4 through G.2.4-6), fatality estimates are not available 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 on the Atlantic OCS. However, aerial surveys of the Massachusetts wind development areas conducted in all seasons from November 2011 to January 2015 identified only 25 species (Veit et al. 2016). Further, as shown in Veit et al. (2016), the mean densities of the 15 most commonly observed species (including all 12 species in Tables G.2.4-4 through G.2.4-6) were relatively low, as would be expected based on predicted species occurrence as modeled by the Marine-life Data and Analysis Team (Figure G.2.4-3 and Figure G.2.4-4). Additionally, the biological diversity of the modeled species provides a representative sample of the majority of marine bird species that would be expected to encounter operating WTGs in the RI/MA Lease Areas based on past surveys on the OCS.



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

Figure G.2.4-3: Total Avian Relative Abundance Distribution Map for the Higher Collision Sensitivity Species Group



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

Figure G.2.4-4: Total Avian Relative Abundance Distribution Map for the Higher Displacement Sensitivity Species Group

Overall, annual bird mortality due to WTG interactions is generally expected to be relatively low. Generally, only a small percentage of individuals that occur or migrate along the Atlantic coast are expected to encounter the rotor swept area of one or more operating Alternative A WTGs. The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. However, a recent study of long-term data collected in the North Sea found that despite the extensive observed displacement of loons in response to the development of 20 wind farms, there was no decline in the region's loon population (Vilela et al. 2021). Furthermore, substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas; therefore, no individual fitness or population-level impacts would occur.

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

Conclusions

Impacts of Alternative A. Under Alternative A, birds 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 under Alternative A, ongoing activities would have continuing temporary to permanent impacts on birds, primarily through the presence of structures. The impacts of ongoing activities would be **minor**, with **minor** beneficial impacts due to the presence of structures.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities may also contribute to impacts on birds. Considering all the IPFs together, Alternative A combined with ongoing and planned activities in the geographic analysis area would result in **moderate** cumulative impacts and could potentially include **moderate** beneficial impacts on foraging birds due to the 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 RI/MA Lease Areas during all or parts of the year would either be exposed to new collision risk or have long-term functional habitat loss due to behavioral avoidance and displacement. The offshore wind development would also be responsible for the majority of impacts related to cable emplacement and maintenance and noise, but impacts on birds resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant.

The individual offshore wind projects in Alternative A may or may not include post-construction avian monitoring for migratory birds and ESA-listed species and annual mortality reporting that the applicant has committed to performing as part of Alternative B (EIS Appendix H, Mitigation and Monitoring). This monitoring could provide an understanding of the impacts 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.

Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (EIS Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on birds:

- The number, size, and location of WTGs and ESPs;
- The type of lighting to be used; and
- The time of year construction occurs.

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 be expected to result in similar or lower impacts than described below. The following sections summarize the potential impacts of Phases 1 and 2 of the proposed Project on birds. Routine activities associated with both proposed Project phases would include construction, operations, and decommissioning, as described in EIS Chapter 2, Alternatives. The most impactful IPF is expected to be the presence of structures, which could lead to impacts including injury and mortality or elicit an avoidance response. BOEM prepared a BA for the potential impacts on USFWS federally listed species, which found that the proposed Project was not likely to adversely affect listed bird species or designated critical habitat (BOEM 2022b).

Impacts of Alternative B – Proposed Action on Birds

This section identifies potential impacts of Alternative B on birds.

Impacts of Phase 1

Phase 1 would affect birds through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: As described in Table G.1-18, some potential for mortality, decreased fitness, and health impacts exist due to the accidental release of fuel, hazardous materials, and trash and debris from Phase 1 vessels. Operational waste from Phase 1 vessels could include bilge and ballast water, sanitary and domestic wastes, and trash and debris. All Phase 1 vessels would comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize impacts on bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of proposed 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, there would be localized and temporary **negligible** impacts on birds.

Cable emplacement and maintenance: Phase 1 would disturb up to 278 acres of seafloor through cable installation and up to 67 acres by dredging prior to cable installation, resulting in turbidity impacts that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species. These impacts would be temporary, lasting up to 12 hours and generally localized to the emplacement corridor, extending up on 1.2 miles (EIS Section G.2.2). 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 due to the localized and temporary nature of the potential impacts. Based on the assumptions in Table E-1, cable installation from up to seven other offshore wind projects could overlap in time with Phase 1 in 2025. However, given the localized nature of these impacts, impacts associated with the emplacement of export and inter-array cabling of other offshore wind projects would not overlap spatially with Phase 1, 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. Cable maintenance activities would result in similar impacts as cable emplacement and would also be expected to be **negligible.**

Lighting: The distance of the proposed Project's permanent structures from shore reduces the exposure of coastal birds to construction activities. To further minimize potential bird mortality from collision, the applicant would reduce lighting as much as is practicable during construction. Vessel lights during construction would be minimal and likely limited to vessels transiting to and from construction areas. In addition, whenever practicable, the applicant would use down-shield lighting or down-lighting to limit bird attraction and disorientation. To further reduce impacts on birds, when practicable, the applicant would reduce the number of lights, use low intensity lights, avoid white lights, use flashing lights where appropriate, and use lights only when necessary for work crews to minimize the potential bird attraction and disorientation and thus collision mortality (EIS Appendix H).

During Phase 1 construction, offshore WTGs and ESPs added to the OCS would be lit in accordance with BOEM, USCG, and FAA requirements for both aviation safety (lights atop WTG nacelles) and vessel navigation (lights atop WTG and ESP foundations).

While the level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measures to address impacts on commercial fisheries and for-hire recreational fishing, as described in detail in Table H-2 of EIS Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Use of minimal lighting intensity necessary to permit safe operations and reduce potential attraction of birds to proposed Project vessels, WTGs, and ESPs.

Up to 62 WTGs and 1 or 2 ESPs associated with Phase 1 would all be lit with marine navigation and FAA hazard lighting. To comply with FAA requirements while minimizing lighting impacts, the applicant has committed to using ADLS for WTG nacelle-top lights. ADLS would only activate red flashing WTG nacelle-top lighting when aircraft enter a predefined airspace. Any new lights have some potential to attract birds and result in increased collision risk (Hüppop 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 to unlit turbine towers (Kerlinger et al. 2010; Orr et al. 2013). Moreover, for Phase 1, ADLS was estimated to occur for less than 10 hours per year—less than 0.1 percent of annual nighttime hours (COP Appendix III-K; Epsilon 2022).

Marine navigation lighting would consist of multiple flashing yellow lights on each WTG and on the corners of each ESP. The impacts from lighting, if any, would be long term but **negligible** due to the use of red flashing lights and ADLS. Vessel lights during operations and decommissioning would be minimal and likely limited to vessels transiting to and from construction areas.

The expected **negligible** impact of Phase 1 would not noticeably increase the impacts of light beyond the impacts described under Alternative A.

Noise: The expected **negligible** impacts of aircraft, G&G survey, and pile-driving noise associated with Phase 1 would not increase the impacts of noise beyond the impacts described under Alternative A. Pile-driving noise could affect bird species during Phase 1 construction. These impacts would be short term (4 to 6 hours per day). Vessel and construction noise could disturb bird species, but birds would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). Because only temporary impacts, if any, are expected to occur, impacts would be **negligible** from construction of the offshore components.

Presence of structures: The various types of impacts on birds that could result from the presence of Phase 1 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 similar to those described for Alternative A. The impacts of Phase 1 from the presence of structures would be **minor** and may include **minor** beneficial impacts. Due to the anticipated use of ADLS, the restricted time period of exposure during migration, and the small number of migrants that could cross the SWDA annually, BOEM concludes that the impacts are **negligible** for Roseate Terns, Piping Plovers, and

Red Knots. The BA for the proposed Project (BOEM 2022b) provides a complete discussion of the potential collision risk to ESA-listed species as a result of operations of the proposed Project.

As described above and depicted for the SWDA on Figures G.2.4-3 and G.2.4-4, the locations of the OCS wind development areas were generally 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 generally use a corridor between the coast and several miles out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of miles inland (Watts 2010). Phase 1 operations would result in impacts on some individuals of 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 SWDA during all seasons (as modeled by the Marine-life Data and Analysis Team [Figure G.2.4-3]), suggesting that the likelihood of bird fatalities due to collision is low. Species in the higher collision sensitivity group that are unlikely to be present in the SWDA 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 (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 (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). The applicant performed an exposure assessment to estimate the risk of various bird species encountering WTGs in the SWDA (COP Appendix III-C; Epsilon 2022). 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 potential attraction of gulls to vessels and offshore structures, upon which they may perch. While there is some possibility of marine birds perching on WTG structures, given the modeled low total abundance of marine birds within the SWDA (Figure G.2.4-2), increased collision risk would be limited to relatively few individuals of relatively few species. Based on the results of the exposure assessment (COP Appendix III-C; Epsilon 2022), only cormorants, jaegers, and gulls would exhibit a significant chance of encountering the SWDA. While cormorants’ typical low flight altitudes make them less vulnerable to collision, this is not the case with jaegers and gulls, although jaegers would only be expected to encounter operating WTGs during migration in the winter (COP Volume III, Section 6.2.2 and Appendix III-C; Epsilon 2022). In Massachusetts, jaegers and gulls are not listed as special concern species (MNHESP 2020).

During migration, many bird species, including songbirds, likely fly at heights well above the rotor swept zone (up to 1,047 feet above mean sea level for Phase 1) (COP Volume III, Section 6.2.2; Epsilon 2022). Species with low collision sensitivity include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the rotor swept zone (Robinson Willmott et al. 2013). It is generally assumed that inclement weather and reduced visibility change 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 passerine species detected on the OCS during migration as part of BOEM's Acoustic/Thermographic Offshore Monitoring Project (Robinson Willmott and Forcey 2014) were documented in relatively low numbers. In addition, most observed activity (including Blackpoll warblers [*Setophaga striata*]) was during windspeeds less than 6.2 miles per hour—below the turbine cut in speed (Robinson Willmott and Forcey 2014), suggesting little risk to migrating passerines. Further, most carcasses of small migratory songbirds found at land-based wind energy facilities in the northeast were within 6.6 feet of the turbine towers, suggesting collisions 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 (Stabile et al. 2017).

Some marine bird species might avoid the SWDA 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, 2013), sea ducks (Drewitt and Langston 2006; Petersen et al. 2006), and Northern Gannets (Drewitt and Langston 2006; Lindeboom et al. 2011; Petersen et al. 2006) have been shown to typically avoid offshore wind developments. However, loons, sea ducks, grebes, and several gull species were not observed or observed in low densities in the SWDA during Massachusetts Clean Energy Center surveys, while Razorbills and Black-legged Kittiwakes were relatively common in winter (COP Appendix III-C, Table 4; Epsilon 2022). While the area of ocean occupied by Phase 1 would no longer provide foraging opportunities to 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 RI/MA Lease Areas and would remain available to these species following the anticipated development of the RI/MA Lease Areas. As depicted on Figure G.2.4-4, modeled use of the SWDA by bird species with high displacement sensitivity, including, but not limited to, the Common Loon (*Gavia immer*), 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 RI/MA Lease Areas avoid high-value sea duck habitat and are not likely to contain important foraging habitat for the other species susceptible to displacement, this loss of habitat would be insignificant (COP Volume III, Section 6.2.2; Epsilon 2022). Population-level long-term impacts resulting from habitat loss would be **negligible.**

While the level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measures to address impacts on birds, as described in detail in Table H-2 of EIS Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Install bird deterrent devices to minimize bird attraction to operating WTGs and ESPs, where and if appropriate.
- Require the applicant to coordinate with BOEM and the USFWS to finalize a post-construction bird monitoring plan prior to the commencement of operations. Such a plan would require the applicant, within the first year of operations, to install digital very high frequency telemetry automated receiving stations and acoustic monitoring devices to estimate the exposure of ESA species and other migratory birds to the operating wind facility. The monitoring plan could also require the applicant to install acoustic detectors for birds and provide periodic monitoring progress reports plus comprehensive annual reports, followed by a discussion of each year's results with BOEM and the USFWS, which would

include the potential need for reasonable revisions to the monitoring plan. All data generated as part of pre- and post-construction monitoring would be made available to the public through BOEM's website.

- Provide annual mortality reporting to BOEM and the USFWS.

Traffic: The expected **negligible** impacts of aircraft traffic associated with Phase 1 would not increase the impacts of this IPF beyond the impacts described under Alternative A.

Impacts of Phase 2

As described in this section, impact levels for Phase 2 are expected to be similar to those of Phase 1 (EIS Section 3.4.4.1) due to the use of similar construction and decommissioning techniques.

Accidental releases: Accidental releases associated with Phase 2 would be similar to those described for Phase 1 and would result in localized and temporary **negligible** impacts on birds.

Cable emplacement and maintenance: The impacts of Phase 2 from cable emplacement and maintenance would be similar to, but occur in a slightly larger area than, those described for Phase 1. Phase 2 construction would contribute up to 489 acres of seafloor disturbed by cable installation and up to 73 acres affected by dredging prior to cable installation resulting in turbidity impacts. Phase 2 cable emplacement would result in non-measurable **negligible** impacts, if any, on individuals or populations due to the localized and temporary nature of the potential impacts.

Lighting: Up to 88 WTGs and 2 or 3 ESPs associated with Phase 2 would be lit with navigational and FAA hazard lighting, as described under Phase 1, and would have similar **negligible** impacts that would not noticeably increase the impacts of light beyond the impacts described for Alternative A.

Noise: The expected **negligible** impacts of noise associated with Phase 2 would be similar to those described under Phase 1.

Presence of structures: The impacts on birds from the presence of Phase 2 structures would be similar to those described under Phase 1; they would be **minor** and may include **minor** beneficial impacts. As described in the BA (BOEM 2022b), Alternative B would have **negligible** impacts on Roseate Terns, Piping Plovers, and Red Knots (BOEM 2022b).

Traffic: The expected **negligible** impacts of aircraft traffic associated with Phase 2 would not increase the impacts of this IPF beyond the impacts described under Alternative A.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-17 would contribute to impacts on birds through the primary IPF of the presence of structures. These impacts would primarily occur through potential mortality associated with collisions with operating WTGs on the OCS. The cumulative impacts from the presence of structures from ongoing and planned activities, including Alternative B, would range from **negligible** to **moderate** and may result in **moderate** beneficial impacts due to the large number of structures. Because Alternative B would comprise approximately 12.5 percent of the WTGs in the RI/MA Lease Areas, a majority of the impacts on birds due to the presence of structures would be associated with other future offshore wind development. Construction-related impacts from accidental releases, noise, and cable emplacement and maintenance associated with Alternative are likely to only minimally overlap (if at all) temporally or spatially with similar impacts from other future offshore wind activities.

The cumulative impacts of all IPFs from ongoing and planned activities, including Alternative B, would be **moderate,** with a **moderate** beneficial impact from the presence of structures until decommissioning

Conclusions

Impacts of Alternative B. Activities associated with construction, operations, and decommissioning of Alternative B 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. Operations of WTGs and ESPs could result in habitat loss and in collision-induced mortality, leading to **negligible** to **minor** impacts, with potential **minor** beneficial impacts. Offshore decommissioning would have impacts comparable to the construction stage.

Cumulative Impacts of Alternative B. The cumulative impacts on birds within the geographic analysis area resulting from ongoing and planned activities, including Alternative B, would range from **negligible** to **moderate** and could potentially include **moderate** beneficial impacts. Considering all the IPFs together, the impacts from ongoing and planned activities, including Alternative B, would result in **moderate** impacts on birds, primarily through ongoing climate change and the potential for direct mortality resulting from fatal interactions with operating WTGs associated planned activities. Alternative B 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.

Impacts of Alternative C – Habitat Impact Minimization Alternative on Birds

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. While Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project—and could, thus, affect the exact length of cable installed and area of ocean floor disturbed—these changes would not result in meaningfully different impacts on birds compared to Alternative B due to the homogenous nature of the habitat in the SWDA. Therefore, the impacts of Alternatives C-1 and C-2 on birds would the same as those for Alternative B.

G.2.5 Terrestrial Habitats and Fauna

G.2.5.1 Description of the Affected Environment

Geographic Analysis Area

This section discusses existing conditions in the geographic analysis area for terrestrial habitats and fauna, as described in Table D-1 in EIS Appendix D, Geographic Analysis Areas, and shown on Figure G.2.5-1. This includes all waters within the 3-nautical-mile (3.4-mile) seaward limit of Massachusetts' territorial sea that are within a 1-mile buffer of the OECC. It also includes all land areas that would be disturbed by the proposed Project, plus a 0.5-mile buffer. The faunal resources in the geographic analysis area would have small home ranges; therefore, impacts outside these home ranges would be unlikely to affect those resources. EIS Sections G.2.3 and G.2.4 discuss the potential impacts of offshore activities on bats and birds, respectively. EIS Section 3.5 discusses impacts on habitats along the shoreline and in nearshore waters. Table G.1-18 describes existing conditions and the impacts, based on the IPFs assessed, of ongoing and planned activities other than offshore wind.

Overview

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 proposed Project work would take place. The geographic analysis area for terrestrial habitats and fauna is in a densely developed part of the state, and several wetlands, streams, rivers, and freshwater ponds occur within a 0.5-mile buffer around the OECR. EIS Section G.2.6 discusses wetlands and other waters of the U.S. Wetlands and riparian habitats in Massachusetts are gradually declining as a result of human development (Commonwealth of Massachusetts 2016). Much of the other habitat in the geographic analysis area is already fragmented and/or developed for human uses, including roads, utility ROW, and commercial and light industrial operations. Table G.2.5-1 lists some of the threatened and endangered plant species potentially occurring in the geographic analysis area. 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 flora and fauna has been degraded. Past activities have been taken into consideration in defining the existing conditions of the resource (Table G.2.5-1).

COP Section 6.1.1.2 and Tables 1 and 3 of COP Appendix III-D (Epsilon 2022) list terrestrial faunal resources that are likely to occur near the geographic analysis area (Table G.2.5-2). 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 USFWS. Additionally, the proposed Project does not cross priority habitats or estimated habitats mapped by the Massachusetts Division of Fish and Wildlife Natural Heritage and Endangered Species Program (COP Volume III, Figure 6.1.2; Epsilon 2022).

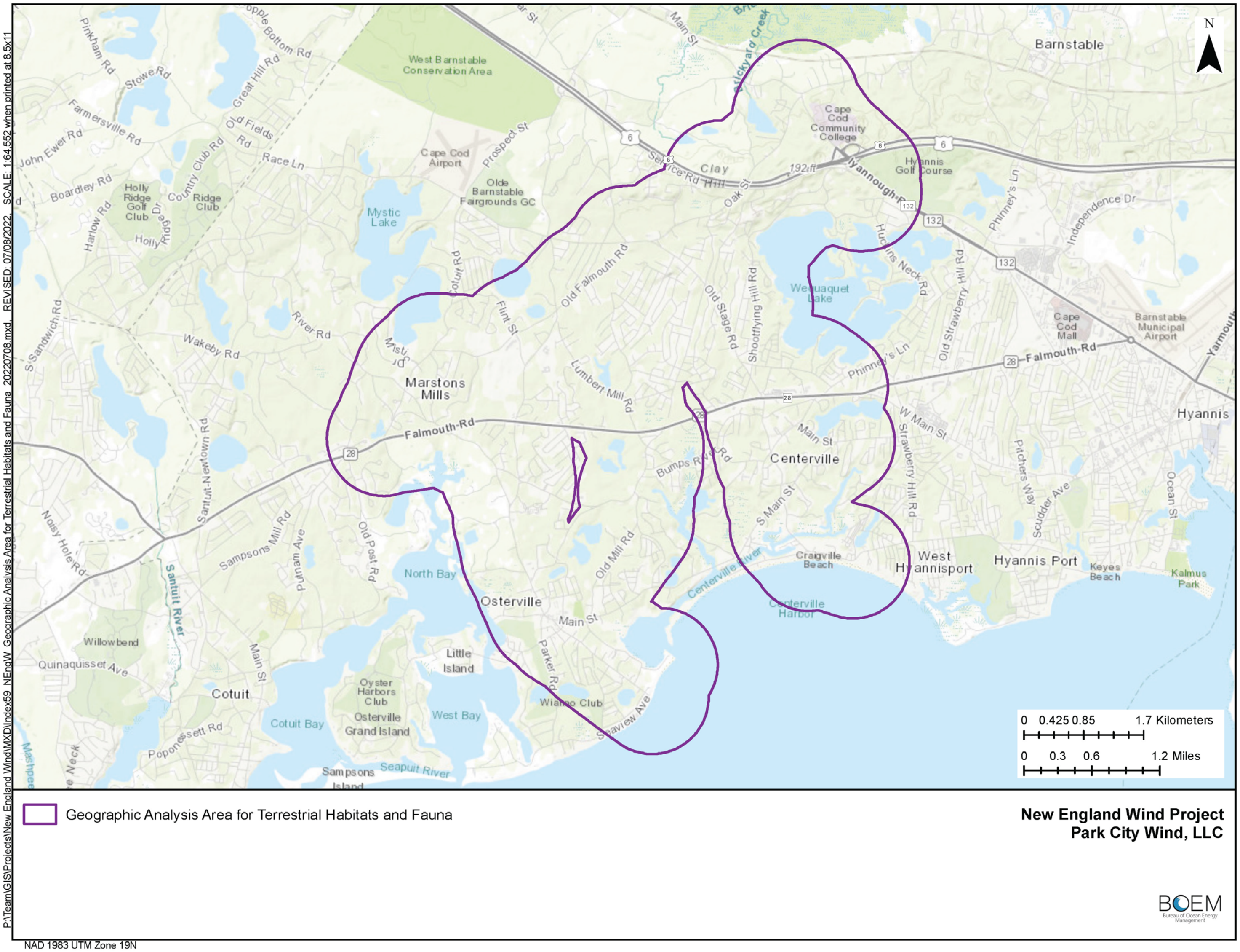


Figure G.2.5-1: Geographic Analysis Area for Terrestrial Habitats and Fauna

Table G.2.5-1: Threatened and Endangered Plant Species Reported near the Proposed Project

Common Name	Scientific Name
Adder's tongue fern	*Ophioglossum pusillum*
Cranefly orchid	*Tipularia discolor*
Dwarf bulrush	*Typha minima*
Grass-leaved ladies'-tresses	*Spiranthes vernalis*
Heartleaf twayblade	*Neottia cordata*
Maryland meadow-beauty	*Rhexia mariana*
Mitchell's sedge	*Carex mitchelliana*
Papillose nut sedge	*Scleria pauciflora*
Purple needlegrass	*Nassella pulchra*
Sandplain gerardia	*Agalinis acuta*
Short-beaked beaksedge	*Rhynchospora nitens*
Slender marsh pink	*Sabatia campanulata*
Stiff yellow flax	*Linum medium* var. *texanum*
Swamp oats	*Sphenopholis pensylvanica*
Torrey's beaksedge	*Rhynchospora torreyana*

Source: Commonwealth of Massachusetts 2022

The northern red-bellied cooter (*Pseudemys rubriventris*) is listed as a federal and state-endangered species. The closest northern red-bellied cooter population is more than 11 miles from the geographic analysis area; therefore, the species 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 northern red-bellied cooter population appears likely to be slowly growing (MNHESP 2016).

Land Animals

Table G.2.5-2 lists terrestrial faunal resources that are likely to occur in the geographic analysis area. Prominent animal communities include residents of woodlands, amphibians and reptiles, and inland birds. (DeGraaf and Yamasaki 2001).

Table G.2.5-2: 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	Gray tree frog	*Hyla versicolor*
Amphibian	Northern spring peeper	*Pseudacris crucifer*
Bird	Turkey vulture	*Cathartes aura*
Bird	Cooper’s hawk	*Accipiter cooperii*
Bird	Sharp-shinned hawk	*Accipiter structus*
Bird	Northern saw-whet owl	*Aegolius acadicus*
Bird	Red-tailed hawk	*Buteo jamaicensis*
Bird	Wild turkey	*Meleagris gallopavo*
Bird	Mourning dove	*Zeneida macroura*
Bird	Whip-poor-will	*Caprimulgus vociferous*

Taxonomic Group	Common Name	Scientific Name
Bird	Downy woodpecker	*Picoides pubescens*
Bird	Eastern phoebe	*Sayornis phoebe*
Bird	Blue jay	*Cyanocitta cristata*
Bird	American crow	*Corvus brachyrhynchos*
Bird	Fish crow	*Corvus ossifragus*
Bird	Tufted titmouse	*Beeoloptus bicolor*
Bird	White-breasted nuthatch	*Sitta caroliniensis*
Bird	Hermit thrush	*Catharus guttatus*
Bird	Yellow-rumped warbler	*Setophaga coronate*
Bird	Ovenbird	*Seiurus aurcopillus*
Bird	Eastern towhee	*Pipilo erythro-phtalmus*
Bird	Chipping sparrow	*Spizella passerine*
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*
Mammal	Beaver	*Castor canadensis*
Mammal	Coyote	*Canis latrans*
Mammal	Gray fox	*Urocyon cinereoargenteus*
Mammal	New England cottontail	*Sylvilagus transitionalis*
Mammal	Muskrat	*Ondatra zibethicus*
Mammal	Red fox	*Vulpes vulpes*
Mammal	Raccoon	*Procyon lotor*
Mammal	Striped skunk	*Mephitis mephitis*
Mammal	Fisher	*Martes pennant*
Mammal	White-tailed deer	*Odocoileus virginianus*
Mammal	Red squirrel	*Tamiasciurus hudsonicus*
Mammal	Virginia opossum	*Didelphis virginiana*
Mammal	Woodchuck	*Marmota monax*
Reptile	Eastern hognose snake	*Heterodon platirhinos*
Reptile	Eastern ribbon snake	*Thamnophis sauritus*
Reptile	Milk snake	*Lampropeltis triangulum*
Reptile	Painted turtle	*Chrysemys picta*
Reptile	Diamondback terrapin	*Malaclemys terrapin*
Reptile	Snapping turtle	*Chelydra serpentine*
Reptile	Common musk turtle	*Sternotherus odoratus*
Reptile	Eastern hognose snake	*Heterodon platirhinos*
Reptile	Eastern ribbon snake	*Thamnophis sauritus*
Reptile	Milk snake	*Lampropeltis triangulum*

Source: COP Volume III, Section 6.1; Epsilon 2022

Trends

The current state of local terrestrial habitats and fauna resources is generally stable, although land disturbance from ongoing activities periodically affects terrestrial habitats and fauna in the geographic analysis area. Land disturbance from onshore construction periodically causes temporary and permanent habitat loss, temporary displacement, collision, injury, and mortality, resulting in minimal, short-term impacts on terrestrial habitats and fauna. Ground-disturbing activities contribute to elevated levels of erosion and sedimentation but not to a degree that affects terrestrial habitats and fauna. Periodic clearing of shrubs and tree saplings along existing utility ROWs 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 habitats for terrestrial fauna.

Maintenance of existing roads and public utilities will continue indefinitely. Outside of currently protected areas, the conversion of natural areas to developed residential, commercial, and industrial uses is also likely to continue. Climate change, influenced in part by GHG emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent changes of unknown intensity (Friggens et al. 2018). Climate change, sea level rise, and other ongoing activities and planned activities could also affect the land-water interface. Because the offshore components of the proposed Project have no potential impacts on terrestrial fauna other than certain flying species, this section does not discuss offshore activities.

G.2.5.2 Environmental Consequences

Definitions of impact levels for terrestrial habitats and fauna are described in Table G.2.5-3. There are no beneficial impacts on terrestrial habitats and fauna.

Table G.2.5-3: Impact Level Definitions for Terrestrial Habitats and Fauna

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be so small as to be unmeasurable.
Minor	Adverse	Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur are temporary or short term in nature.
Moderate	Adverse	Impacts on species would be unavoidable but would not result in population-level impacts. Impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats but would not result in population-level impacts on species that rely on them.
Major	Adverse	Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would result in population-level impacts on species that rely on them.

Impacts of Alternative A – No Action Alternative on Terrestrial Habitats and Fauna

When analyzing the impacts of Alternative A on terrestrial habitats and fauna, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for terrestrial habitats and fauna (Table G.1-18). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in EIS Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for terrestrial habitats and fauna and wetlands described in Section G.2.6.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on terrestrial habitats and fauna include land disturbance—as described in the Trends discussion in Section G.2.5.1. Terrestrial habitats and fauna would continue to follow current regional trends and respond to current and future environmental and societal activities. Considering current conditions and the modest pace of development in the geographic analysis area, terrestrial fauna is expected to remain generally stable under Alternative A.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on terrestrial habitats and fauna include construction of the landfall sites, onshore cables, and substations for the Vineyard Wind 1 Project in Barnstable County. The extent of impacts on terrestrial habitats and fauna would depend on landfall locations, OECR routing, and onshore substation locations. To the degree that planned offshore wind activities involve landfall locations and cable routes in Bristol County, these projects could contribute to the impacts of the SCV. Ongoing and planned activities (including offshore wind) would affect terrestrial habitats and fauna through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). To the degree that any future offshore wind activities other than the proposed Project occur in the geographic analysis area for terrestrial habitats and fauna, these projects could cause impacts such as displacement, mortality, and habitat loss, primarily through land disturbance, although the majority of this IPF would be attributable to ongoing activities. Future offshore wind development activities would affect terrestrial habitats and fauna through the following primary IPFs.

Climate change: Climate change would contribute to impacts on terrestrial habitats and 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 habitats and fauna, terrestrial 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). EIS Section G.2.1, Air Quality, discusses the expected contribution of offshore wind activities to climate change.

Land disturbance: Impacts due to onshore land use changes from ongoing and planned activities 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 habitats and fauna. Onshore construction associated with future offshore wind projects could result in minimal temporary impacts on terrestrial habitats and fauna during construction, including disturbance, displacement, and potential injury and/or mortality of individuals. Collisions between animals and vehicles or construction equipment could cause mortality. This would be rare because most individuals would likely avoid the noise and vibration of the construction areas, although animals with limited mobility, especially reptiles and amphibians (COP Volume III, Table 6.1-1; Epsilon 2022), may be vulnerable to this type of impact. However, there would be little to no impact on these populations in light of the expected limited construction footprint and use of existing utility ROWs and previously disturbed areas.

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 2022). It is possible that individuals could experience repeated stress events if they returned to a site during pauses in construction activity, only for renewed construction activity to drive them away again later. These impacts would be limited and temporary. Normal operations of project substations associated with future offshore wind development would generate continuous noise, but there would be little associated impact due to the presence of existing commercial and industrial noises in the region. Terrestrial fauna may habituate to noise so that it has little to no impact on their behavior or biology (Kight and Swaddle 2011). Management of the existing utility ROW would continue to involve periodic removal of tree saplings. 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 habitats and fauna would be temporary, lasting only as long as repair or remediation activities necessary to address these non-routine events. Considering that the geographic analysis area for terrestrial habitats and fauna is largely developed and contains many roads, terrestrial habitats and fauna in this area are likely to be already subject to anthropogenic noise.

Conclusions

Impacts of Alternative A. Impacts on terrestrial habitats and fauna from ongoing activities, especially climate change and land disturbance, would be **minor** to **moderate**. In addition to ongoing activities, planned activities other than offshore wind, primarily increasing onshore construction, may also contribute to impacts on terrestrial habitats and fauna.

Cumulative Impacts of Alternative A. No future construction projects were identified within the geographic analysis area for terrestrial habitats and fauna; the impacts of planned activities other than offshore wind would be **negligible** to **minor**. Ongoing and planned activities would result in **minor** to **moderate** impacts on terrestrial habitats and fauna, primarily driven by climate change and land disturbance.

To the degree that any future offshore wind activities other than the proposed Project occur in the geographic analysis area for terrestrial habitats and fauna, the impacts of those future offshore wind activities on terrestrial habitats and fauna would be similar to those of Alternative B. Considering the IPFs collectively, ongoing and planned activities in the geographic analysis area would result in **moderate** cumulative impacts, primarily through climate change and land disturbance. Future offshore wind activities would contribute to the impacts through land disturbance, although the majority of this IPF would be attributable to ongoing activities.

Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (EIS Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on terrestrial habitats and fauna:

- The routing variants within the OECR;
- The time of year during which construction occurs; and
- Changes to the size, configuration, and location of onshore substations.

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 habitats and fauna in this area, especially for reptiles and amphibians. Therefore, construction during months in which terrestrial habitats and fauna are not present, not breeding, or less active would have lesser impacts on terrestrial fauna than construction during more active times.

Impacts of Alternative B – Proposed Action on Terrestrial Habitats and Fauna

This section identifies potential impacts of Alternative B on terrestrial habitats and fauna.

Impacts of Phase 1

Phase 1 would affect terrestrial habitats and fauna through the following primary IPFs during construction, operations, and decommissioning

Climate change: Climate change would contribute to impacts on terrestrial habitats and fauna, primarily through existing global and regional climate trends. As discussed in EIS Section G.2.1, Phase 1 construction would have **negligible** impacts on climate change, and this IPF would, therefore, have **negligible** impacts on terrestrial habitats and fauna. Phase 1 would have no measurable influence on this IPF.

Land disturbance: Onshore construction of the proposed Project could contribute to elevated levels of erosion and sedimentation due to periodic ground-disturbing activities but usually not to a degree that affects terrestrial habitats and fauna, assuming that industry standard BMPs are implemented.

Phase 1 construction activities would temporarily disturb up to 15.5 acres in the OECR. The estimation of temporary disturbance is based upon the maximum buildout scenario of a 6.5-mile-long, 21-foot-wide OECR (COP Volume I, Section 3.2.2; Epsilon 2022). Onshore construction of the proposed Project would permanently disturb up to 10.5 acres in a maximum buildout scenario, accounting for the clearing and grading of the onshore substation site, access road, and potential onshore substation equipment site. Onshore construction associated with the future offshore wind projects could result in minimal temporary impacts on terrestrial fauna during construction, including disturbance, displacement, and potential injury and/or mortality of individuals. Collisions between animals and vehicles or construction equipment could cause mortality. This would be rare, as most individuals would likely avoid the construction areas. However, animals with limited mobility, especially reptiles and amphibians (COP Appendix III-D, Table 1; Epsilon 2022), may be vulnerable to this type of impact. In light of the limited construction footprint, there would be little to no impact on populations.

The proposed Project would not involve permanent habitat alteration in the OECR, but construction of the substation site would permanently convert up to approximately 3.0 acres of pine-oak forested habitat at the Phase 1 onshore substation site at 8 Shootflying Hill Road, up to 1.0 acre for a potential substation site access road at 6 Shootflying Hill Road, and up to 2.8 acres at Parcel #214-001. These changes would have a minimal impact on terrestrial habitats and fauna because this type of forest habitat is common across Cape Cod and is available as a high quality, contiguous block in the Barnstable State Forest, which lies as near as 0.25 mile from the proposed substation area. The land disturbance involved in Phase 1 would, therefore, result in **minor** impacts due to habitat alteration, mortality, and temporary displacement of terrestrial habitats and fauna from the proposed substation site.

Noise: Construction noise and vibration could lead to the disturbance and temporary displacement of mobile species. Noise and human activity from trenching would be temporary and localized to the OECR and the substation site(s). Displaced wildlife could use adjacent habitat and would repopulate these areas once construction ceases. Displaced individuals would likely return to the affected areas once the noise and vibration have ended (COP Volume III, Section 6.1.2.1.2; Epsilon 2022). 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. These impacts would be limited and temporary in nature and, therefore, **minor**.

BOEM would not expect normal operations activities to involve further habitat alteration or otherwise impact terrestrial fauna. Normal operations of the Phase 1 substation would generate continuous noise, but there would be **negligible** impacts. Phase 1 onshore facilities would be monitored and controlled remotely, and the proposed Project 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 (COP Volume III, Section 6.1.2.2; Epsilon 2022)., and these impacts would be **negligible**.

Many of the Phase 1 onshore components could be retired in place or retained for future use, although removal of onshore cables via existing manholes may occur if required (COP Volume I, Section 3.3.3; Epsilon 2022). The splice vaults, duct bank, and onshore substations would likely remain as infrastructure that would be available for future offshore wind or other projects. To the extent that decommissioning of the onshore facilities occurs, the impacts from decommissioning would be similar to, but less than, the impacts from construction (short term and **minor**).

Impacts of Phase 2

The impacts of Phase 2 construction, operations, and decommissioning on terrestrial habitats and fauna from the IPFs for climate change and noise would be the same as described for Phase 1. Phase 2 would affect terrestrial habitats and fauna through the IPF for land disturbance as described below.

Land disturbance: Phase 2 construction activities would temporarily disturb up to 26.9 acres in the OECR. The estimation of temporary disturbance is based on the maximum buildout scenario of a 10.6-mile-long, 21-foot-wide OECR (COP Volume I, Section 4.2.2; Epsilon 2022). Onshore construction of the proposed Project would permanently disturb up to 54 acres in a maximum buildout scenario, accounting for the clearing and grading of the onshore substation site(s) and access roads. There would be little to no impact on terrestrial habitats and fauna because of the limited construction footprint and use of existing utility ROWs and previously disturbed areas.

Phase 2 would not involve permanent habitat alteration in the OECR, but construction of the onshore substation site would permanently convert up to approximately 19 acres. Additionally, the maximum area of tree clearing anticipated to be required to accommodate access during Phase 2 onshore substation construction is approximately 8 acres. These changes would have a minimal impact on terrestrial habitats and be unlikely to have population-level impacts on terrestrial fauna.

The applicant has not yet defined the SCV OECC route within state waters in Buzzards Bay or the SCV OECR in Bristol County, Massachusetts. The land disturbance impacts of the finalized SCV OECC and OECR route (including a 0.5-mile buffer) will be evaluated in a supplemental NEPA analysis.

The land disturbance required for Phase 2 would result in **minor** habitat alteration, mortality, and temporary displacement of terrestrial habitats and fauna from the proposed substation site. The potential impacts of Phase 2 operations on terrestrial habitats and fauna would be similar to those of Phase 1 and, therefore, **negligible**. The potential impacts of decommissioning would be similar to those of Phase 1 and, therefore, short term and **minor**.

Cumulative Impacts

If a future project were to cross the geographic analysis area or be collocated (partly or completely) within the geographic analysis area, the impacts of those future projects on terrestrial habitats and fauna would be of the same type as those of Phase 1; the degree of impacts may increase, depending on the exact location and timing of planned activities. For example, repeated construction in a single ROW corridor would have less impact (e.g., displacement, mortality, habitat loss) on terrestrial habitats and fauna than construction in an equivalent area of undisturbed habitat. The only ongoing or planned project that would overlap with the proposed Project is construction of the Vineyard Wind 1 OECR and onshore substation. Cumulative impacts on terrestrial habitats and fauna would therefore be **minor** to **moderate**.

Conclusions

Impacts of Alternative B. The activities associated with Alternative B could affect terrestrial habitats and fauna through temporary disturbance, injury, or mortality, and permanent conversion of a minimal proportion of the overall habitat available regionally. Construction of Alternative B would have **minor** impacts on terrestrial habitats and fauna.

Cumulative Impacts of Alternative B. In the context of ongoing and planned activities in the geographic analysis area, impacts resulting from individual IPFs would range from **minor** to **moderate**. Considering all the IPFs together, the combined impacts on terrestrial habitats and fauna from ongoing and planned activities, including Alternative B, would be **moderate,** primarily through climate change and land disturbance.

Impacts of Alternative C – Habitat Impact Minimization Alternative on Terrestrial Habitats and Fauna

Under Alternatives C-1 and C-2, onshore activities and impacts would be identical to those for Alternative B.

G.2.6 Wetlands and Other Waters of the United States

G.2.6.1 Description of the Affected Environment

This section discusses the existing conditions of wetlands and other waters of the U.S. in the geographic analysis area, as described in Table D-1 in EIS Appendix D, Geographical Analysis Areas, and shown on Figure G.2.6-1. The geographic analysis area includes onshore development areas within the watersheds for Cape Cod (hydrologic unit code [HUC]-0109000202), Martha's Vineyard and the Elizabeth Islands (HUC-0109000206), Nantucket Island (HUC-0109000207), and open ocean areas within USACE's jurisdiction. Under Section 404 of the Clean Water Act (CWA), the USACE regulates the discharge of dredged or fill material into waters of the U.S. The limits of USACE jurisdiction in non-tidal waters (33 CFR § 328.4) are as follows:

- In the absence of adjacent wetlands, the jurisdiction extends to the ordinary high water mark; or when adjacent wetlands are present, the jurisdiction extends beyond the ordinary high water mark to the limit of the adjacent wetlands.
- When the water of the U.S. consists only of wetlands, the jurisdiction extends to the limit of the wetland.

In addition, under Section 10 of the Rivers and Harbors Act of 1899, the USACE regulates construction of any structure and work that are located in or that affect "navigable waters of the U.S." from the mean high water line to the seaward limit of the OCS (43 USC 1333[e] and 33 CFR 320.2).

These marine environments within the geographic analysis area are included in the affected environment and are shown on Figure G.2.6-1 as a reflection of the full extent of USACE jurisdiction. However, to avoid duplication of analysis this section focuses only on non-tidal waters and wetlands. Impacts on tidal waters and wetlands, including all USACE jurisdictional waters and wetlands from the high tide line to the 3-nautical-mile (3.5-mile) limit of territorial seas are discussed in EIS Section 3.5, Coastal Habitats and Fauna. Existing conditions and impacts for open waters from the limits of territorial seas to the edge of the U.S. Exclusive Economic Zone are discussed in EIS Section G.2.2, Water Quality, as well as other resource sections related to open water environments.

Non-tidal wetlands are important features in the landscape that provide numerous beneficial services or functions. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, providing aesthetic value, ensuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. The land within the geographic analysis area for the proposed Project is located in Barnstable County, Massachusetts. Of the approximately 48,000 acres of wetlands in Massachusetts, approximately 1,250 acres (2.6 percent) were changed to other land cover types between 1991 and 2005 (MassDEP 2022). The geographic analysis area is in a densely developed part of the state with several nearby wetlands.

Within the Cape Cod watershed, two subwatersheds overlap the proposed Project: Hyannis Harbor-Frontal Nantucket Sound Subwatershed (HUC-010900020203) and Barnstable Harbor-Cape Cod Bay Subwatershed (HUC-010900020201) (USGS 2020). A variety of freshwater wetlands are located within or near the onshore portions of the proposed Project, including vernal pools, cranberry bogs, and wooded marshes. Non-tidal portions of the Centerville River, Herring River, Long Pond, Wequaquet Lake, Shallow Pond, and Bearse Pond are also located within or near the onshore portions of the proposed Project (COP Volume III, Section 6.1.1; Epsilon 2022). Because the geographic analysis area has been heavily developed for decades, habitat quality in the vicinity, including wetlands, has been degraded (MassDEP 2019). About 91,900 acres of non-tidal wetlands and non-tidal waters are within the geographic analysis area.

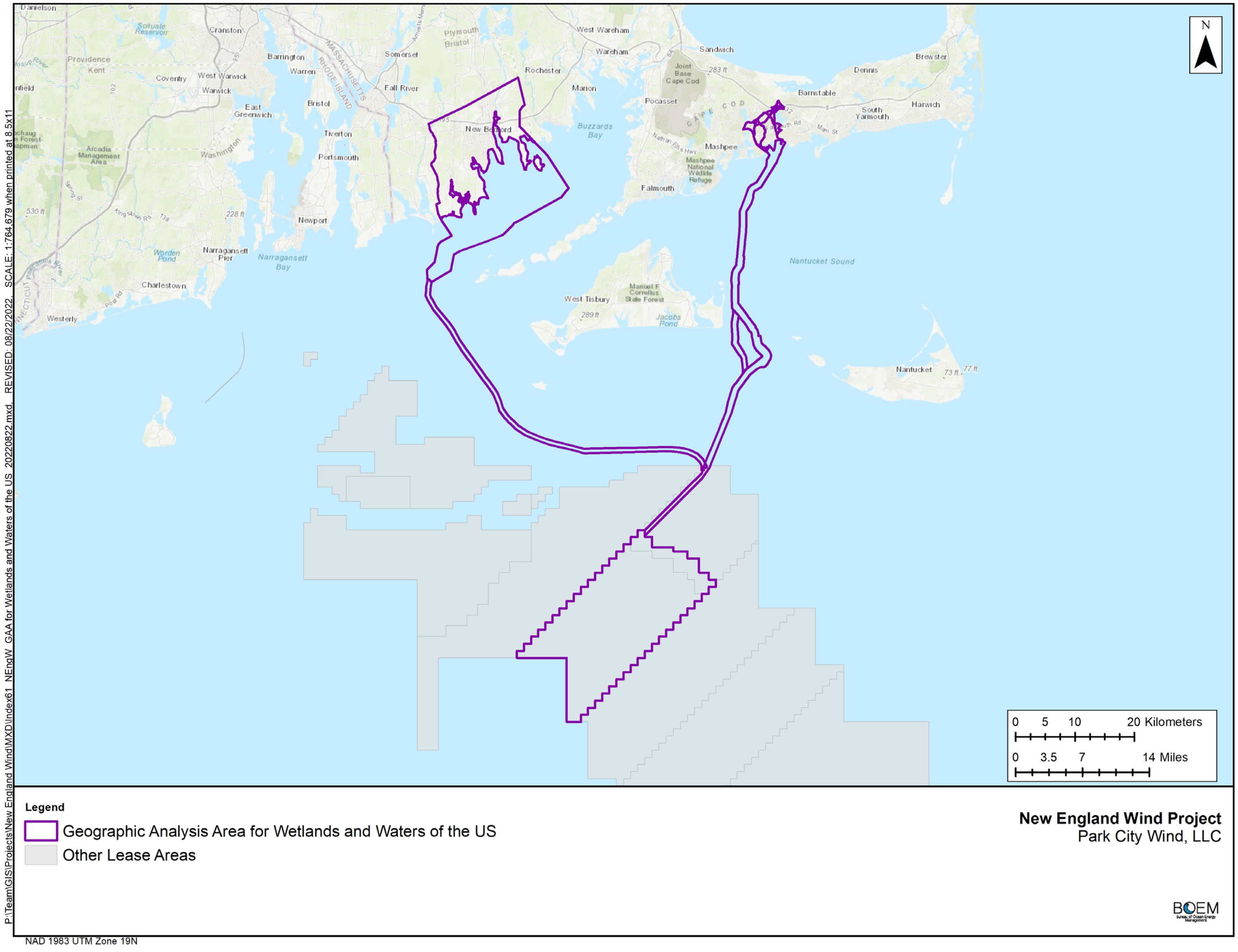


Figure G.2.6-1: Geographic Analysis Area for Wetlands and Other Waters of the United States

G.2.6.2 Environmental Consequences

Definitions of potential impact levels are provided in Table G.2.6-1. There are no beneficial impacts on tidal waters and wetlands. USACE define wetland impacts differently than BOEM due to requirements under CWA Section 404 (as summarized below).

Table G.2.6-1: Impact Level Definitions for Wetlands and Other Waters of the United States

Impact Level	Definition
Negligible	Impacts on wetlands would be so small as to be unmeasurable, and impacts would not result in a detectable change in wetland quality and function.
Minor	Impacts on wetlands would be minimized and would be relatively small and localized. If impacts occur, wetlands would completely recover.
Moderate	Impacts on wetlands would be minimized; however, permanent impacts would be unavoidable. Compensatory mitigation required to offset impacts on wetland functions and values would have a high probability of success.
Major	Impacts on wetlands would be minimized; however, permanent impacts would be regionally detectable. Extensive compensatory mitigation required to offset impacts on wetland functions and values would have a marginal or unknown probability of success.

Impacts of Alternative A – No Action Alternative on Wetlands and Other Waters of the United States

When analyzing the impacts of Alternative A on tidal waters and wetlands, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for tidal waters and wetlands (Table G.1-19). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in EIS Appendix E, Planned Activities Scenario.

Under Alternative A, baseline conditions for tidal waters and wetlands described in Section G.2.6.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts tidal waters and wetlands include human activities such as roads; utility ROW; an airport; residential, commercial, and light industrial activities; and other future offshore wind activities. Future non-offshore wind actions include residential, commercial, and industrial development; dredging and port improvement projects; and proposed onshore WTGs and communications towers. The conversion of wetlands in Massachusetts (Section G.2.6.1) has led the Massachusetts Department of Environmental Protection (MassDEP) to implement the Wetlands Loss Project to prevent further alterations and loss of wetlands. This program compiles aerial photographs across the state to enable comparisons of wetland loss over time and better focus the state's enforcement and restoration activities (MassDEP 2022). Accumulation of sediments from upland erosion may also decrease wetland volume naturally. Discharges from septic tank systems onshore can create potential nutrient loading and other non-point source pollution in nearby non-tidal waters and wetlands.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on tidal waters and wetlands include construction of the landfall sites, onshore cables, and substations for the Vineyard Wind 1 Project in Barnstable County. The extent of impacts on non-tidal waters and wetlands would depend on landfall locations, OECR routing, and onshore substation locations. In Massachusetts, any proposed work must meet certain standards in the Wetlands Protection Act (Massachusetts General Laws Chapter 131, Section 40), which is administered by each local community's conservation commission to prevent long-term impacts on wetlands. To the degree that planned offshore wind activities involve landfall locations and cable routes in Bristol County, these projects could contribute to the impacts of the SCV. Ongoing and planned activities (including offshore wind) would affect tidal waters and wetlands through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Tidal waters and wetlands could potentially be affected by future offshore wind activities through the following primary IPFs.

Accidental releases: Accidental releases from onshore components (i.e., transformers and construction equipment) could affect nearby and adjacent non-tidal waters or wetlands. During onshore construction of offshore wind projects in the geographic analysis area, oil leaks and accidental spills from construction equipment are potential sources of contamination for non-tidal waters and wetlands. Onshore substations would house transformers and other electrical components that may leak hazardous fluids, such as dielectric fluid. While many wetlands act to filter out contaminants, any significant increase in contaminant loading could exceed the capacity of a wetland to perform its normal water quality functions. Although degradation of water quality in non-tidal waters and wetlands could occur during construction, decommissioning, and, to a lesser extent, operations, due to the small volumes of spilled material anticipated, these impacts would all be short term until the source of the contamination is removed. Compliance with applicable state and federal regulations related to oil spills and waste handling would minimize potential impacts from accidental releases. These include the Resource Conservation and Recovery Act (42 USC § 6901 et seq.), U.S. Department of Transportation Hazardous Material regulations (49 CFR Parts 100–185), and implementation of a spill prevention, control, and countermeasure plan (EIS Appendix H, Mitigation and Monitoring). Impacts from accidental releases on wetlands would be minimal and localized, and compliance with state and federal regulations would avoid or minimize potential impacts on wetland quality or functions. The potential for accidental releases would be higher during construction and decommissioning of onshore components and less during operations. Impacts of releases on offshore waters are discussed in EIS Section G.2.2, Water Quality.

Climate change: Although sources of GHG emissions contributing to regional and global climate change mostly occur outside the geographic analysis area, climate change would contribute to impacts on non-tidal waters and wetlands in the geographic analysis area resulting from changes in temperature and changes in the frequency of, and total, precipitation. These changes can alter hydrology and the types of habitats and biodiversity that wetlands and other waters of the U.S. support. EIS Section G.2.1, Air Quality, discusses the expected contribution of offshore wind activities to climate change.

Land disturbance: Construction of onshore components (e.g., onshore export cables, substations) in the geographic analysis area for the proposed Project could include clearing, excavating, trenching, filling, and grading, which could result in the loss or alteration of wetlands, causing impacts on wetland habitat, water quality, and flood and storage capacity functions. Fill material permanently placed in wetlands during construction would result in the permanent loss of wetlands, including any habitat, flood and storage capacity, and water quality functions that the wetlands may provide. If a wetland were partially filled and fragmented or if wetland vegetation were trimmed, cleared, or converted to a different vegetation type (e.g., forest to herbaceous), habitat would be altered and degraded (affecting wildlife use), and water quality and flood and storage capacity functions would be reduced by changing natural hydrologic flows and reducing the wetland's ability to impede and retain stormwater and floodwater. On a watershed level, any permanent wetland loss or alteration could reduce the capacity of regional wetlands to provide wetland functions. Short-term wetland impacts may occur from construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands, as well as alter wetland functions if sediment loads are high (e.g., habitat impacts from burying vegetation). The extent of wetland impacts would depend on specific construction activities and their proximity to wetlands. These impacts would occur primarily during construction and decommissioning; impacts during operations would only occur if new ground disturbance were required, such as to repair a buried component. Onshore project components from other offshore wind projects would likely be sited in disturbed areas (e.g., along existing roadways), which would avoid and minimize wetland impacts. In addition, the offshore wind projects would be designed to avoid wetlands to the extent feasible. Because Vineyard Wind 1 is the only project whose onshore construction would overlap the geographic analysis area, and because that project, like all other offshore wind projects, would be required to comply with local, state, and federal regulations related to the protection of wetlands by avoiding or minimizing impacts, land disturbance from onshore construction of future offshore wind projects in the geographic analysis area would have only temporary impacts on nearby non-tidal waters and wetlands.

Conclusions

Impacts of Alternative A. Under Alternative A, non-tidal waters and wetlands 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 under Alternative A, ongoing activities would have continuing impacts primarily through accidental releases and land disturbance. Considering all the IPFs together, ongoing and planned activities in the geographic analysis area would have **minor** impacts on non-tidal waters and wetlands, predominantly due to accidental releases and climate change.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities may also contribute to impacts on non-tidal waters and wetlands, primarily through accidental releases and land disturbance. Considering all the IPFs together, Alternative A combined with ongoing and planned activities would result in **minor** cumulative impacts on non-tidal waters and wetlands.

Relevant Design Parameters and Potential Variances in Impacts

The following primary proposed Project design parameters (EIS Appendix C, Project Design Envelope and Maximum-Case Scenarios) would influence the magnitude of the impacts on non-tidal waters and wetlands:

- While most Phase 1 and Phase 2 OECR alignments would primarily follow public roadway layouts, portions of the routes may also be located within utility ROWs and could cross non-tidal waters and wetlands;
- Different construction techniques, including HDD, microtunneling, direct pipe, or a new utility bridge, could have different impacts on lands adjacent to or near non-tidal waters and wetlands. Trenchless methods would be used (at minimum) at the onshore cable landing sites; and
- Changes to the number or design capacity of offshore wind turbines would not alter the maximum potential impacts on non-tidal waters and wetlands. because the number of turbines would not affect onshore infrastructure.

Impacts of Alternative B – Proposed Action on Wetlands and Other Waters of the United States

This section identifies potential impacts of Alternative B on non-tidal waters and wetlands.

Impacts of Phase 1

Phase 1 would affect non-tidal waters and wetlands through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: Onshore construction activities would require heavy equipment use, and potential spills of petroleum products could result from an inadvertent release from machinery or refueling activities. The proposed Project would perform the majority of fueling and equipment maintenance activities at service stations or a contractor's yard (COP Volume III, Table 4.2-1; Epsilon 2022). Less-mobile equipment, such as excavators or paving equipment, would be refueled on site but not within 100 feet of wetlands, waterbodies, or known private or community potable wells (COP Volume III, Section 5.2.2; Epsilon 2022). Additionally, the applicant would prepare a spill prevention, control, and countermeasure plan in accordance with federal requirements (40 CFR Part 112) and any other state or local requirements to outline spill prevention plans and measures to contain and clean up spills if they were to occur (EIS Appendix H, Mitigation and Monitoring). The applicant would also implement its OSRP (COP Appendix I-F; Epsilon 2022). Lastly, the proposed Project would use solid export cables that do not contain fluids. Due to the limited volume of potential pollutants involved in onshore construction (i.e., fluids contained in construction equipment), any accidental onshore releases that are not completely controlled by the proposed Project's precautionary measures and spill prevention, control, and countermeasure plan would result in **negligible** and short-term impacts on wetlands and water resources with which they come in contact. Offshore releases are discussed in EIS Section G.2.2.

Climate change: Climate change would contribute to impacts on non-tidal waters and wetlands primarily through existing global and regional climate trends. Phase 1 would have no measurable influence on this IPF. The intensity of impacts on non-tidal waters and wetlands resulting from climate change are uncertain but are anticipated to be **minor**.

Land disturbance: The proposed onshore substation sites and cable landing sites would not contain any freshwater or wetland resources. However, non-tidal waters and wetlands that are not found on publicly available maps may also be identified by pre-construction field surveys. As a result, installation of the Phase 1 onshore export cable could affect wetlands or wetland-adjacent areas.

The proposed Project would comply with all requirements of any issued permits and employ proper erosion and sedimentation controls. The proposed Project would comply with the federal CWA, the MassDEP, and local regulations to prevent degradation of rivers and streams. The use of HDD would avoid construction-related impacts in intertidal areas at the landing sites. The underground transition vault located at the selected onshore cable landing site would be installed outside of wetlands and waterbodies, within a paved roadway or parking lot, and would have a manhole cover at the ground surface.

Temporary, localized sedimentation and decreases in water quality in freshwater wetlands could occur from increased sedimentation during construction of the Phase 1 OECR and onshore substation (EIS Section G.2.2). All land disturbances from construction activities would be conducted in compliance with the NPDES 2022 Construction General Permit and the approved storm water pollution prevention plan for the proposed Project. In the event of fault or failure of the proposed Project's precautionary measures and storm water pollution prevention plan, sediment could enter non-tidal waters and wetlands. Such sedimentation could result in **negligible** impacts due to the short duration of increased sedimentation, and because the resource would be expected to return to existing conditions.

The onshore underground transition vault, cable route, and interconnection facility have no maintenance needs unless a fault or failure occurs; therefore, Phase 1 operations are not expected to impact non-tidal waters and wetlands. The onshore substation would house transformers and other electrical components that may leak hazardous fluids, such as dielectric fluid. In the event that repairs become necessary, any impacts would be similar to construction, but to a lesser degree, and short term and **negligible**.

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

Impacts of Phase 2

The potential impacts on non-tidal waters and wetlands resulting from Phase 2 would be similar to those described for Phase 1 for construction, operations, and decommissioning. The applicant has not yet defined the SCV OECC route within state waters in Buzzards Bay or the SCV OECR in Bristol County, Massachusetts. The impacts of the finalized SCV OECC and OECR route on wetlands and other waters of the U.S. will be evaluated in a supplemental NEPA analysis.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of the proposed Project in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-19 would contribute to impact on tidal waters and wetlands through the primary IPFs of accidental releases and land disturbance. Cumulative impacts on tidal waters and wetlands would be **minor** due to occasional disturbance along onshore cable routes and at substation sites.

Conclusions

Impacts of Alternative B. Temporary low-level sedimentation of non-tidal waters and wetlands could occur during construction of the OECR and onshore substation. Little to no impacts from operations or decommissioning are anticipated. The impacts of Alternative B on non-tidal waters and wetlands would be short term and **negligible** because the impact would be small, and the resource would be expected to recover to existing conditions without remedial or mitigating action.

Cumulative Impacts of Alternative B. Considering all the IPFs together, the overall cumulative impacts of Alternative B and other ongoing and planned activities on tidal waters and wetlands would be **minor.** Impacts would be small in extent and short term, and the resources would be expected to return to existing conditions.

Impacts of Alternative C – Habitat Impact Minimization Alternative on Wetlands and Other Waters of the United States

Under Alternatives C-1 and C-2, all onshore proposed Project components and activities would be the same as those of Alternative B. Offshore impacts of Alternatives C-1 and C-2 would be similar to those described under Alternative B.

G.2.7 Land Use and Coastal Infrastructure

G.2.7.1 Description of the Affected Environment

This section discusses existing conditions in the geographic analysis area for land use and coastal infrastructure, as described in Table D-1 in EIS Appendix D, Geographic Analysis Areas, and shown on Figure G.2.7-1. The geographic analysis area includes the following counties that contain onshore infrastructure or ports that may be used to support proposed Project construction or operations (EIS Section 2.1.2, Alternative B – Proposed Action):

- Onshore proposed Project infrastructure (landfall sites, cable routes, substations, electrical grid interconnection routes)
  - Massachusetts: Barnstable and Bristol counties
- Ports
  - Massachusetts: Bristol, Dukes, and Essex counties
  - Rhode Island: Providence and Washington counties
  - Connecticut: Fairfield and New London counties
  - New York: Albany, Kings, Rensselaer, Richmond, and Suffolk counties
  - New Jersey: Gloucester County

Table G.1-20 describes existing conditions and impacts, based on the IPFs assessed, of ongoing and planned activities other than offshore wind, which is discussed below.

Land use and coastal infrastructure are diverse within coastal New Jersey, New York, Connecticut, Rhode Island, and Massachusetts due to the presence of large coastal population centers and coastal-dependent industries (marine transportation, fishing, recreation, and tourism), as well as residential, commercial, and industrial development, agricultural lands, and natural resource areas (forests, surface waters, and wetlands) (NOAA 2010). The larger metropolitan regions within the geographic analysis area include New York City and Albany, New York; Providence, Rhode Island; Bridgeport, Connecticut; and New Bedford and Fall River, Massachusetts.

As listed in Table G.2.7-1, all counties in the geographic analysis area experienced an increase in developed land cover between 2001 and 2019 (MRLC 2021). The Town of Barnstable, the primary location for planned landfall sites, OECR, and substations, is the largest community on Cape Cod in both land area and population and serves as the Barnstable County seat. Barnstable has a mix of low- to medium-density residential development, business, and industry, as well as extensive recreation and tourist-oriented commercial and public uses. Most of the town's residential development has occurred in the last 40 years.

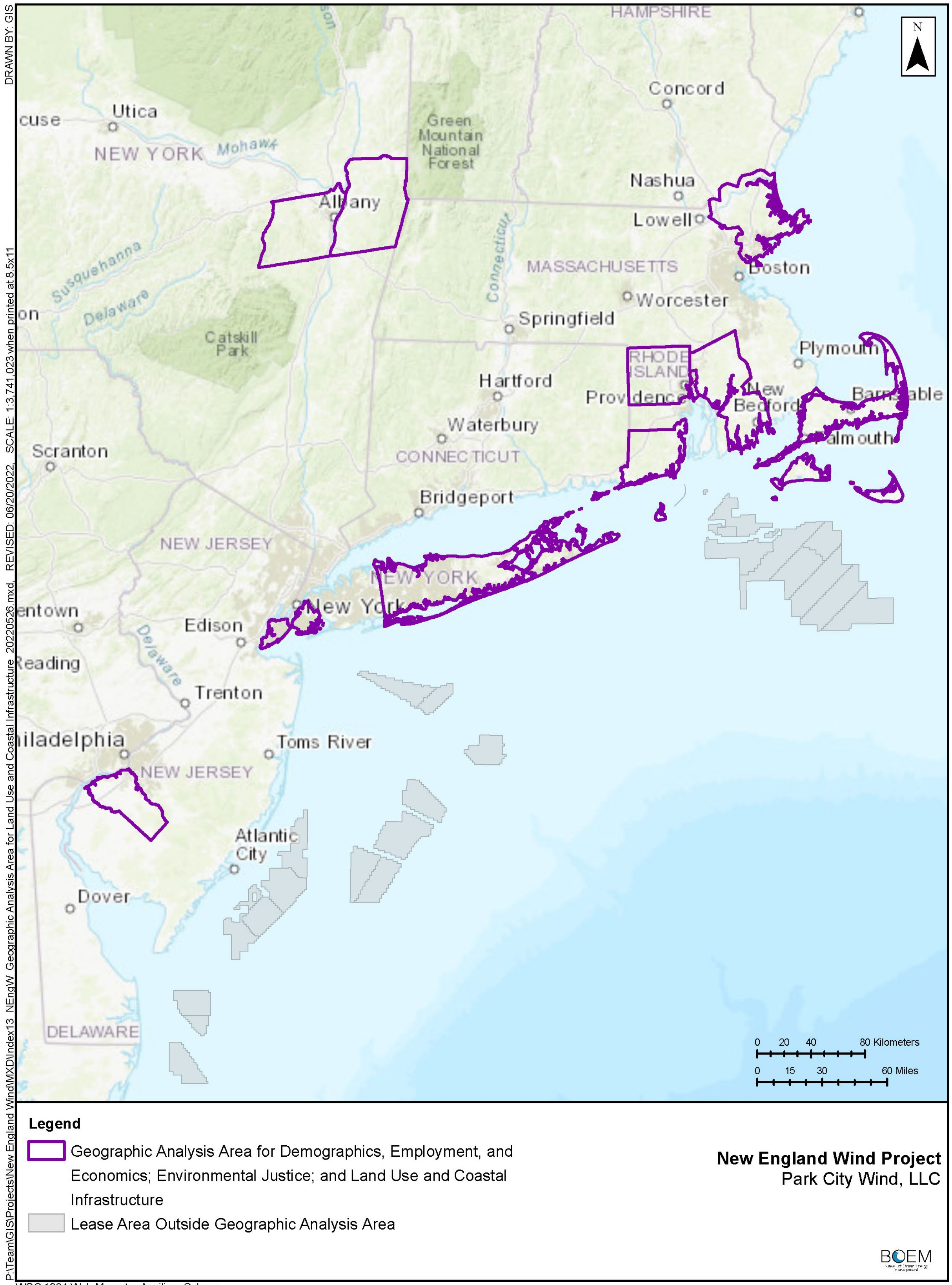


Figure G.2.7-1: Geographic Analysis Area for Land Use and Coastal Infrastructure

The Hyannis area (part of the Town of Barnstable) contains important regional assets, including two ferry terminals, the region's largest commercial airport, the Cape Cod Hospital, and a regional commercial area along Route 132 (Town of Barnstable 2010). Of the town's 38,500 acres, 29 percent is protected open space and 11 percent is public open space, public or private recreation, public use (including the airport), or private agriculture/forest lands (Town of Barnstable 2018). Working waterfronts are a long-established feature of Barnstable County's harbors, which support traditional fishing activities and recreational boating (Town of Barnstable 2010). The community plan for Barnstable recommends no substantial changes in land uses near proposed Project onshore facilities (Town of Barnstable 2010).

Barnstable County's developed land cover grew by 3.4 percent, with most of the newly developed land converted from forested land. Barnstable County's development patterns and growth pressures have resulted in concerns about loss of forest cover, surface water quality, the use of on-site septic systems that do not adequately protect water quality, climate change, lack of protection for historic buildings, inadequate affordable housing supply for year-round residents, and limited public infrastructure (Cape Cod Commission 2021).

Table G.2.7-1. Developed Land Cover in Geographic Analysis Area

County	Developed Land Cover 2019 (%)	Increase in Developed Land Cover 2001–2019 (%)
Barnstable County, Massachusetts	12.9	3.4
Bristol County, Massachusetts	27.6	11.8
Dukes County, Massachusetts	4.2	1.5
Essex County, Massachusetts	24.9	7.3
Fairfield County, Connecticut	34.7	4.7
New London County, Connecticut	15.7	5.4
Gloucester County, New Jersey	34.2	15.3
Albany County, New York	22.3	7.3
Kings County, New York	67.2	0.3
Rensselaer County, New York	12.1	10.0
Richmond County, New York	42.5	2.1
Suffolk County, New York	22.8	3.7
Providence County, Rhode Island	32.2	6.4
Washington County, Rhode Island	13.5	5.1

Source: MRLC 2021

As listed in Table G.2.7-2, proposed Project construction and operations may be supported by ports or terminals located within land use contexts that include large and small cities, suburban areas, and small towns. The primary long-term shore base for operations is most likely to be within the Port of Bridgeport, with crew transfer vessels (CTV) and service vessels also operating out of Vineyard Haven Harbor and the Port of New Bedford. Other port facilities identified as possibly supporting proposed Project construction, operations, or decommissioning are listed in Table G.2.7-2 (COP Volume III; Epsilon 2022). The proposed Project may also use ports in Canada, which are not within the scope of BOEM's analysis.

These sites are generally industrial in character, or adjacent to other industrial or commercial land uses, and have access to major transportation corridors (COP Volume III; Epsilon 2022). The sections below briefly characterize the jurisdictions and port or terminal facilities listed in Table G.2.7-2.

Table G.2.7-2: Port Facilities by County

County	Potential Port Usage, Construction, Operations, and Decommissioning (Site Type)[a]
Bristol County, Massachusetts	Port of New Bedford (E) Brayton Point Commerce Center (P) Fall River terminal facilities (P)
Dukes County, Massachusetts	Vineyard Haven Harbor (E)
Essex County, Massachusetts	Salem Offshore Wind Port (P)
Fairfield County, Connecticut	Port of Bridgeport (E)
New London County, Connecticut	Port of New London (E)
Gloucester County, New Jersey	Paulsboro Marine Terminal (E)
Albany County, New York	Port of Albany Beacon Island expansion (P) Port of Coeymans (E)
Kings County, New York	GMD Shipyard (E) South Brooklyn Marine Terminal (E)
Rensselaer County, New York	New York State Offshore Wind Port (P)
Richmond County, New York	Homeport Pier (P) Arthur Kill Terminal (G)
Suffolk County, New York	Shoreham site (P) Greenport Harbor (E)[b]
Providence County, Rhode Island	ProvPort (E) South Quay Terminal (G)
Washington County, Rhode Island	Port of Davisville (E)

Source: COP Volume III; Epsilon 2022

ProvPort = Port of Providence

[a] Site types include the following:
E: Existing ports or industrial terminals that may be expanded to serve the offshore wind industry
P: Industrial facilities proposed for redevelopment to serve offshore wind activities, regardless of the status of the proposed Project
G: Greenfield sites that have not been previously developed

[b] This site is for operations only.

Bristol County, Massachusetts

Bristol County is in southeast Massachusetts, bordered by Rhode Island to the west, Buzzards Bay to the south, and Plymouth County to the east. It contains the Port of New Bedford and Brayton Point Commerce Center.

The City of New Bedford is a densely developed, historic, manufacturing center, and port within Bristol County. The city's master plan establishes goals that include developing emerging industry sectors, linking brownfields and historic mills with new development opportunities, diversifying industries in the Port of New Bedford, supporting traditional harbor industries, and promoting sustainable 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 New Bedford Marine Commerce Terminal, a facility owned by the Massachusetts Clean Energy Center, developed with support from the Commonwealth of Massachusetts to serve the offshore wind energy industry.

The Brayton Point Commerce Center is the site of the former coal-fired Brayton Point Power Plant, a 307-acre property located on Mount Hope Bay, less than 1 mile from Interstate 195. The site owners plan to develop the former power plant site as a port, manufacturing hub, and support center for the offshore wind industry.

Fall River is the second most populous city in Bristol County (after New Bedford), located on the eastern shore of Mount Hope Bay at the mouth of the Taunton River. Like New Bedford, Fall River was historically a manufacturing and port city. Several Fall River waterfront port and industrial facilities have been identified by the Massachusetts Clean Energy Center as potential offshore wind ports and could be used by the applicant if the necessary upgrades are made by the owner(s)/lessor(s).

Dukes County, Massachusetts

Dukes County consists of Martha's Vineyard and ten neighboring islands off the southeast coast of Massachusetts. Vineyard Haven Harbor in the Town of Tisbury on Martha's Vineyard 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 2022). The area of Tisbury near the Vineyard Haven Harbor is a mix of marine-related, commercial, and residential uses. Approximately 2 percent of Martha's Vineyard is zoned for commercial or industrial use, 40 percent is preserved from development, and nearly all the remaining land area is developed for residential uses (Martha's Vineyard Commission 2010).

Essex County, Massachusetts

Essex County is a coastal county north of Boston. The Town of Salem contains Salem Harbor, which provides marine recreational, water transportation, and commercial uses (COP Volume III; Epsilon 2022). The recently commissioned Salem Harbor Power Station natural gas power plant replaced a coal and oil plant along Salem's waterfront in 2018. The decommissioning opened 42 acres of available land that is proposed for development as the Salem Offshore Wind Port, a facility that could support staging activities, storage, and assembly of components such as blades, nacelles, and tower sections in preparation for offshore installation (City of Salem 2021).

Fairfield County, Connecticut

Fairfield County in southwestern Connecticut contains the City of Bridgeport, an historic waterfront manufacturing center. Bridgeport experienced deindustrialization during the latter half of the twentieth century and is seeking new investment, expanded economic opportunities, and new waterfront development that provides a mix of land uses and public amenities (City of Bridgeport 2017, Metrocog 2015). The Port of Bridgeport, which includes Bridgeport Harbor and Black Rock Harbor, has several private cargo facilities that handle a range of goods, including petroleum products; break-bulk cargo; and sand, gravel, and coal (COP Volume III; Epsilon 2022).

New London County, Connecticut

New London County in southeastern Connecticut contains the City of New London, located on the Atlantic coast at the mouth of the Thames River. The City of New London's downtown waterfront is developed with water-dependent uses including piers, docks, marinas, port facilities, shipyards, and ferry terminals (COP Volume III; Epsilon 2022). A 1,000-foot-long cargo pier, the Admiral Harold E. Shear State Pier (state pier), is planned to be redeveloped to serve offshore wind development through a private-public partnership between the Connecticut Port Authority, Eversource, and Ørsted (COP Volume III; Epsilon 2022). Although located within downtown New London, the state pier has highway access from Interstate 95 via major arterial roads and local roads that serve an industrial area.

Gloucester County, New Jersey

Gloucester County in southwestern New Jersey contains the City of Paulsboro on a stretch of the Delaware River that hosts numerous refineries and other fossil fuel facilities. The Paulsboro Marine Terminal, located on the Delaware River at the site of a former BP oil terminal, has been suggested as the site of an offshore wind monopile factory (NJB Magazine 2021). At full buildout, the Paulsboro Marine Terminal could include three vessel berths and a barge berth (COP Volume III; Epsilon 2022).

Albany County, New York

Albany County has two potential port facilities along the Hudson River that could support the proposed Project. The Port of Coeymans is an existing 400-acre, privately owned marine terminal approximately 11.5 miles south of the City of Albany (COP Volume III; Epsilon 2022). It is an industrial terminal used for large-scale construction projects, bulk commodities, break-bulk, heavy lift items, and containers.

The Albany Port District Commission has proposed to expand the Port of Albany by developing approximately 81.5 acres of riverfront property on Beacon Island in Glenmont, New York (south of downtown Albany) as a manufacturing facility, staging area, and bulkhead for on- and off-loading of equipment, materials, and offshore wind farm components (COP Volume III; Epsilon 2022). The Beacon Island site is vacant, former industrial land.

Kings County, New York (New York City, Brooklyn Borough)

Kings County is coterminous with the Brooklyn Borough of New York City. The South Brooklyn Marine Terminal is an existing port with two piers on the Upper Bay of New York Harbor (COP Volume III; Epsilon 2022). The port is proposed to be upgraded to support staging, installation, and maintenance activities for offshore wind. The existing site hosts parking lots, utility buildings, warehouses, and an operational railroad. The terminal is in a heavily industrialized waterfront area with residential and commercial uses nearby. The GMD Shipyard is a full-service shipyard (ship repair and servicing) located within the Brooklyn Navy Yard on the East River (COP Volume III; Epsilon 2022).

Rensselaer County, New York

Across the Hudson River from Albany County, the New York State Offshore Wind Port is proposed to be constructed on currently vacant land in East Greenbush, Rensselaer County, New York. The 30-acre facility would be part of a proposed 112-acre industrial development south of the City of Albany (COP Volume III; Epsilon 2022).

Richmond County, New York (New York City, Staten Island Borough)

Richmond County is coterminous with the Staten Island Borough of New York City. The proposed Arthur Kill Terminal is a greenfield site on Staten Island that would be developed into a 32-acre port facility designed for the staging and assembly of offshore wind farm components. The Arthur Kill Terminal site is surrounded by developed land uses that include low-density commercial uses and marine industrial facilities, both active and unused (COP Volume III; Epsilon 2022). Richmond County also contains the Homeport Pier, a former naval base with an existing pier approximately 2 miles north of the Verrazano-Narrows Bridge. The New York City Economic Development Corporation is exploring the potential development of the site to support the offshore wind industry (COP Volume III; Epsilon 2022).

Suffolk County, New York

Suffolk County covers the eastern portion of Long Island. The 700-acre Shoreham site contains the non-operating Shoreham Nuclear Power Plant buildings and has been identified by the New York State Energy Research and Development Authority as a potential site for offshore wind port facilities (COP Volume III; Epsilon 2022). The site, on Long Island Sound and surrounded by a creek, marshlands, and residential properties, would require significant investment and upgrades to create a waterfront terminal (COP Volume III; Epsilon 2022).

Greenport Harbor is an existing facility at the northeastern tip of Long Island with commercial docks that could be rented to offshore wind developers and used for provisioning, crew changes, weather standby, repairs, equipment change, and possibly fuel and water delivery (COP Volume III; Epsilon 2022).

Providence County, Rhode Island

The proposed Project may use port facilities at ProvPort and/or South Quay Terminal in Providence County, Rhode Island's northernmost county and home of the City of Providence, the state's largest municipality. ProvPort is a privately owned marine terminal located within the City of Providence that occupies approximately 115 acres along the Providence River. ProvPort is Rhode Island's principal commercial port and has interstate highway and rail access (COP Volume III; Epsilon 2022). The South Quay Terminal is a 30+ acre greenfield site located on the Providence River in the City of East Providence. Waterfront Enterprises, LLC has announced plans to develop a staging area for offshore wind construction at the site, as well as other mixed uses (COP Volume III; Epsilon 2022).

Washington County, Rhode Island

Washington County is Rhode Island's coastal county and is characterized by rural farming enclaves, seasonal beach communities, and low-density residential development (COP Volume III; Epsilon 2022). The Port of Davisville is near the mouth of Narragansett Bay and within the 3,212-acre Quonset Business Park in North Kingstown, a former military installation (COP Volume III; Epsilon 2022). The Port of Davisville offers five terminals, piers, a bulkhead, on-dock rail, and laydown and terminal storage. Ongoing renovations at the Port of Davisville's Pier 2 to service the offshore wind industry include constructing a new steel bulkhead, dredging to accommodate larger ships, and extending piers. The Port of Davisville currently hosts marine service businesses, industrial uses, and recreational boating uses.

G.2.7.2 Environmental Consequences

Definitions of impact levels for land use and coastal infrastructure are described in Table G.2.7-3.

Table G.2.7-3: Impact Level Definitions for Land Use and Coastal Infrastructure

Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on area land use would not be detectable.
	Beneficial	Beneficial impacts on area land use would not be detectable.
Minor	Adverse	Adverse impacts would be detectable but would be short term and localized.
	Beneficial	Beneficial impacts would be detectable but would be short term and localized.
Moderate	Adverse	Adverse impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
	Beneficial	Beneficial impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
Major	Adverse	Adverse impacts would be detectable, long term, and extensive, and result in permanent land use change.
	Beneficial	Beneficial impacts would be detectable, long term, and extensive, and result in permanent land use change.

Impacts of Alternative A – No Action Alternative on Land Use and Coastal Infrastructure

When analyzing the impacts of Alternative A on land use and coastal infrastructure, BOEM considered the impacts of ongoing activities including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for land use and coastal infrastructure (Table G.1-20). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in EIS Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for land use and coastal infrastructure described in Section G.2.7.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure include onshore and coastal regional trends, development projects, and port expansion (Table G.1-20). 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.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure include construction of the landfall sites, onshore cables, and substations for the Vineyard Wind 1 project in Barnstable County. To the degree that planned offshore wind activities involve landfall locations and cable routes in Bristol County, these projects could contribute to the impacts of the SCV. Ongoing and planned activities (including offshore wind) would affect land use and coastal infrastructure through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind development activities would affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazardous materials may increase as a result of future offshore wind activities. The risk of accidental releases would be increased primarily 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. Accidental releases 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 EIS Section G.2.2, Water Quality, 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).

Land disturbance: Future offshore wind construction would require installation of onshore transmission cable infrastructure and substations, which would cause temporary land disturbance and could temporarily affect access to adjacent properties. These impacts would only last through construction and rarely occur during operations 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, Alternative A would generally have localized and short-term impacts due to land disturbance during construction or maintenance.

Lighting: The permanent aviation warning lighting required for offshore wind WTGs would be visible from some beaches and coastlines and could affect land use if coastal views of the lighting influences property values or visitor/resident decisions in selecting coastal residential, business, or recreational locations to visit, rent, or buy. A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles) could impact the rental price of properties with ocean views (Lutzeyer et al. 2017). The study does not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles from shore.

Aviation hazard lighting from all 903 WTGs in the RI/MA Lease Areas (other than the proposed Project) could potentially be visible from beaches and coastal areas in and near the geographic analysis area for land use and coastal infrastructure (EIS Appendix E). Of the 903 WTGs that would be added within the geographic analysis area, 692 WTGs could be within 37.5 miles of the coastlines of Martha's Vineyard and Nantucket (the limit for visibility of nacelle-tops, assuming a 725-foot above mean sea level maximum nacelle-top height, as viewed from sea level). Visibility would depend on distance from shore, topography, and atmospheric conditions but would generally be localized, constant, and long term (EIS Section 3.16, Scenic and Visual Resources). BOEM assumes that FAA hazard lighting for offshore wind projects in the RI/MA Lease Areas would use ADLS. ADLS would activate the aviation warning lighting only when aircraft approach WTGs, reducing the visibility and associated land use impacts associated with WTG lighting.

Nighttime lighting from onshore electrical substations could affect the desirability of nearby properties or decisions about where to establish permanent or temporary residences. The extent of lighting impacts would depend on the substation locations and the lighting design but would generally be localized, constant, and long term.

Noise: Use of ports for offshore wind construction would generate localized noise from road and marine traffic and equipment usage for the duration of the construction period. Noise impacts would increase if multiple projects rely on the same port and overlap in time. Short-term noise would result from installation of onshore cables and substations. Noise resulting from offshore wind construction would have less impact on land use and coastal infrastructure within the context of an existing port or industrial area than if it occurred near a residential land use. Operations would generate lower levels of port activity and related noise.

Port utilization: Future offshore wind activity could necessitate port expansion in the geographic analysis area, including coastal New Jersey, New York, Connecticut, Rhode Island, and Massachusetts. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts such as support for maintenance and improvements, 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.

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 increase the marine traffic in the area. As described in Section G.2.7.1, new or expanded port, terminal, and manufacturing facilities are proposed to support offshore wind development within the geographic analysis area.

While no single new or expanded port facility is associated with a specific offshore wind project, completion of the projects included in Alternative A would likely result in numerous port or terminal expansions, including new manufacturing and staging facilities, within the geographic analysis area

(EIS Appendix E). Many of these actions would provide redevelopment and improvements for vacant or under-used industrial waterfront sites. Individual port upgrades and expansions would be reviewed through required local, state, and federal permitting and are not part of this assessment. Overall, Alternative A would have constant, long-term, beneficial impacts on port development and utilization due to the productive use of ports and other lands designated or appropriate for offshore wind activity, as well as localized, short-term impacts in cases where individual ports and surrounding coastal areas experience marine traffic congestion and scarcity of port facilities (docks, laydown areas, storage).

Presence of structures: During operations, the views of offshore wind WTGs from coastal locations within the geographic analysis area could affect land use if the views affect property values or visitor/resident decisions in selecting coastal locations to visit or buy. Based on the currently available studies, portions of all 903 WTGs associated with Alternative A could be visible from some shorelines (depending on vegetation, topography, and atmospheric conditions), of which up to 50 (fewer than 5 percent) would be within 15 miles of shore (EIS Section 3.16). Visibility would vary with distance from shore, topography, and atmospheric conditions and would generally be localized, constant, and long term, with minimal impacts on land use. While the views may influence some individual decisions, the visual impacts would not alter land use patterns or reduce the use of coastal infrastructure (Gibbons 2015; Parsons and Firestone 2018; Lutzeyer et al. 2017).

The presence of onshore, underground transmission cable infrastructure would have minimal long-term impacts on land use because these would typically be collocated with roads and/or other utilities. The impacts of new substations would depend on their location and design (especially sound attenuation and vegetative screening). With appropriate design, the operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Traffic: Vehicle traffic generated by offshore wind construction would occur between supply sources and ports used to support construction. Traffic would be distributed among the various ports that would be used and could result in periodic, short-term congestion due to transportation of offshore wind components to the ports, and especially the movement of slow-moving, oversized loads. Congestion on port access roads could also result from the volume of traffic generated, especially if multiple projects rely on the same port and overlap in time. Installation of onshore cables would result in short-term road delays and congestion during the placement of cable ducts within the ROWs of existing roads. Traffic delays and congestion would have localized, short-term impacts on land uses adjoining the affected roads or relying on the affected roads for access or travel. Operations would generate lower levels of port activity and related traffic.

Conclusions

Impacts of Alternative A. Under Alternative A, 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. The identified IPFs relevant to land use and coastal infrastructure are accidental releases; land disturbance from construction; nighttime lighting of substations; noise from construction, port activities, and substation operation; port utilization, presence of structures; presence of onshore infrastructure (especially new or expanded substations); and traffic generation.

Ongoing activities—especially onshore and coastal commerce, industry, and construction projects—would have **minor** impacts, both adverse and beneficial, on the geographic analysis area (the port areas and Barnstable). Accidental releases, land disturbance, road traffic, and construction-related noise could have temporary impacts on local land uses, but 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 harbors. The jurisdictions within the geographic analysis area would experience a continued need to protect natural resources while attracting new economic development, providing or upgrading infrastructure, and ensuring a reasonable housing supply.

Cumulative Impacts of Alternative A. Planned activities other than offshore wind, primarily increased port maintenance and expansion and construction activity, would have impacts similar to ongoing activities, with **minor** impacts, both adverse and beneficial. The combination of ongoing and planned activities would result in **minor** cumulative impacts, both adverse and beneficial, on land use and coastal infrastructure.

Considering all the IPFs, ongoing and future activities including future offshore wind activities near the geographic analysis area would result in **minor** cumulative impacts, both adverse and beneficial. Future offshore wind would affect land use through land disturbance (during installation of onshore cable and substations), road traffic, noise, and accidental releases during onshore construction, intensive use of ports, and views of offshore structures that could affect the use of onshore properties. The presence of new substations could also affect land use if not properly located and screened. Beneficial impacts on land use and coastal infrastructure would occur because the development of offshore wind (excluding the proposed Project) would support the productive use of ports and related lands and infrastructure designed or appropriate for future offshore wind activity (including construction, operations, and decommissioning).

Relevant Design Parameters and Potential Variances in Impacts

The proposed Project design parameters described below (EIS Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on land use and coastal infrastructure:

- The Phase 1 landfall site selected (Craigville Beach or Covell's Beach) and the selected Phase 1 onshore cable route (the Oak Street Route or Shootflying Hill Road Route) and grid interconnection route (the grid interconnection route or the variant).
- The substation design for Phase 1, including:
  - Whether the substation is installed entirely within the parcel at 8 Shootflying Hill Road or whether some of the onshore substation equipment is instead placed on Parcel #214 001, immediately southeast of the West Barnstable Substation;
  - Design of sound attenuation walls on the west side of the parcel at 8 Shootflying Hill Road; and
  - Design of landscaping provided for visual screening.
- The location of the substations and onshore cable route for Phase 2.
- The time of year in which construction occurs. For Phase 1, the applicant would adhere to summer limitations on construction activities on Cape Cod by generally scheduling onshore construction to occur after Labor Day and before Memorial Day, outside of the busiest tourist season. Cable installation may continue through June 15 with permission from the Town of Barnstable (COP Volume III; Epsilon 2022). If proposed Project delays were to change this schedule, the impacts on roads and land uses during the busy tourist season would be exacerbated. No scheduling commitments are made in the COP for Phase 2, but the applicant would consult with the Town of Barnstable regarding the construction schedule for Phase 1 and Phase 2.

- The development of a Traffic Management Plan (TMP) in coordination with municipal authorities to manage the impacts of onshore construction, especially cable duct bank installation. A TMP can reduce impacts on land uses along routes affected by construction.
- The port facilities chosen for construction support.

Changes to the number or design capacity of offshore wind turbines would not alter the maximum potential impacts on land use and coastal infrastructure because the number of turbines would not affect onshore infrastructure or port utilization.

Impacts of Alternative B – Proposed Action on Land Use and Coastal Infrastructure

This section identifies potential impacts of Alternative B on land use and coastal infrastructure.

Impacts of Phase 1

Phase 1 would affect land use and coastal infrastructure through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: Accidental releases from construction could include release of fuel/fluids/hazardous materials as a result of port usage and installation of the onshore cables and substation. BOEM assumes all activities would comply with laws and regulations to minimize releases. Accidental releases would result in temporary restriction on the use of adjacent properties and coastal infrastructure during the cleanup process. Accordingly, accidental releases from Phase 1 would have localized, short-term, and **negligible** to **minor** impacts on land use and coastal infrastructure.

Accidental releases from Phase 1 during operations could include release of fuel/fluids/hazardous materials as a result of port usage and substation operation. BOEM assumes all 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 is within Barnstable's Groundwater Protection Overlay District. The applicant plans to provide full-volume (110 percent) containment systems for components using dielectric fluid at the substation site, including Parcel #214-001. The containment would fully contain the dielectric fluid in the event of a complete, catastrophic equipment failure. Also included in the design is a common drain system that routes each individual containment area after passing through an oil-absorbing inhibition device to an oil/water separator before draining to the infiltration basin (COP Volume III; Epsilon 2022). Mitigation to provide additional containment for an extreme rain event, included in EIS Appendix H, Mitigation and Monitoring, would provide for the probable maximum precipitation event in a 24-hour period, as determined in consultation with the Town of Barnstable (EIS Section G.2.2, Water Quality). This mitigation would further reduce the potential impact of accidental releases on land use (COP Volume III; Epsilon 2022).

With the additional containment mitigation listed in EIS Appendix H, accidental releases from Phase 1 would have localized, short-term, and **negligible** to **minor** impacts on land use and coastal mitigation.

Decommissioning would require vessel and equipment usage for removal of offshore structures. Onshore cables, if removed, would require truck-mounted equipment but would not require land disturbance. Accidental releases could include release of fuel/fluids/hazardous materials as a result of vessel and equipment usage, with localized, short-term, and **negligible** to **minor** impacts on land use and coastal infrastructure.

Land disturbance: Installation of the landfall sites and onshore cables and construction of the substations would temporarily disturb neighboring residential land uses through construction noise, vibration, dust, and travel delays along the impacted roads.

The proposed new substation site and surrounding properties are in the Town of Barnstable's RF and RF-1 residential zoning districts. Both of these districts require a 1-acre minimum lot size (Town of Barnstable 2021). The new substation would also be within the town's Groundwater Protection Overlay District. The substation site is currently improved by a vacant motel building that would be removed. Land uses surrounding the proposed substation site include three single-family residences on wooded lots to the west and undeveloped, wooded land owned by the Cape Cod Chamber of Commerce to the east (Town of Barnstable 2022). East of the Chamber of Commerce parcel is unimproved, wooded land bordering State Route 132 and owned by the Commonwealth of Massachusetts Department of Public Works. To the south of the proposed new substation is a cleared transmission line ROW, approximately 270 feet wide, and south of the transmission line are two unimproved, wooded lots that are privately owned and part of a residential subdivision. To the north, across Shootflying Hill Road from the proposed substation site, is a 160-foot-wide strip of undeveloped, wooded land that is part of the ROW of U.S. Route 6 (the Mid-Cape Highway). To the north of the wooded strip is a ramp to the interchange of U.S. Route 6 with State Route 132.

The proposed expansion of the West Barnstable Substation is also within and surrounded by the RF residential zoning district. The expansion area is bordered to the east by an undeveloped wooded property owned by an electric utility. East of the utility-owned parcel is wooded land owned by the Town of Barnstable Conservation Commission and the Barnstable State Forest. To the west of the expansion area is the existing West Barnstable Substation, and to the south is U.S. Route 6, a four-lane divided highway with a wooded median. Single-family residences are separated from the proposed expansion area by the existing substation and an undeveloped, wooded lot owned by an electric utility company.

Substations are not an itemized permitted use within any zoning district under the Barnstable zoning ordinance; however, Massachusetts General Law Chapter 40A, § 3 provides that the Massachusetts Energy Facility Siting Board may exempt a public service corporation from particular local zoning provisions based on findings that the proposed use of the land or structure is reasonably necessary for the convenience or welfare of the public and the proposed use requires exemption from the zoning ordinance or bylaw.

The Phase 1 offshore export cables would transition onshore via HDD at one of two potential landfall sites:

- Craigville Public Beach Landfall Site is within a 3.5-acre paved parking area associated with a public beach that is owned and managed by the Town of Barnstable. Adjoining land uses include homes along the north side of Craigville Beach Road, a private beach club (Craigville Beach Club) and parking to the west, a private bathhouse and parking to the east (owned by the nearby Christian Campground), and undeveloped land.
- Covell's Beach Landfall Site is in a paved parking area associated with Covell's Beach, which is a residents-only beach owned by the Town of Barnstable. Residences and a building associated with the public beach are west of the landfall site, between Craigville Beach Road and the beach. Residential neighborhoods (single-family homes and one multi-family community) are located on both sides of the road to the north and northeast.

Landfall site construction would reduce the public parking available for Craigville or Covell's Beach during the construction period. Upon completion, the applicant would repave and restore disturbed areas to match existing conditions. This analysis assumes that upon restoration, the available parking area would be the same as before construction. Construction activities at the landfall site are not anticipated to be performed between June and September (the peak period for beach use) unless authorized by the Town of Barnstable.

Table G.2.7-4 shows that the cable route from the two potential landfall sites to the substation would be approximately 4.0 to 6.1 miles, depending on the landfall site and exact route selected.

In addition to the OECR, an underground interconnection cable would be installed from the Phase 1 substation to the existing West Barnstable Substation (COP Volume I, Section S-3.1.7; Epsilon 2022). The interconnection route would have a length of 0.6 mile if it follows existing transmission line ROWs, or 1.8 miles if it follows roads (Service Road, Route 132, and Oak Street). Adjoining land along Oak Street and the transmission line ROW is single-family residential and wooded, undeveloped land. Route 132 is bordered by undeveloped wooded land and commercial and civic uses, including a community college campus and a YMCA.

Table G.2.7-4: Phase 1 Onshore Cable Routes

Road or ROW Used	Distance (miles)	Comments and Primary Adjoining Land Uses
Shootflying Road Onshore Cable Route		
Craigville Beach Road	0.5	Single-family residential and Centerville River
Main Street	0.5	Centerville Historic District. Single-family residential and civic
Old Stage Road	0.7	Single-family residential, cemetery, commercial and apartments at intersection with Route 28, water tower
Shootflying Hill Road	2.2	Single-family residential, undeveloped wooded, public (parking, boat ramp and lake access)
ROW #343	0.1	Single-family residential, wooded
Total Distance, Shootflying Road Route	**4.0**	
Shootflying Road Route Variant 1[a]		
Craigville Beach Road	1.0	Beach-related parking and visitor buildings, single-family residential and commercial
Total Distance, Variant 1	**1.0**	
Shootflying Road Route Variant 2[a]		
South Main Street	0.7	Commercial, civic, single-family residential
Main Street	0.4	Single-family residential
Mothers Park Road	0.1	Single-family residential, public park
Phinneys Lane	0.4	Single-family residential, cemetery
Great Marsh Road	0.8	Single-family residential
Total Distance, Variant 2	**2.4**	
Shootflying Road Route Variant 3[a]		**In lieu of ROW #343**
Continue on Shootflying Hill Road	0.2	Wooded, residential
Total Distance, Variant 3	**0.2**	
Oak Street Route		
Craigville Beach Road	0.5	Single-family residential and Centerville River
South Main Street	0.7	Commercial, civic, single-family residential
Main Street	0.4	Single-family residential
Mothers Park Road	0.1	Single-family residential, public park
Phinneys Lane	0.4	Single-family residential, cemetery
Great Marsh Road	0.9	Single-family residential
Old Stage Road	1.3	Single-family residential, cemetery, commercial and apartments at intersection with Route 28, water tower
Oak Street	1.0	Single-family residential and undeveloped wooded
Service Road	0.8	Single-family residential and undeveloped wooded
Shootflying Hill Road	0.0	Residential
Total Distance, Oak Street Route	**6.1**	

Road or ROW Used	Distance (miles)	Comments and Primary Adjoining Land Uses
Oak Street Route Variant 1[b]		
Old Stage Road	0.9	Uses utility ROW #345 between Old Stage Road and Substation Site and shortens route but requires tree clearing and wetland crossing
ROW #345 and #343	1.6	Single-family residential, cemetery, commercial and apartments at intersection with Route 28, water tower
Total Distance, Oak Street Variant 1	**2.5**	

Source: COP Volume I; Epsilon 2022

ROW = right-of-way
[a] This excludes distance associated with other components of the main Shootflying Hill Road Route.
[b] This excludes distance associated with other components of the main Oak Street Route.

Construction disturbances would be temporary, lasting up to 1 year for OECR installation (excluding the June through August peak tourist season); however, the applicant would complete construction at any one location in a shorter time period (days or weeks). Substation construction would occur over a 2-year period. Overall, land disturbance during installation of the Phase 1 landfall site and onshore cable ducts, and construction of the substation(s), would have localized, short-term, and **minor** impacts on land use and coastal infrastructure due to construction-related disturbance and temporary access restrictions to either the Craigville Beach or Covell's Beach parking lot.

The onshore substation site, onshore export cables, and splice vaults would require minimal maintenance, typically completed by accessing the cables through manholes or within the fenced perimeter of the substation, with no impacts on surrounding land uses or coastal infrastructure. Excavation for repairs would be rare and have **negligible** impacts on adjacent land uses.

During decommissioning, onshore cables may be retained for other use or removed. The removal of onshore cables would be accomplished without land disturbance or excavation.

Lighting: Phase 1 construction would require periodic, temporary nighttime lighting for offshore WTG construction, cable duct installation along the OECC, and substation construction. Visibility of offshore nighttime lighting during construction would be limited to the southern coasts of Martha's Vineyard, Nantucket, and adjacent islands and would depend on vegetation, topography, and atmospheric conditions. Onshore nighttime construction would result in lighting visible from adjacent and nearby properties and roads. As a result, lighting during Phase 1 construction would have a short-term, intermittent, and **negligible** impact on land use and coastal infrastructure in the geographic analysis area due to potential impacts on the use of property with views of construction lighting.

Phase 1 operations would include the nighttime use of aviation hazard avoidance lighting on WTGs and ESPs. Lighting from Phase 1 WTGs would not be visible from mainland Massachusetts but would be visible from certain coastal locations on Martha's Vineyard and Nantucket (COP Appendix III.H-a, Section 1.2; Epsilon 2022). The applicant anticipates using ADLS, which would activate Phase 1's WTG lighting when aircraft approach the WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. As a result, WTG lighting of up to 62 WTGs included in Phase 1 would have a long-term, continuous, and **negligible** impact on land use and coastal infrastructure in the geographic analysis area due to potential impacts on property use and value.

Nighttime security lighting for the proposed substation could result in glare and nuisance for nearby residential properties. The applicant would install evergreen plantings between the proposed substation and adjacent residential properties to the west (COP Appendix III-H.a; Epsilon 2022). BOEM would also require a lighting plan as listed in EIS Appendix H to ensure that lighting is shielded and directed to eliminate glare and spillover onto adjacent properties.

The Phase 1 expansion of the West Barnstable Substation would not be adjacent to developed residential lots but would be separated from the existing homes by an undeveloped, wooded lot (300 feet wide) and the existing substation site (300 feet wide, with no vegetative screening). Additional substation lighting impacts on land use would be minimal due to the distance from the residential lots to the new substation and would also be subject to a lighting plan required as mitigation (EIS Appendix H) to ensure that Phase 1-related lighting is directed downward and shielded to eliminate glare and light spillover.

Accordingly, with implementation of mitigation (EIS Appendix H), security lighting for the new substation and expansion of the West Barnstable Substation would have a long-term, continuous, and **negligible** to **minor** impact on land use due to potential impacts on the use and value of adjacent residential properties.

Decommissioning may require periodic, temporary nighttime lighting for offshore removal of the WTGs, with a short-term, intermittent, and **negligible** impact on land use and coastal infrastructure in the geographic analysis area.

Noise: Activities associated with Phase 1 construction would add incrementally to the noise and vibration typical for ports that support industrial activities and commercial shipping. These short-term impacts would not hinder use of nearby land uses or coastal infrastructure. OECR installation and substation construction would temporarily disturb neighboring residential, recreational, civic, and commercial land uses through construction noise and vibration. Construction-generated noise would have localized, short-term, and **minor** impacts on land use and coastal infrastructure.

The applicant intends to install noise attenuation shielding along the western boundary of the proposed new substation, adjacent to existing homes, or place the noise-producing equipment on the property adjacent to the existing West Barnstable Substation instead (COP Volume I; Epsilon 2022). Either option—effective noise attenuation or placement of noise-producing equipment adjacent to the West Barnstable Substation—would mitigate substation noise during operations for the residences to the west. The undeveloped property to the east is owned by the Barnstable Chamber of Commerce and as such may be developed for uses that are less noise-sensitive than residences. Nevertheless, given the residential use permitted by the underlying zoning, noise attenuation at the substation site along the eastern boundary would prevent substation noise from discouraging potential future development and use of that land in accordance with its residential zoning designation. Accordingly, BOEM would require noise attenuation along the east and west substation boundaries unless the noise-producing equipment is placed adjacent to the West Barnstable Substation (EIS Appendix H). The site adjacent to the West Barnstable Substation is separated from existing or potential residential development by the existing substation, Route 6, and conservation or state forest lands.

Maintenance operations along the OECC would produce rare, short-term noise. Port utilization would result in incremental noise generation typical of port operations. Subject to the mitigation for substation noise, the impact on land use and coastal infrastructure resulting from Phase 1 operational noise would be long term and **negligible** to **minor**.

Decommissioning would produce increased noise in the vicinity of ports due to port utilization and related road traffic and along the OECR if cables are to be removed, with short-term and **minor** impacts on land use and coastal infrastructure.

Port utilization: Land use and coastal infrastructure impacted by construction of offshore components would include the port facilities used for shipping, storing, and fabricating Alternative B components and the adjacent and nearby land uses. Alternative B includes no port expansion activities but would use ports that have expanded or will expand to support the wind energy industry. As described in Section G.2.7.1, potential ports are identified in Massachusetts, Connecticut, Rhode Island, New Jersey, and New York.

Ports in Canada may also be used but are outside of BOEM's jurisdiction; thus, the impacts are not evaluated. Port facilities have varying land use contexts and constraints and are designated by local zoning and land use plans for industrial or marine activity. While port facilities are typically adjacent to other industrial or commercial land uses or major transportation corridors, some are also close to residential neighborhoods.

Phase 1 may increase the level of port activity above the levels typically experienced at a particular facility, resulting in localized, short-term marine traffic congestion and scarcity of port facilities (i.e., docks, laydown areas, and storage). These short-term impacts would not hinder use of the ports, nearby land uses, or other coastal infrastructure. Overall, the construction of offshore components for Phase 1 would have **minor** beneficial impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

Operations facilities needed for Phase 1 would include offices, a control room, training space, and warehouse space, in addition to piers for CTVs and larger vessels such as service operation vessels (SOV). The applicant plans to establish a long-term SOV operations base in Bridgeport, Connecticut, with related warehousing and a control room located near this base. The Bridgeport property selected for the operations base is a 3-acre portion of an 18-acre waterfront parcel zoned by the City of Bridgeport for industrial and mixed use (COP Volume III; Epsilon 2022; City of Bridgeport 2018). The 18-acre waterfront parcel, currently vacant and without port infrastructure, is planned for improvements to serve as a staging facility for offshore wind construction (Durakovic 2021). The city's comprehensive plan calls for leveraging the economic value of the waterfront and encouraging development of brownfields and other underutilized or vacant industrial properties (City of Bridgeport 2019).

The applicant may operate CTVs or the SOV daughter craft out of Vineyard Haven on Martha's Vineyard or Greenport Harbor on Long Island, existing ports that support commercial, ferry, fishing, and recreational vessel traffic. Other ports listed in Table 2.1-4 could also be used to support operations activities. An existing port identified in Table 2.1-4 may be needed as an operations base on an interim basis if the facilities in Bridgeport are not available by the start of Phase 1 operations.

Overall, operations for Phase 1 would have **minor** beneficial impacts on land use and coastal infrastructure by supporting the economic development objectives of the Bridgeport comprehensive plan, the plan's designated land uses, and planned infrastructure improvements at ports.

Decommissioning would result in short-term use of port facilities that provide docking and storage facilities, with short-term, beneficial impacts. Upon completion of decommissioning, the impact of port utilization for operations would be reversed.

Presence of structures: Phase 1 WTGs could be visible from southern coasts of Martha's Vineyard, Nantucket, and nearby adjacent islands, depending on vegetation, topography, and atmospheric conditions (COP Appendix III.H-a, Section 1.2; Epsilon 2022). All of the 50 to 62 WTGs in Phase 1 would be more than 20 miles from coastal viewers, and the WTGs would not dominate offshore views. Phase 1 WTGs would have a long-term, continuous, and **negligible** impact on land use and coastal infrastructure in the geographic analysis area due to views of WTGs and the potential impacts on property use and value.

The Phase 1 proposed cable landfall site, cable route, and substation would be within the Town of Barnstable. From the surface, the only visible components of the cable system would be the manhole covers and substations (COP Volume I; Epsilon 2022). The cable route would follow roads and transmission line ROWs and would not displace or change any existing land uses.

The proposed new substation site consists of two lots containing a vacant motel (to be removed) and undeveloped, wooded land. The site is zoned for residential use, and its use would result in a negligible reduction in the available residential land within the Town of Barnstable. The applicant intends to provide an evergreen landscaped screen along the northern boundary (along Shootflying Hill Road) and a landscaped screen along the western boundary adjacent to existing homes (COP Volume I; Epsilon 2022). Phase 1 provides no screening along the transmission line ROW to the south or undeveloped, wooded lots to the east.

The land to the east is currently undeveloped, wooded, and owned by the Barnstable Chamber of Commerce. Lack of screening at the substation site may reduce value and discourage potential future development and use of the land for Chamber of Commerce purposes or for the residential development allowed by the zoning designation. Accordingly, BOEM would require that landscape screening be provided along the east and west substation boundaries to separate and buffer the adjoining properties from the substation use (EIS Appendix H).

The possible substation site adjacent to the West Barnstable Substation is separated from existing or potential residential development by the existing substation and Route 6. The Barnstable State Forest, 500 feet east, separates the site from other nearby residential areas.

The presence of the Phase 1 onshore transmission cable infrastructure would have no impacts on land use; the cable conduits would be underground and located within the existing ROW. With implementation of vegetative screening on the new substation property along the eastern and western boundaries (EIS Appendix H), the new and expanded substations would not discourage residential use or development. Subject to these mitigation and monitoring measures, Phase 1 impacts on land use would be long term and **negligible** to **minor**.

Upon completion of decommissioning, the Phase 1 WTGs would no longer be visible from coastlines, reversing the **negligible** impacts attributable to the views of WTGs. Onshore substations may be removed or continue in use as part of the regional electrical infrastructure.

Traffic: Use of ports for Phase 1 construction would add incrementally to the road traffic volume typically generated by ports that support industrial activity and commercial shipping. Construction may require oversized truck loads for movement of large components from supply sources to ports. Large truck movements, especially oversized loads, would produce temporary traffic delays and congestion.

The Phase 1 OECR would be installed in an underground duct bank within existing road or transmission line ROWs, resulting in construction work zones and possibly temporary lane closures along the roads listed in Table G.2.7-4. Prior to construction, the applicant would work with the Town of Barnstable to develop a TMP to be submitted for review and approval by appropriate municipal authorities (typically department of public works/town engineer and police) (COP Volume III; Epsilon 2022). In addition, BOEM is evaluating the following mitigation and monitoring measure to address impacts on land use and coastal infrastructure, as described in detail in Table H-2 of EIS Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Restore and repave of all disturbed surfaces;
- Develop and implement of TMPs in coordination with county and municipal governments;
- Public outreach as established in the TMPs to notify residents and business owners of schedules, vehicular access, and traffic movement impacts of construction;
- Schedule construction to avoid tourist seasons for coastal and beach locations with a summer tourism season; and
- Use existing road and utility ROWs for cable routes.

Any unanticipated change in construction location, timing, or method would result in revision of the TMP before construction changes are implemented. The applicant would use various methods of public outreach to keep residents, business owners, officials, and other stakeholders updated on the schedules, vehicular access, and other details related to traffic movement during construction. Construction disturbances would last up to 1 year for OECR installation (excluding the June through August peak tourist season); however, the applicant would complete construction at any one location along a public road in a shorter time period (days or weeks).

Given the incremental addition to existing road traffic in the vicinity of ports and the applicant's commitment to develop a TMP in coordination with municipal authorities for OECR installation, construction-generated traffic and road disturbance would have localized, short-term, and **minor** impacts on land use and coastal infrastructure.

Road traffic during Phase 1 operations would be generated by worker commute trips and as-needed truck transportation of components or supplies to ports. Access roads to the planned operations base in Bridgeport, Connecticut, would be most affected by proposed Project-related traffic. Access roads to Vineyard Haven and New Bedford Harbor may also support a portion of the traffic from Phase 1. While road traffic estimates are not available, the applicant estimates that Phase 1 operations would generate approximately 250 vessel round trips annually (EIS Section 3.13, Navigation and Vessel Traffic). The road traffic generated by crew and supplies traveling to the ports for these marine trips would only incrementally increase the traffic generated by the existing ports and surrounding marine, industrial, and commercial land uses. Occasional repairs or maintenance along the OECR could briefly disrupt road traffic. The increase in or occasional disruption to road traffic during operations would have a long-term, localized, and **negligible** to **minor** impact on land use and coastal infrastructure.

Decommissioning would result in impacts on road traffic as traffic increases to the port facilities that provide support facilities, with short-term and **minor** impacts on land use and coastal infrastructure, similar to impacts during construction.

Impacts of Phase 2

The land use and coastal infrastructure impacts of Phase 2 construction, operations, and decommissioning (with or without the SCV) would be similar to those described for Phase 1 for IPFs related to accidental releases, lighting, noise, port utilization, and traffic. While Phase 2 would involve more WTGs and ESPs and a different OECR in Barnstable, the incremental differences in activity between Phase 2 and Phase 1, as well as the combined effect of Phase 1 and Phase 2 together would not change any of the impact magnitudes described for Phase 1 construction, except as discussed below.

If the applicant includes the SCV as part of the final proposed Project design, BOEM would provide a more detailed analysis of the SCV and the Phase 2 OECC impacts on land use and coastal infrastructure in a supplemental NEPA analysis. The SCV could be proposed either as an alternative to or in addition to the Phase 2 OECR through Barnstable County.

Land disturbance: For the Phase 2 OECR within Barnstable County, the potential landfall site at Dowses Beach would temporarily disrupt the paved beach parking area, while the potential landfall site at the end of Wianno Avenue would disrupt a road stub that may also be used for parking. Onshore installation and construction of the OECR would temporarily disturb neighboring land uses and reduce beach or waterfront parking and activities. The applicant's planned use of the West Barnstable Substation for interconnection would limit the need for additional land disturbance for substation construction; however, an expanded or additional substation site in Barnstable County may be needed. Overall, construction of Phase 2's Barnstable County landfall site and OECR would have localized, short-term, and **minor** impacts on land use and coastal infrastructure due to construction-related land disturbance.

Construction of the SCV would have short-term land disturbance impacts in Bristol County similar to those described for the Phase 1 and Phase 2 OECR in Barnstable County. Potential impacts would depend upon the landfall site, cable route, and substation locations. If the SCV is selected, a detailed impacts analysis would be provided in a subsequent filing.

During operations, the land disturbance impacts of the Phase 2 OECR within Barnstable County and Bristol County (if the SCV is selected) would be similar to those of Phase 1, with **negligible** impacts on land use and coastal infrastructure.

During decommissioning, removal of onshore cables would be accomplished without land disturbance or excavation.

Presence of structures: The Phase 2 WTGs (up to 88 WTGs) would be further from the coastline than Phase 1 WTGs. Phase 2 would have a long-term, continuous, and **negligible** impact on land use and coastal infrastructure in the geographic analysis area due to views of WTGs and the potential impacts on property use and value.

The Phase 2 OECR within Barnstable County would follow roads and transmission line ROWs and would not displace or change any existing land uses, resulting in **negligible** impacts on land use and coastal infrastructure. If a new substation is required within Barnstable County for Phase 2, the new substation could result in a **negligible** to **moderate** impact on neighboring land uses, depending on the location and design of the substation.

Upon completion of decommissioning, the impacts on land use and coastal infrastructure resulting from the Phase 2 WTGs would be reversed. Onshore substations may be removed or continue in use as part of the regional electrical infrastructure.

The SCV onshore cable route would follow roads and transmission line ROWs and require a new substation, with impacts on land use within Bristol County dependent upon substation location and screening. If the SCV is selected, a detailed impacts analysis would be provided in a subsequent filing.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of the proposed Project in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-20 would contribute to impact on land use and coastal infrastructure through the primary IPFs of land disturbance and the presence of structures. It is unlikely that onshore cables or substations from other offshore wind projects would be located close enough and constructed during the same time period to generate an overlapping land disturbance impact.

If any such overlaps occur, the cumulative impacts on land use and coastal infrastructure would be **minor**, due to occasional disturbance along onshore cable routes and at substation sites. None of these cumulative impacts would affect overall land use patterns.

Conclusions

Impacts of Alternative B. Alternative B would have **minor** impacts and **minor** beneficial impacts on land use and coastal infrastructure within the geographic analysis area based on all IPFs. The impacts of Alternative B 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 lasting a few days to weeks, and the utilization of ports, which would lead to a beneficial impact. IPFs would range from **negligible** to **moderate** (depending on the location of the Phase 2 substation site) and **minor** beneficial. This would include **minor** beneficial impacts resulting from port utilization; **minor** impacts resulting from land disturbance, noise, and traffic disruption during cable and substation installation; **minor** impacts resulting from the presence of the new substation; **minor** impacts resulting from traffic and noise in the vicinity of ports supporting construction; and **negligible** to **minor** impacts resulting from accidental releases. Phase 2 would have similar impacts, with a range of **minor** to **moderate** impacts resulting from land disturbance during construction. The SCV would require additional substations, with impacts that would depend on the location and design of these facilities.

Cumulative Impacts of Alternative B. The cumulative impacts on land use and coastal infrastructure in the geographic analysis area would be **minor** and **minor** beneficial**.** As with Alternative B alone, these cumulative impacts would not alter the overall character of land use and coastal infrastructure in the geographic analysis area. Cumulative impacts on land use and coastal infrastructure would be additive only if land disturbance associated with one or more other offshore wind project occurs in close spatial and temporal proximity. Individual IPFs would range from **negligible** to **moderate** adverse impacts and **negligible** to **minor** beneficial impacts. This includes the **minor** beneficial impacts of port utilization and **minor** adverse impacts of land disturbance, traffic, noise, and the presence of new substations. Phases 1 and 2 would contribute to the overall impact rating primarily through port-related traffic and noise and the onshore OECR and substation installation and operation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

Impacts of Alternative C – Habitat Impact Minimization Alternative on Land Use and Coastal Infrastructure

Alternatives C-1 and C-2 would not alter the impacts of Phase 1 or Phase 2 on land use and coastal infrastructure. The WTG and offshore cable routing alterations for Alternative B would not change the discussion and conclusions above regarding the IPFs relevant to land use and coastal infrastructure. Therefore, the impacts of Alternatives C-1 and C-2 would be the same as those of Alternative B.

G.3 References

Ainley, D.G., E. Porzig, D. Zajanc, and L.B. Spear. 2015. "Seabird flight behavior in response to altered wind strength and direction." Marine Ornithology 43:25-36.

Arnett, E.B., K. Brown, W.P. Erickson, J. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Kolford, C.P. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersley, Jr. 2008. "Patterns of Bat Fatalities at Wind Energy Facilities in North America." Journal of Wildlife Management, Vol. 72:61–78.

Baerwald, E.F., and R.M.R. Barclay. 2009. "Geographic Variation in Activity and Fatality of Migratory Bats at Wind Energy Facilities." Journal of Mammalogy, Vol. 90:1341–1349. Accessed: March 16, 2022. Retrieved from: https://academic.oup.com/jmammal/article/90/6/1341/898849.

Band, B. 2012. Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Windfarms. Report to the Crown Estate Strategic Ornithological Support Services (SOSS), SOSS-02. Accessed: April 15, 2022. Retrieved from: https://www.bto.org/sites/default/files/u28/downloads/Projects/Final_Report_SOSS02_Band1ModelGuidance.pdf

Barnstable County. 2022. "Dredge Facts." Accessed: June 17, 2022. Retrieved from: https://www.capecod.gov/departments/dredge-program/dredge-facts/

Bartol, S.M. 1999. "Auditory Evoked Potentials of the Loggerhead Sea Turtle (*Caretta caretta*)." Master's Thesis, College of William and Mary–Virginia Institute of Marine Science. Accessed: February 24, 2022. Retrieved from: https://scholarworks.wm.edu/cgi/viewcontent.cgi?article=2805&context=etd

Baulch, S., and C. Perry. 2014. "Evaluating the Impacts of Marine Debris on Cetaceans." *Marine Pollution Bulletin* 80:210–221.

Bejarano, A.C., J. Michel, J. Rowe, Z. Li, D. French McCay, L. McStay, and D.S. Etkin. 2013. *Environmental Risks, Fate and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf.* U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213.

Bembenek-Bailey, S.A., J.N. Niemuth, P.D. McClellan-Green, M.H. Godfrey, C.A. Harms, H. Gracz, and M.K. Stoskopf. 2019. "NMR Metabolomics Analysis of Skeletal Muscle, Heart, and Liver of Hatchling Loggerhead Sea Turtles (*Caretta caretta*) Experimentally Exposed to Crude Oil and/or Corexit." *Metabolites*, 9(2):21. Accessed February 24, 2022. Retrieved from: https://doi.org/10.3390/metabo9020021

Berreiros, J.P., and V.S. Raykov. 2014. "Lethal Lesions and Amputation Caused by Plastic Debris and Fishing Gear on the Loggerhead Turtle *Caretta caretta* (Linnaeus, 1758). Three case reports from Terceira Island, Azores (NE Atlantic)." *Marine Pollution Bulletin* 86:518-522.

Blehart, D.S., A.C. Hicks, M. Behr, C.U. Meteyer, B.M. Berlowski-Zier, E.L. Buckles, J.T.H. Coleman, S.R. Darling, A. Gargas, R. Niver, J.C. Okoniewski, R.J. Judd, and W.B. Stone. 2009. "Bat White-Nose Syndrome: An Emerging Fungal Pathogen?" Science 323: 227. Accessed: March 16, 2022. Retrieved from: https://www.science.org/doi/10.1126/science.1163874

Blodget, B.C. 2002. Bird list for the commonwealth of Massachussetts. Massachussetts Div Fish Wildlife. Accessed: April 15, 2022. Retrieved from: https://www.mass.gov/doc/bird-list/download

BOEM (Bureau of Ocean Energy Management). Undated. "Renewable Energy Research." Accessed: April 15, 2022. Retrieved from: https://www.boem.gov/environment/environmental-studies/renewable-energy-research-ongoing-studies

BOEM (Bureau of Ocean Energy Management). 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Environmental Assessment. OCS EIS/EA BOEM 2012-087. Accessed: April 15, 2022. Retrieved from: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/2012/BOEM-2012-087.pdf

BOEM (Bureau of Ocean Energy Management). 2014. Atlantic OCS Proposed Geological and Geophysical Activities: Final Programmatic Environmental Impact Statement. Mid-Atlantic and South Atlantic Planning Areas. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2014-001. February 2014. Accessed: April 15, 2022. Retrieved from: https://www.boem.gov/oil-gas-energy/atlantic-geological-and-geophysical-gg-activities-programmatic-environmental-impact

BOEM (Bureau of Ocean Energy Management). 2015. Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia: Revised Environmental Assessment. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2015-031. Accessed: March 16, 2022. Retrieved from: https://www.boem.gov/sites/default/files/renewable%1eenergy%1eprogram/State%1eActivities/VA/VOWTAP%1eEA.pdf%20

BOEM (Bureau of Ocean Energy Management). 2019. National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study BOEM 2019- 036. May 2019. Accessed: March 16, 2022. Retrieved from: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf

BOEM (Bureau of Ocean Energy Management). 2019b. Draft Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development. October 2019.

BOEM (Bureau of Ocean Energy Management). 2019c. *Vineyard Wind Offshore Wind Energy Project Biological Assessment.* For the U.S. Fish and Wildlife Service.

BOEM (Bureau of Ocean Energy Management). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement Volume II*. OCS EIS/EA BOEM 2021-0012. 642 pp. Accessed: March 7, 2022. Retrieved from: https://www.boem.gov/vineyard-wind

BOEM (Bureau of Ocean Energy Management). 2021b. *Hydrodynamic Modeling, Particle Tracking and Agent-Based Modeling of Larvae in the U.S. Mid-Atlantic Bight*. OCS Study BOEM 2021-0049. 232 pp. Accessed: May 23, 2022. Retrieved from: https://espis.boem.gov/final%20reports/BOEM_2021-049.pdf

BOEM (Bureau of Ocean Energy Management). 2022a. *New England Wind Project Biological Assessment.* For the National Marine Fisheries Service. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs.

BOEM (Bureau of Ocean Energy Management). 2022b. *New England Wind Project Biological Assessment.* For the U.S. Fish and Wildlife Service.

BOEM (Bureau of Ocean Energy Management). 2022c. *Supporting National Environmental Policy Act Documentation for Offshore Wind Energy Development Related to High Voltage Direct Current Cooling Systems*. OCS Study BOEM 2022-023. Accessed: August 24, 2022. Retrieved from: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/HVDC%20Cooling%20Systems%20White%20Paper.pdf

Brabant, R, Y. Laurent, B. Jonge Poerink, and S. Degraer. 2021."The Relation between Migratory Activity of *Pipistrellus* Bats at Sea and Weather Conditions Offers Possibilities to Reduce Offshore Wind Farm Effects." *Animals* 2021, 11, 3457. doi.org/10.3390/ani11123457. Accessed: June 22, 2022. Retrieved from: https://www.mdpi.com/2076-2615/11/12/3457

Brack, V., Jr., and J.O. Whitaker, Jr. 2001. "Foods of the Northern Myotis, *Myotis septentrionalis*, from Missouri and Indiana, with Notes on Foraging." *Acta Chiropterologica* 3, no. 2: 203-210.

Briggs, K.T., M.E. Gershwin, and D.W. Anderson. 1997. "Consequences of petrochemical ingestion and stress on the immune system of seabirds." *ICES Journal of Marine Science* 54:718-725.

Broders, H.G., G.J. Forbes, S. Woodley, and I.D. Thompson. 2006. "Range Extent and Stand Selection for Roosting and Foraging in Forest-Dwelling Northern Long-eared Bats and Little Brown Bats in the Greater Fundy Ecosystem, New Brunswick." Journal of Wildlife Management 70, no. 5: 1174-1184.

Browne, M.A., A.J. Underwood, M.G. Chapman, R. Williams, R.C. Thompson, and J.A. van Franeker. 2015. "Linking Effects of Anthropogenic Debris to Ecological Impacts." *Proceedings of the Royal Society B,* Vol. 282: 20142929.

Bugoni, L., L. Krause, and M.V. Petry. 2001. "Marine Debris and Human Impacts on Sea Turtles in Southern Brazil." *Marine Pollution Bulletin* 42(12):1330-1334.

Buonocore, J.J., K.F. Lambert, D. Burtraw, S. Sekar, and C.T. Driscoll. 2016. "Correction: An Analysis of Costs and Health Co-Benefits for a U.S. Power Plant Carbon Standard." *PLOS ONE* 11(6): e0158792. Accessed: March 15, 2022. Retrieved from: https://doi.org/10.1371/journal.pone.0158792

Burge, C.A., C.M. Eakin, C.S. Friedman, B. Froelich, P.K. Hershberger, E.E. Hofmann, L.E. Petes, K.C. Prager, E. Weil, B.L. Willis, S.E. Ford, and C.D. Harvell. 2014. "Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society." *Annual Review of Marine Science* 6:249-277.

Buzzards Bay Coalition. 2021. "Bay Health New Bedford Harbor." Accessed: May 23, 2022. Retrieved from: https://www.savebuzzardsbay.org/bay-health/waterway/new-bedford-harbor/

Camacho, M., O.P. Luzardo, L.D. Boada, L.F.L. Jurado, M. Medina, M. Zumbado, and J. Orós. 2013. "Potential Adverse Health Effects of Persistent Organic Pollutants on Sea Turtles: Evidence from a Cross-Sectional Study on Cape Verde Loggerhead Sea Turtles." *Science of the Total Environment* 458-460:283-289.

CapeCod.com. 2019. "New Dredge Coming to Barnstable County." June 28, 2019. Accessed: July 13, 2022. Retrieved from: https://www.capecod.com/newscenter/new-dredge-coming-to-barnstable-county/

Cape Cod Commission. 2013. Cape Cod Rail Trail Extension Yarmouth/Barnstable. Presentation, Barnstable and Yarmouth Public Meetings. Accessed: February 14, 2022. Retrieved from: https://capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/transportation/CapeCodRailTrailExtension_%20PublicMeeting021213.pdf

Cape Cod Commission. 2021. *Cape Cod Regional Policy Plan*. December 2018; amended effective March 30, 2021. Accessed: January 2022. Retrieved from: https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/RPP/2018_Cape_Cod_Regional_Policy_Plan_for_web.pdf

Causon, P.D., and A.B. Gill. 2018. "Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms." Environmental Science and Policy 89: 340-347.

Center for Coastal Studies. 2020. Water quality monitoring data file. Accessed: December 15, 2021. Retrieved from: http://www.capecodbay-monitor.org/

Choi, D.Y., T.W. Wittig, and B.M. Kluever. 2020. "An Evaluation of Bird and Bat Mortality at Wind Turbines in the Northeastern United States." PLoS ON*E*, Vol. 15(8): e0238034. Accessed: March 16, 2022. Retrieved from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0238034

City of Bridgeport. 2017. *Waterfront Bridgeport: Waterfront Master Plan*. Accessed: January 2022. Retrieved from: https://www.bridgeportct.gov/filestorage/341650/341652/346105/342427/20170221_Waterfront_Bridgeport_Plan_combined_report_med.pdf

City of Bridgeport. 2018. *City of Bridgeport: Zoning Map*. Accessed: January 14, 2022. Retrieved from: https://www.bridgeportct.gov/filestorage/341650/341652/345965/343658/Zoning_Map.pdf

City of Bridgeport. 2019. *Plan Bridgeport*. Produced by Fitzgerald and Halliday, Inc. Accessed: January 28, 2022. Retrieved from: http://planbridgeport.com/documents/plan.pdf

City of Salem. 2021. Vineyard Wind Partnership for Salem Harbor Port. September 30, 2021. Accessed: January 28, 2022. Retrieved from: https://www.salem.com/home/news/vineyard-wind-partnership-salem-harbor-port

Claisse, J.T., D.J. Pondella II, M. Love, L.A. Zahn, C.M. Williams, J.P. Williams, and A.S. Bull. 2014. "Oil Platforms Off California are among the Most Productive Marine Fish Habitats Globally." *Proceedings of the National Academy of Sciences of the United States of America* 111(43):15462-15467. Accessed: April 16, 2022. Retrieved from: https://www.pnas.org/doi/pdf/10.1073/pnas.1411477111

Commonwealth of Massachusetts. 2016. *Pitch Pine-Oak Forest Woodland*. Division of Fisheries & Wildlife, Natural Heritage & Endangered Species Program. Accessed: January 25, 2022. Retrieved from: https://web.archive.org/web/20180714110520/https://www.mass.gov/files/documents/2016/08/uw/pitch-pine-oak-forest-woodland-fs.pdf

Commonwealth of Massachusetts. 2022. "Rare Species Viewer." Accessed: January 25, 2022. Retrieved from: https://www.mass.gov/info-details/rare-species-viewer

Cook, A.S.C.P., and N.H.K. Burton. 2010. *A Review of Potential Impacts of Marine Aggregate Extraction on Seabirds.* Marine Environment Protection Fund Project 09/P130. Accessed: April 15, 2022. Retrieved from: https://www.bto.org/sites/default/files/shared_documents/publications/research-reports/2010/rr563.pdf

Cryan, P.M. 2008. "Mating Behavior as a Possible Cause of Bat Fatalities at Wind Turbines." Journal of Wildlife Management, Vol. 72(3):845–849; 2008). Accessed: March 16, 2022. Retrieved from: https://bioone.org/journals/journal-of-wildlife-management/volume-72/issue-3/2007-371/Mating-Behavior-as-a-Possible-Cause-of-Bat-Fatalities-at/10.2193/2007-371.short

Cryan, P.M., and R.M.R. Barclay. 2009. "Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions." Journal of Mammalogy 90:1330-1340.

Cryan P.M., M. Gorresen, C.D. Hein, M.R. Schirmacher, R.H. Diehld, M.M. Husoe, D.T.S. Hayman, P.D. Fricker, F.J. Bonaccorso, D.H. Johnson, K. Heist, and D.C. Dalton. 2014. "Behavior of Bats at Wind Turbines." Proceedings of the National Academy of Sciences. 11(42): 15126-15131.

CSA Ocean Sciences Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England.* Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-049. Accessed: January 25, 2022. Retrieved from: https://espis.boem.gov/final%20reports/BOEM_2019-049.pdf

Curtice, C., J. Cleary, E. Shumchenia, and P. Halpin. 2019. Marine-Life Data and Analysis Team (MDAT) Technical Report on the Methods and Development of Marine-Life Data to Support Regional Ocean Planning and Management. Prepared on behalf of the Marine-life Data and Analysis Team (MDAT). Accessed: April 15, 2022. Retrieved from: https://seamap.env.duke.edu/models/mdat/MDAT-Technical-Report.pdf

DeGraaf, R., and M. Yamasaki. 2001. *New England Wildlife: Habitat, Natural History, and Distribution*. Hanover, NH: University Press of New England.

Degraer, S., R. Brabant, B. Rumes, and L. Vigin, 2019. *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Marking a Decade of Monitoring, Research, and Innovation*. Brussels: Royal Belgian Institute of Natural Sciences, 134 pp. Accessed: July 12, 2022. Retrieved from: https://tethys.pnnl.gov/publications/environmental-impacts-offshore-wind-farms-belgian-part-north-sea-marking-decade

Desholm, M. 2006. *Wind Farm Related Mortality Among Avian Migrants—a Remote Sensing Study and Model Analysis.* PhD thesis. Dept. of Wildlife Ecology and Biodiversity, NERI, and Dept. of Population Biology, University of Copenhagen. National Environmental Research Institute, Denmark. 128 pp.

Desholm, M., and J. Kahlert. 2005. "Avian Collision Risk at an Offshore Wind Farm." Biology Letters 1, no. 3: 296–298. doi:10.1098/rsbl.2005.0336

Dierschke, V., R.W. Furness, and S. Garthe. 2016. "Seabirds and Offshore Wind Farms in European Waters: Avoidance and Attraction." Biological Conservation 202:59-68.

Dolbeer, R.A., M.J. Begier, P.R. Miller, J.R. Weller, and A.L. Anderson. 2019. *Wildlife Strikes to Civil Aircraft in the United States, 1990–2018.* Federal Aviation Administration National Wildlife Strike Database Serial Report Number 25. 95 pp. + Appendices.

Donovan, C. 2017. *Stochastic Band CRM–GUI User Manual (Draft V1.0).* Marine Scotland. 25 pp. Accessed: April 15, 2022. Retrieved from: https://www2.gov.scot/Resource/0053/00535991.pdf

Dowling, Z., P.R. Sievert, E. Baldwin, L. Johnson, S. von Oettingen, and J. Reichard. 2017. *Flight Activity and Offshore Movements of Nano-Tagged Bats on Martha's Vineyard, MA*. U.S. Department of the Interior, BOEM, Office of Renewable Energy Programs, Sterling, Virginia. OCS Study BOEM 2017-054. Accessed: March 16, 2022. Retrieved from: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/Flight-Activity-and-Offshore-Movements-of-Nano-Tagged-Bats-on-Martha%27s-Vineyard%2C-MA.pdf

Drewitt, Allan L., and Rowena H.W. Langston. 2006. "Assessing the Impacts of Wind Farms on Birds." Ibis 148: 29-42. Retrieved from: https://doi.org/10.1111/j.1474-919X.2006.00516.x

Durakovic, A. 2021. Park City Wind Homeports in Connecticut. offshoreWIND.biz. Accessed: January 14, 2022. Retrieved from: https://www.offshorewind.biz/2021/05/20/park-city-wind-homeports-in-connecticut/

eBird. 2022. "An Online Database of Bird Distribution and Abundance." The Cornell Lab of Ornithology. Accessed: April 15, 2022. Retrieved from: https://ebird.org/home

Efroymson, R.A., W. Hodge Rose, S. Nemth, and G.W. Suter II. 2000. *Ecological Risk Assessment Framework for Low Altitude Overflights by Fixed-Wing and Rotary-Wing Military Aircraft.* Research sponsored by Strategic Environmental Research and Development Program of the U.S. Department of Defense under Interagency Agreement 2107-N218-S1. Publication No. 5010, Environmental Sciences Division, ORNL.

English, P.A., T.I. Mason, J.T. Backstrom, B.J. Tibbles, A.A. Mackay, M.J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-026.

Epsilon (Epsilon Associates, Inc.). 2022. *Draft New England Wind Construction and Operations Plan for Lease Area OCS-A 0534*. New England Wind Project. Accessed: October 2022. Retrieved from: https://www.boem.gov/renewable-energy/state-activities/new-england-wind-formerly-vineyard-wind-south

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, Jr., K.J. Sernka, R.E. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. *Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments*. Bonneville Power Administration, Portland, Oregon, USA.

Erickson, W.P., M.M. Wolfe, K.J. Bay, D.H. Johnson, and J.L. Gehring. 2014. "A Comprehensive Analysis of Small-passerine Fatalities from Collision with Turbines at Wind Energy Facilities." PLoS ONE 9(9): e107491.

ESS Group, Inc. 2014. Cape Wind Avian and Bat Pre-Construction Monitoring Report: 2013-2014. Unpublished Report to Cape Wind Associates.

Fabrizio, M.C., J.P. Manderson, and J.P. Pessutti. 2014. "Home Range and Seasonal Movements of Black Sea Bass (Centropristis striata) During their Inshore Residency at a Reef in the Mid-Atlantic Bight." *Fishery Bulletin* 112:82–97. doi: 10.7755/FB.112.1.5.

Fiedler, J.K. 2004. "Assessment of Bat Mortality and Activity at Buffalo Mountain Windfarm, Eastern Tennessee." Master's Thesis, University of Tennessee, 2004. Accessed: March 16, 2022. Retrieved from: https://trace.tennessee.edu/cgi/viewcontent.cgi?article=3488&context=utk_gradthes

Fox, A.D., M. Desholm, J. Kahlert, T. Kjaer Christensen, and I.K. Peterson. 2006. "Information Needs to Support Environmental Impact Assessment of the Effects of European Marine Offshore Wind Farms on Birds." Ibis 148: 129-144.

Frady, T., and E. Mecray. 2004. "Invasive Sea Squirt Alive and Well on Georges Bank." NOAA NMFS Northeast Fisheries Science Center. Accessed: April 16, 2022. Retrieved from: https://web.archive.org/web/20170521042859/https://www.nefsc.noaa.gov/press_release/2004/news04.19.pdf

Friggens, Megan M., Mary I. Williams, Karen E. Bagne, Tosha T. Wixom, and Samuel A. Cushman. 2018. "Chapter 9: Effects of Climate Change on Terrestrial Animals." Climate Change Vulnerability and Adaptation in the Intermountain Region. USDA Forest Service RMRS-GTR-375.

Furness, B. and H. Wade. 2012. *Vulnerability of Scottish seabirds to offshore wind turbines*. Marine Scotland Report. Accessed: April 15, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/Furness%20and%20Wade%202012.pdf

Furness, R.W., H.M. Wade, and E. Masden. 2013. "Assessing vulnerability of marine bird populations to offshore wind farms." *Journal of Environmental Management* 119:56–66.

Furness, R.W., S. Garthe, M. Trinder, J. Matthiopoulos, S. Wanless, and J. Jeglinski. 2018. Nocturnal Flight Activity of Northern Gannets Morus bassanus and Implications for Modeling Collision Risk at Offshore Wind Farms, Environmental Impact Assessment Review, Volume 73, Pages 1-6. Accessed: April 15, 2022. Retrieved from: https://doi.org/10.1016/j.eiar.2018.06.006

Gall, S.C., and R.C. Thompson. 2015. "The Impact of Marine Debris on Marine Life." *Marine Pollution Bulletin* 92:170-179.

Gargas, A., M.T. Trest, M. Christensen, T.J. Volk, and D.S. Blehert. 2009. "*Geomyces destructans* sp. nov. Associated with Bat White-Nose Syndrome." *Mycotaxon* 108: 147-154.

Garthe, S., and O. Hűppop. 2004. "Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index." *Journal of Applied Ecology*, 41, 724–734.

GE (GE Renewable Energy). 2019. Press Release: GE Renewable Energy unveils the first Haliade-X 12 MW, the world's most powerful offshore wind turbine. Accessed: April 15, 2022. Retrieved from: https://www.ge.com/news/press-releases/ge-renewable-energy-unveils-first-haliade-x-12-mw-worlds-most-powerful-offshore-wind

Gibbons, S. 2015. "Gone with the Wind: Valuing the Visual Impacts of Wind Turbines through House Prices." *Journal of Environmental Economics and Management*, Vol. 72, 177-196. Accessed: January 14, 2022. Retrieved from: http://eprints.lse.ac.uk/62880/1/__lse.ac.uk_storage_LIBRARY_Secondary_libfile_shared_repository_Content_Gibbons,%20S_Gone%20with%20wind_Gibbons_Gone%20with%20wind_2015.pdf

Gill, A.B., I. Gloyne-Phillips, K.J. Neal, and J.A. Kimber. 2005. *The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms–A Review*. Collaborative Offshore Wind Research into the Environment (COWRIE), Ltd, UK. COWRIE-EM FIELD 2-06-2004. Accessed: February 20, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/The_Potential_Effects_of_Electromagnetic_Fields_Generated_by_Sub_Sea_Power_Cables.pdf

GMI (Geo-Marine, Inc.). 2010. *Ocean/Wind Power Ecological Baseline Studies: January 2008 - December 2009*. Final Report prepared for the New Jersey Department of Environmental Protection, Office of Science, Trenton, New Jersey. 2824 pp. Accessed: April 15, 2022. Retrieved from: https://www.nj.gov/dep/dsr/ocean-wind/

Goodale, M.W., and A. Millman. 2016. "Cumulative Adverse Effects of Offshore Wind Energy Development on Wildlife." Journal of Environmental Planning and Management 59, no. 1: 1-29. doi: 10.1080/09640568.2014.973483.

Goyert, H.F., B. Gardner, R. Sollmann, R.R. Veit, A.T. Gilbert, E.E. Connelly, and K.A. Williams. 2016. "Predicting the Offshore Distribution and Abundance of Marine Birds with a Hierarchical Community Distance Sampling Model." Ecological Applications 26, 1797–1815. Accessed: April 15, 2022. Retrieved from: https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/15-1955.1

Greene, J, M. Anderson, J. Odell, and N. Steinberg. 2010. *The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One.* Boston, MA: The Nature Conservancy, Eastern U.S. Division. Accessed: January 25, 2020. Retrieved from: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/namera-phase1-fullreport.pdf

Gregory, M.R. 2009. "Environmental Implications of Plastic Debris in Marine Setting –Entanglement, Ingestion, Smothering, Hangers-on, Hitch-hiking, and Alien Invasion." *Philosophical Transactions of the Royal Society B* 364:2013-2025.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas.* Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. 312 p. Accessed: January 25, 2022. Retrieved from: https://espis.boem.gov/final%20reports/5647.pdf

Gulf of Maine Census. 2018. Gulf of Maine Currents. Accessed: February 14, 2022.

Hamilton, R.M. 2012. "Spatial and Temporal Activity of Migratory Bats at Landscape Features." Electronic Thesis and Dissertation Repository. 886.

Haney, J.C., P.G.R. Jodice, W.A. Montevecchi, and D.C. Evers. 2017. "Challenges to oil spill assessments for seabirds in the deep ocean." *Archives of Environmental Contamination and Toxicology* 73:33-39. G.1,

Hann, Z.A., M.J. Hosler, and P.R. Mooseman, Jr. 2017. "Roosting Habits of Two *Lasiurus borealis* (eastern red bat) in the Blue Ridge Mountains of Virginia." Northeastern Naturalist Vol. 24 (2): N15-N18.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kircheis, J.F. Kocik, S. M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Marancik, and C.A. Griswold. 2016. "A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf." *PLoS ONE* 11(2):e0146756. Accessed: January 27, 2022. Retrieved from: https://doi.org/10.1371/journal.pone.0146756

Harris, J., R. Whitehouse, and J. Sutherland. 2011. "Marine Scour and Offshore Wind: Lessons Learnt and Future Challenges. Proceedings of the International Conference on Offshore Mechanics and Arctic Engineering" OMAE. 5. DOI: 10.1115/OMAE2011-50117.

Hatch, S.A. 2017. “Comprehensive estimates of seabird-fishery interaction for the US Northeast Atlantic and mid-Atlantic.” *Aquatic Conservation: Marine and Freshwater Ecosystems* 28(1): 182-193.

Hatch, S.K., E.E. Connelly, T.J. Divoll, I.J. Stenhouse, and K.A. Williams. 2013. “Offshore Observations of Eastern Red Bats (*Lasiurus borealis*) in the Mid-Atlantic United States Using Multiple Survey Methods.” *PLoS ONE*, Vol. 8(12): e83803.

Hawkins, A., and A. Popper. 2017. “A Sound Approach to Assessing the Impact of Underwater Noise on Marine Fishes and Invertebrates.” *ICES Journal of Marine Science* 74(3):635-651. Accessed: January 28, 2022. Retrieved from: https://doi.org/10.1093/icesjms/fsw205

Hazel, J., I.R. Lawler, H. Marsh, and S. Robson. 2007. “Vessel Speed Increases Collision Risk for the Green Turtle *Chelonia mydas*.” *Endangered Species Research* 3:105-113.

HDR. 2019. *Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island–Year 2*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-019. Accessed: July 13, 2022. Retrieved from: https://espis.boem.gov/final%20reports/BOEM_2019-019.pdf

Henderson, L.E., and H.G. Broders. 2008. “Movements and Resource Selection of the Northern Long-eared Myotis (*Myotis septentrionalis*) in a Forest-agricultural Landscape.” Journal of Mammalogy 89(4): 952-963.

Hoarau, L., L. Ainley, C. Jean, and S. Ciccione. 2014. “Ingestion and Defecation of Marine Debris by Loggerhead Sea Turtles, from By-catches in the South-West Indian Ocean.” *Marine Pollution Bulletin* 84:90-96.

Hűppop, O., J. Dierschke, K. Exo, E. Frerich, and R. Hill. 2006. “Bird Migration and Potential Collision Risk with Offshore Wind Turbines.” *Ibis* 148: 90-109.

Hutchison, Z.L., P. Sigray, H. He, A.B. Gill, J. King, and C. Gibson. 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (Shark, Rays, and Skates) and American Lobster Movement and Migration from Direct Current Cables*. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-003. Accessed: January 28, 2022. Retrieved from: https://espis.boem.gov/final%20reports/5659.pdf

ITOPF (International Tanker Owners Pollution Federation). 2022. *Oil Tanker Spill Statistics 2021*. Accessed June 17, 2022. Retrieved from: https://www.itopf.org/fileadmin/uploads/itopf/data/Documents/Company_Lit/Oil_Spill_Stats_2021.pdf

Jensen, J.H., L. Bejder, M. Wahlberg, N. Aguilar Solo, M. Johnson, and P.T. Madsen. 2009. “Vessel Noise Effects on Delphinid Communication.” *Marine Ecology Progress Series* 395:161–175. G.1

Johnston, A., A.S.C.P. Cook, L.J. Wright, E.M. Humphreys, and N.H.K. Burton. 2014. “Modeling Flight Heights of Marine Birds to More Accurately Assess Collision Risk with Offshore Wind Turbines.” Journal of Applied Ecology 51, 31-41.

Kaplan, B. 2011. Literature Synthesis for the North and Central Atlantic Ocean. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement. Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-012. Accessed: December 15, 2021. Retrieved from: https://espis.boem.gov/final%20reports/5139.pdf

Katzenstein, W. and J. Apt. 2009. "Air Emissions Due To Wind and Solar Power." *Environmental Science and Technology*, Vol. 43, 253–258. Accessed: March 15, 2022. Retrieved from: https://docs.wind-watch.org/Katzenstein-Apt-Emissions-EST-2009-43-253.pdf

Kellar, N.M., Speakman, T.R., Smith, C.R., Lane, S.M., Balmer, B.C., Trego, M.L., Catelani, K.N., Robbins, M.N., Allen, C.D., Wells, R.S., Zolman, E.S., Rowles, T.K., and Schwacke, L.H. 2017. "Low Reproductive Success Rates of Common Bottlenose Dolphins *Tursiops truncatus* in the Northern Gulf of Mexico Following the Deepwater Horizon Disaster (2010–2015)." *Endangered Species Research* 33:1432–158. Accessed: July 13, 2022. Retrieved from: https://www.int-res.com/articles/esr2017/33/n033p143.pdf

Kempton, W., J. Firestone, J Lilley, T. Rouleau, and P. Whitaker. 2005. "The Offshore Wind Power Debate: Views from Cape Cod." *Coastal Management*, Vol. 33(2), 119-149. Accessed: March 15, 2022. Retrieved from: https://www.tandfonline.com/doi/abs/10.1080/08920750590917530

Kerckhof, F., B. Rumes, and S. Degraer. 2019. "About 'Mytilisation' and 'Slimeification': A Decade of Succession of the Fouling Assemblages on Wind Turbines off the Belgian Coast." In: *Memoirs on the Marine Environment: Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea*. S. Degraer, R. Brabant, B. Rumes, and L. Vigin, eds. 73-84. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management. Accessed: February 12, 2020. Retrieved from: https://odnature.naturalsciences.be/downloads/mumm/windfarms/winmon_report_2019_final.pdf

Kerlinger, P., J.L. Gehring, W.P. Erickson, R. Curry, A. Jain, and J. Guarnaccia. 2010. "Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America." *The Wilson Journal of Ornithology* 122 (4): 744-754.

Kerns, J., W.P. Erickson, and E.B. Arnett. 2005. "Bat and bird fatality at wind energy facilities in Pennsylvania and West Virginia." Pages 24–95 In. B. Arnett, editor. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Bat Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. A final report submitted to the Bats and Wind Energy Cooperative, pp 24–95. B. Arnett, editor. Bat Conservation International, Austin, Texas, USA. Accessed: March 16, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/Arnett_et_al_2005.pdf

Kight, C.R., and P. Swaddle. 2011. "How and Why Environmental Noise Impacts Animals: an Integrative, Mechanistic Review." *Ecology Letters*, (2011) 14: 1052–1061.

Kirchgeorg, T., I. Weinberg, M. Hornig, R. Baier, M.J. Schmid, and B. Brockmeyer. 2018. "Emissions from corrosion protection systems of offshore wind farms: Evaluation of the potential impact on the marine environment." Marine Pollution Bulletin. 136: 257-268. Accessed: June 20, 2022. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0025326X18306301

Kirschvink, J.L. 1990. "Geomagnetic Sensitivity in Cetaceans: an Update with Live,Stranding Records in the United States." In *Sensory Abilities of Cetaceans*, Edited by J. Thomas and R. Kastelein, 639-649. New York: Plenum Press. Accessed: February 20, 2022. Retrieved from: http://web.gps.caltech.edu/~jkirschvink/pdfs/Kirschvink1990_Chapter_GeomagneticSensitivityInCetace.pdf

Kite-Powell, H.L., A. Knowlton, and M. Brown. 2007. *Modeling the Effect of Vessel Speed on Right Whale Ship Strike Risk.* Unpublished Report for NOAA/NMFS Project NA04NMF47202394. Accessed: February 20, 2022. Retrieved from:

https://tethys.pnnl.gov/publications/modeling-effect-vessel-speed-right-whale-ship-strike-risk#:~:text=Vesselspeedrestrictionshavethree,theeventofacollision

Kraus, S.D., M.W. Brown, H. Caswell, C.W. Clark, M. Fujiwara, P.H. Hamilton, R.D. Kenney, A.R. Knowlton, S. Landry, C.A. Mayo, W.A. McLellan, M.J. Moore, D.P. Nowacek, D.A. Pabst, A.J. Read, and R.M. Rolland. 2005. "North Atlantic Right Whales in Crisis." *Science* 309:561–562.

Kraus, S.D., S. Leiter, K. Stone, B. Wikgren, C. Mayo, P. Hughes, R.D. Kenney, C.W. Clark, A.N. Rice, B. Estabrook, and J. Tielens. 2016. *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles. Final Report.* Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2016-054. Accessed: February 24, 2022. Retrieved from: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/Northeast-Large-Pelagic-Survey-Collaborative-Aerial-and-Acoustic-Surveys-for-Large-Whales-and-Sea-Turtles.pdf

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. "Ecological Impacts of Wind Energy Development on Bats: Questions, Research Needs, and Hypotheses." Frontiers in Ecology and the Environment 5:315–324.

Lacki, M.J., D.R. Cox, L.E. Dodd, and M.B. Dickinson. 2009. "Response of Northern Bats (*Mytois septentrionlalis*) to Prescribed Fires in Eastern Kentucky Forests." Journal of Mammalogy, Vol. 90(5): 1165-1175.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. "Collisions between Ships and Whales." *Marine Mammal Science* 17(1):35-75.

Law, K.L., S. Morét-Ferguson, N. A. Maximenko, G. Proskurowski, E.E. Peacock, J. Hafner, and C.M. Reddy. 2010. "Plastic Accumulation in the North Atlantic Subtropical Gyre." Sciencexpress 19 August 2010, 10.1126/science.1192321.

La Sorte, F.A., K.G. Horton, C. Nilsson, A.M. Dokter. 2019. Projected Changes in Assistance under Climate Change for Nocturnally Migrating Bird Populations. Global Change Biology 25: 589-601.

Leopold, M.F., E.M. Dijkman, and L. Teal. 2011. *Local Birds in and around the Offshore Wind Farm Egmond aan Zee* (OWEZ) (T-0 & T-1, 2002-2010). Report C187/11. IMARES Wageningen UR, Texel, the Netherlands. Appendices.

Leopold, M.F., R.S.A. van Bemmelen, and A.F. Zuur. 2013. *Responses of Local Birds to the Offshore Wind Farms PAWP and OWEZ off the Dutch mainland coast*. Report C151/12. IMARES Wageningen UR, Texel, the Netherlands.

Lindeboom, H.J., H.J. Kouwenhoven, M.J.N. Bergman, S. Bouma, S. Brasseur, R. Daan, R.C. Fijn, D. de Haan, S. Dirksen, R. van Hal, R. Hille Ris Lambers, R. ter Hofstede, K.L. Krijgsveld, M. Leopold, and M. Scheidat. 2011. "Short-term Ecological Effects of an Offshore Wind Farm in the Dutch Coastal Zone; a compilation." Environmental Research Letters 6: 1-13.

LMEHub. 2022. "Large Marine Ecosystems Hub: A Regional Perspective on the World's Oceans." Accessed: April 15, 2022. Retrieved from: https://www.lmehub.net/

Loring, P.H., P.W.C. Paton, J.D. McLaren, H. Bai, R. Janaswamy, H.F. Goyert, C.R. Griffin, and P.R. Sievert. 2019. *Tracking Offshore Occurrence of Common Terns, Endangered Roseate Terns, and Threatened Piping Plovers with VHF Arrays*. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-017. 140 pp. Accessed: April 15, 2022. Retrieved from: https://espis.boem.gov/final%20reports/BOEM_2019-017.pdf

Loss, S.R., T. Will, and P.P. Marra. 2013. "Estimates of Bird Collision Mortality at Wind Facilities in the Contiguous United States." Biological Conservation 168: Pages 201-209. Accessed: April 15, 2022. Retrieved from: https://doi.org/10.1016/j.biocon.2013.10.007

Luschi, P., S. Benhamou, C. Girard, S. Ciccione, D. Roos, J. Sudre, and S. Benvenuti. 2007. "Marine Turtles Use Geomagnetic Cues during Open Sea Homing." *Current Biology* 17:126-133.

Lutzeyer, S., D.J. Phaneuf, L.O. Taylor. 2017. *The Amenity Costs of Offshore Windfarms: Evidence from a Choice Experiment*. North Carolina State University, Center for Environmental and Resource Economic Policy Working Paper Series: No. 17-017. Accessed: January 14, 2022. Retrieved from: https://cenrep.ncsu.edu/cenrep/wp-content/uploads/2016/03/WP-2017-017.pdf

MacLeod, C.D. 2009. "Global Climate Change, Range Changes and Potential Implications for the Conservation of Marine Cetaceans: A Review and Synthesis." Endangered Species Research 7, no. 2: 125-136. doi: 10.3354/esr00197. G

Maggini, I., L.V. Kennedy, A. Macmillan, K.H. Elliot, K. Dean, and C.G. Guglielmo. 2017. "Light oiling of feathers increases flight energy expenditure in a migratory shorebird*." Journal of Experimental Biology* 220: 2372-2379.

Martha's Vineyard Commission. 2010. Island Plan: Charting the Future of the Vineyard. Accessed: March 21, 2022. Retrieved from: https://www.mvcommission.org/sites/default/files/docs/islandplanwebversion.pdf

MassDEP (Massachusetts Department of Environmental Protection). 2019. *Inland and Coastal Wetlands of Massachusetts.* Accessed: April 5, 2022. Retrieved from: https://www.mass.gov/doc/inland-and-coastal-wetlands-of-massachusetts-status-and-trends/download

MassDEP (Massachusetts Department of Environmental Protection). 2022. "Wetlands Loss Maps Q&A." Accessed: March 28, 2022. Retrieved from: https://www.mass.gov/guides/wetlands-loss-maps-qa#-what-is-the-purpose-of-the-wetlands-loss-project

Mass Wildlife (Massachusetts Division of Fisheries & Wildlife). 2015a. *Eastern Small-footed Bat Myotis leibii.* Natural Heritage & Endangered Species Program. Accessed: March 16, 2022. Retrieved from: https://www.mass.gov/files/documents/2016/08/vm/myotis-leibii.pdf

Mass Wildlife (Massachusetts Division of Fisheries & Wildlife). 2015b. *Little Brown Myotis lucifugus*. Natural Heritage & Endangered Species Program. Accessed: March 16, 2022. Retrieved from: https://www.mass.gov/files/documents/2016/08/qd/myotis-lucifugus.pdf

Mass Wildlife (Massachusetts Division of Fisheries & Wildlife). 2015c. *Tricolored Bat Perimyotis subflavus*. Natural Heritage & Endangered Species Program. Accessed: March 16, 2022. Retrieved from: https://www.mass.gov/files/documents/2016/08/wh/perimyotis-subflavus.pdf

Mazet, J.A.K., Gardner, I.A., Jessup, D.A., and Lowenstine, L.J. 2001. "Effects of Petroleum on Mink Applied as a Model for Reproductive Success in Sea Otters." *Journal of Wildlife Diseases* 37(4):686–692. Accessed: July 13, 2022. Retrieved from: https://www.jwildlifedis.org/doi/pdf/10.7589/0090-3558-37.4.686

McConnell, B.J., M.A. Fedak, P. Lovell, and P.S. Hammond. 1999. "Movements and Foraging Areas of Grey Seals in the North Sea." *Journal of Applied Ecology* 36:573–590. Accessed: July 13, 2022. Retrieved from: https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1046/j.1365-2664.1999.00429.x

McCreary, S., and B. Brooks. 2019. "Atlantic Large Whale Take Reduction Team Meeting: Key Outcomes Memorandum. April 23-26, 2019. Providence, Rhode Island. Accessed: February 4, 2022. Retrieved from: https://media.fisheries.noaa.gov/dam-migration/final--atlantic_large_whale_take_reduction_team_meeting_april23-26_kom_(508).pdf

McGregor, R.M., S. King, C.R. Donovan, B. Caneco, and A. Webb. 2018. *A Stochastic Collision Risk Model for Seabirds in Flight.* Marine Scotland. 59 p. Accessed: April 15, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/McGregor-2018-Stochastic.pdf

Metrocog. 2015. *Reconnect Region: A Comprehensive Plan for the Metrocog Region*. Connecticut Metropolitan Council of Governments. Accessed: January 14, 2022. Retrieved from: https://metrocog-website.s3.us-east-2.amazonaws.com/GBRC-Draft-Plan-HQ-ADOPTED-December-17-2015.pdf

Miller, J.H., and G.R. Potty. 2017. "Overview of Underwater Acoustic and Seismic Measurements of the Construction and Operation of the Block Island Wind Farm." *Journal of the Acoustical Society of America* 141(5):3993–3993. doi:10.1121/1.4989144. Accessed: February 24, 2022. Retrieved from: https://asa.scitation.org/doi/10.1121/1.4989144

Mitchelmore, C.L., C.A. Bishop, and T.K. Collier. 2017. "Toxicological Estimation of Mortality of Oceanic Sea Turtles Oiled during the Deepwater Horizon Oil Spill." *Endangered Species Research* 33: 39-50.

MMS (Minerals Management Service). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf: Final Environmental Impact Statement*. OCS Report MMS 2007-046 (Chapters I, II, III, and IV). Accessed: April 15, 2022. Retrieved from: https://www.boem.gov/Guide-To-EIS/ G.1,

MMS (Minerals Management Service). 2008. *Cape Wind Energy Project Nantucket Sound: Biological Assessment*. Accessed: March 16, 2022. Retrieved from: https://www.boem.gov/Renewable-Energy-Program/Studies/FEIS/Appendix-G---May-2008-Cape-Wind-Final-BA.aspx

MMS-USFWS (Minerals Management Service-U.S. Fish and Wildlife Service). 2009. Memorandum of Understanding Between the U.S. Department of the Interior, Minerals Management Service [now BOEM] and the U.S. Department of the Interior, U.S. Fish and Wildlife Service Regarding Implementation of Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. Accessed: April 15, 2022. Retrieved from: https://www.boem.gov/sites/default/files/renewable-energy-program/MMS-FWS_MBTA_MOU_6-4-09.pdf

MNHESP (Massachusetts Natural Heritage and Endangered Species Program). 2016. *Northern Red-bellied Cooter Pseudemys rubriventris pop.1*. Accessed March 31, 2022. Retrieved from: https://www.mass.gov/doc/northern-red-bellied-cooter-factsheet/download

MNHESP (Massachusetts Natural Heritage and Endangered Species Program). 2020. *List of Endangered, Threatened, and Special Concern vertebrate species in Massachusetts*. Accessed: April 15, 2022. Retrieved from: https://www.mass.gov/info-details/list-of-endangered-threatened-and-special-concern-species

Mohr, F.C., B. Lasely, and S. Bursian. 2008. "Chronic Oral Exposure to Bunker C Fuel Oil Causes Adrenal Insufficiency in Ranch Mink." *Archive of Environmental Contamination and Toxicology*, Vol. 54:337–347. Accessed: July 13, 2022. Retrieved from: https://www.academia.edu/14790871/Chronic_Oral_Exposure_to_Bunker_C_Fuel_Oil_Causes_Adrenal_Insufficiency_in_Ranch_Mink_Mustela_vison_

Moore, M.J., and J.M. van der Hoop. 2012. "The Painful Side of Trap and Fixed Net Fisheries: Chronic Entanglement of Large Whales." *Journal of Marine Biology* 2012: 230653. Accessed: July 13, 2022. Retrieved from: https://www.researchgate.net/publication/258382826_The_Painful_Side_of_Trap_and_Fixed_Net_Fisheries_Chronic_Entanglement_of_Large_Whales

Moser, J., and G.R. Shepherd. 2009. "Seasonal Distribution and Movement of Black Sea Bass (Centropristis striata) in the Northwest Atlantic as Determined from a Mark-Recapture Experiment." *Journal of Northwest Atlantic Fisheries Science* 40:17–28. Accessed: January 28, 2022. Retrieved from: https://doi.org/10.2960/J.v40.m638

MRLC (Multi-Resolution Land Characteristics Consortium). 2021. National Land Cover Database EVA (Enhanced Visualization and Analysis). Accessed: January 14, 2022. Retrieved from: https://www.mrlc.gov/eva/

NABCI (North American Bird Conservation Initiative, U.S. Committee). 2016. *The State of the Birds 2016: Report on Public Lands and Waters*. U.S. Department of the Interior. Washington, DC. Accessed: March 29, 2022. Retrieved from: https://www.stateofthebirds.org/2016/wp-content/uploads/2016/05/SoNAB-ENGLISH-web.pdf

Nelms, S.E., E.M. Duncan, A.C. Broderick, T.S. Galloway, M.H. Godfrey, M. Hamann, P.K. Lindeque, and B.J. Godley. 2016. "Plastic and Marine Turtles: a Review and Call for Research." *ICES Journal of Marine Science* 73(2): 165-181.

Nisbet, I.C., R.R. Veit, S.A. Auer, and T.P. White. 2013. Marine birds of the eastern United States and the Bay of Fundy: Distribution, numbers, trends, threats, and management. Nuttall Ornithological Club, Cambridge, MA.

NJB Magazine. 2021. Ocean Wind, EEW Begin Construction of Manufacturing Facility at Port of Paulsboro. April 19, 2021. Accessed: January 28, 2022. Retrieved from: https://njbmagazine.com/njb-news-now/ocean-wind-eew

NMFS (National Marine Fisheries Service). 2015. *Biological Opinion: Deepwater Wind: Block Island Wind Farm and Transmission System*.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 2007. *Green Sea Turtle (Chelonia mydas) 5 Year Review: Summary and Evaluation*. Silver Spring, MMD and Jacksonville, FL National Marine Fisheries Service, Office of Protected Resources and U.S. Fish and Wildlife Service, Southeast Region. Accessed February 24, 2022. Retrieved from: https://repository.library.noaa.gov/view/noaa/17044

NOAA (National Oceanic and Atmospheric Administration). 2010. *Northeast Regional Land Cover Change Report: 1996 to 2010*. Accessed: January 12, 2022. Retrieved from: https://coast.noaa.gov/data/digitalcoast/pdf/landcover-report-northeast.pdf

NOAA (National Oceanic and Atmospheric Administration). 2018. "2017–2019 Minke Whale Unusual Mortality Event Along the Atlantic Coast." Accessed: July 13, 2022. Retrieved from: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2018-minke-whale-unusual-mortality-event-along-atlantic-coast

NOAA (National Oceanic and Atmospheric Administration). 2021. "Climate Change in the Northeast U.S. Shelf Ecosystem." Accessed: January 5, 2022. Retrieved from: https://www.fisheries.noaa.gov/new-england-mid-atlantic/climate/climate-change-northeast-us-shelf-ecosystem

NOAA (National Oceanic and Atmospheric Administration). 2022. "National Buoy Data Center." Accessed: July 13, 2022. Retrieved from: https://www.ndbc.noaa.gov/

Normandeau (Normandeau Associates Inc.). 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranch and Other Marine Species. Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement.* Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region. OCS Study BOEMRE 2011-09. Accessed: February 24, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/Tricas-Gill-2011.pdf

Normandeau (Normandeau Associates, Inc.). 2019. Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy Summer 2016 through Fall 2017 Third Interim Report. 131 p. Accessed: April 15, 2022. Retrieved from: https://remote.normandeau.com/docs/NYSERDA_2016-2017_3rd_Semi-Annual_report.pdf G.2.4

Normandeau (Normandeau Associates, Inc). 2022. "Remote Marine and Onshore Technology: NYSERDA Metocean Buoys." Accessed: June 20, 2022. Retrieved from: https://remote.normandeau.com/portal_buoy_data.php?pj=21&public=1

Northeast Ocean Data. 2019. "Marine Life & Habitat: Birds Stressor Groups." Accessed: April 15, 2022. Retrieved from: https://www.northeastoceandata.org/data-explorer/?birds|stressor-groups

NSF and USGS (National Science Foundation and U.S. Geological Survey). 2011. *Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey*. Arlington, VA and Reston, VA: National Science Foundation and U.S. Geological Survey. Accessed: February 24, 2022. Retrieved from: https://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/nsf-usgs-final-eis-oeis_3june2011.pdf

Nunny, L., and M.P. Simmonds. 2019. Climate Change and Cetaceans: an update. International Whaling Commission. May.

O'Connell, A.F., B. Gardner, A.T. Gilbert, and K. Laurent. 2009. Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the United States, Final Report (Database Section—Seabirds). Prepared by the USGS Patuxent Wildlife Research Center, Beltsville, MD. U.S. Department of the Interior, Geological Survey, and Bureau of Ocean Energy Management Headquarters, OCS Study BOEM 2012-076. Accessed: April 15, 2022. Retrieved from: https://espis.boem.gov/final%20reports/5209.pdf

Orr, Terry L., Susan M. Herz, and Darrell L. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments*. Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-0116. Accessed: April 15, 2022. Retrieved from: https://espis.boem.gov/final%20reports/5298.pdf

Oviatt, C. A. 2004. "The Changing Ecology of Temperate Coastal Waters During a Warming Trend." Estuaries 27, no. 6: 895-904.

Owen, S.F., M.A. Menzel, W.M. Ford, J.W. Edwards, B.R. Chapman, K.V. Miller, and P.B. Wood. 2002. *Roost Tree Selection by Maternal Colonies of Northern Long-eared Myotis in an Intensively Managed Forest*. General Technical Report NE-292. U.S. Forest Service, Newton Square, PA.

Pace, R.M., and G.K. Silber. 2005. "Simple Analysis of Ship and Large Whale Collisions: Does Speed Kill?" Presentation at the *Sixteenth Biennial Conference on the Biology of Marine Mammals*, San Diego, CA, December 2005.

Panuccio, M., G. Dell'Omo, G. Bogliani, C. Catoni, and N. Sapir. 2019. "Migrating Birds Avoid Flying Through Fog and Low Clouds." *International Journal of Biometeorology* 63, 231–239. January 28, 2019. Retrieved from: https://doi.org/10.1007/s00484-018-01656-z

Parsons, G., and J. Firestone. 2018. *Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism.* OCS Study BOEM 2018-013. University of Delaware, Newark, DE 19716-0099. Accessed: March 17, 2022. Retrieved from: https://espis.boem.gov/final%20reports/5662.pdf

Paruk, J.D., E.M. Adams, H. Uher-Koch, K.A. Kovach, D. Long, IV, C. Perkins, N. Schoch, and D.C. Evers. 2016. "Polycylic aromatic hydrocarbons in blood related to lower body mass in common loons." *Science of the Total Environment* 565: 360-368.

Patenaude, N.J., W.J. Richardson, M.A. Smultea, W.R. Koski, and G.W. Miller. 2002. "Aircraft Sound and Disturbance to Bowhead and Beluga Whales during Spring Migration in the Alaskan Beaufort Sea." *Marine Mammal Science*18(2):309-335. Accessed: July 13, 2022. Retrieved from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1748-7692.2002.tb01040.x

Paton, P., K. Winiarski, C. Trocki, and S. McWilliams. 2010. Spatial Distribution, Abundance, and Flight Ecology of Birds in Nearshore and Offshore Waters of Rhode Island. Interim Technical report for the Rhode Island Ocean Special Area Management Plan 2010. University of Rhode Island. Accessed: April 15, 2022. Retrieved from: http://seagrant.gso.uri.edu/oceansamp/pdf/appendix/11a-PatonAvianRept.pdf

Pelletier, S.K., K. Omland, K.S. Watrous, and T.S. Peterson. 2013. *Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities.* Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM No. 2013- 01163. Accessed: March 16, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/BOEM_Bat_Wind_2013.pdf

Pennycuick, C.J. 1990. "Predicting Wingbeat Frequency and Wavelength of Birds." J. Exp. Biol. 150, 171-185.

Pennycuick, C.J., S. A°kesson, and A. Hedenstro¨m. 2013. "Air Speeds of Migrating Birds Observed by Ornithodolite and COMPARED with predictions from Flight Theory." J R Soc Interface 10: 20130419. Accessed: April 15, 2022. Retrieved from: https://royalsocietypublishing.org/doi/pdf/10.1098/rsif.2013.0419

Petersen, I.K., T. Kjær Christensen, J. Kahlert, M. Desholm, and A. D. Fox. 2006. *Final Results of Bird Studies at the Offshore Wind Farms at Nysted and Horns Rev, Denmark*. National Environmental Research Institute, Ministry of the Environment, Denmark. Accessed: April 15, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/NERI_Bird_Studies.pdf

Pettersson, J. 2005. The Impact of Offshore Wind Farms on Bird Life in Southern Kalmar Sound, Sweden: a Final Report Based on Studies 1999–2003. Report for the Swedish Energy Agency, Lund University, Lund, Sweden.

Pezy, J.P., A. Raoux, J.C. Dauvin, and Steven Degraer. 2018. "An Ecosystem Approach for Studying the Impact of Offshore Wind Farms: A French Case Study." ICES Journal of Marine Science, fsy125, September 12, 2018.

Plonczkier, P., and I.C. Simms. 2012. "Radar Monitoring of Migrating Pink-footed Geese: Behavioral Responses to Offshore Wind Farm Development." Journal of Applied Ecology 49: 1187-1194.

Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Rogers, B.L. Southall, D.G. Zeddies, and W.N. Tavolga. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report*. Prepared by ANSI, Accredited Standards Committee S3/SC1 and Registered with ANSI. Cham, Switzerland: ASAPress/Springer. ASA S3/SC1.4 TR-2014. Accessed: January 24, 2022. Retrieved from: https://doi.org/10.1007/978-3-319-06659-2_7

Raoux, A., S. Tecchio, J.P. Pezy, G. Lassalle, S. Degraer, S. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangere, F. Le Loc'h, J.C. Dauvin, and N. Niquil. 2017. "Benthic and Fish Aggregation Inside an Offshore Wind Farm: Which Effects on the Trophic Web Functioning?" Ecological Indicators 72: 33-46.

Record, N.R., J.A. Runge, D.E. Pendleton, W.M. Balch, K.T.A. Davies, A.J. Pershing, C.L. Johnson, K. Stamieszkin, Z. Feng, S.D. Kraus, R.D. Kenney, C.A. Hudak, C.A. Mayo, C. Chen, J.E. Salisbury, and C.R.S. Thompson. 2019. "Rapid Climate-driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales." Oceanography 32(2): 162-196.

Regular, P., W. Montevecchi, A. Hedd, G. Roberson, and S. Wilhelm. 2013. "Canadian Fisheries Closure Provides a Large-scale Test of the Impact of Gillnet Bycatch on Seabird Populations." Biology Letters 9(4): 20130088. Accessed: April 15, 2022. Retrieved from: https://royalsocietypublishing.org/doi/pdf/10.1098/rsbl.2013.0088

Roberts, A.J. 2019. *Atlantic Flyway Harvest and Population Survey Data Book*. U.S. Fish and Wildlife Service, Laurel, MD.

Robinson Willmott, J., G. Forcey, and A. Kent. 2013. The Relative Vulnerability of Migratory Bird Species to Offshore Wind Energy Projects on the Atlantic Outer Continental Shelf: An Assessment Method Database. Final report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-207. Accessed: April 15, 2022. Retrieved from: https://espis.boem.gov/final%20reports/5319.pdf

Robinson Willmott, J., and G. Forcey. 2014. *Acoustic Monitoring of Temporal and Spatial Abundance of Birds near Outer Continental Shelf Structures: Synthesis Report*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Herndon, VA. BOEM 2014-004. 172 pp. Accessed: April 15, 2022. Retrieved from: https://espis.boem.gov/final%20reports/5349.pdf

Roman, L., B.D. Hardesty, M.A. Hindell, and C. Wilcox. 2019. "A Quantitative Analysis Linking Seabird Mortality and Marine Debris Ingestion." *Scientific Reports* 9(1): 1-7.

Royal Haskoning. 2013. *Thanet Offshore Wind Farm Ornithological Monitoring 2012-2013*. Final Report to Report to Thanet Offshore Wind Ltd. 66 pp.

Samuel, Y., S.J. Morreale, C.W. Clark, C.H. Greene, and M.E. Richmond. 2005. "Underwater, Low-frequency Noise in a Coastal Sea Turtle Habitat." *Journal of the Acoustical Society of America* 117(3):1465-1472.

Schaub, A., J. Ostwald, and B.M. Siemers. 2008. "Foraging Bats Avoid Noise." Journal of Experimental Biology, Vol. 211:3147-3180.

Schuyler, Q.A., C. Wilcox, K. Townsend, B.D. Hardesty, and N.J. Marshall. 2014. "Mistaken Identity? Visual Similarities of Marine Debris to Natural Prey Items of Sea Turtles." *BMC Ecology* 14:14.

Secor, D.H., F. Zhang, M.H.P. O'Brien, and M. Li. 2018. "Ocean Destratification and Fish Evacuation Caused by a Mid-Atlantic Tropical Storm." *ICES Journal of Marine Science* 76(2):573-584. Accessed: January 28, 2022. Retrieved from: https://doi.org/10.1093/icesjms/fsx241

Shearman, R.K. and S.J. Lentz. 2010. "Long-Term Sea Surface Temperature Variability along the U.S. East Coast." *Journal of Physical Oceanograph*y, Vol. 40: 1004 -1017.

Shigenaka, G., S. Milton, P. Lutz, R. Hoff, R. Yender, and A. Mearns. 2010. *Oil and Sea Turtles: Biology, Planning, and Response.* Reprinted in 2010. NOAA Office of Restoration and Response Publication.

Sigourney, D.B., C.D. Orphanides, and J.M. Hatch. 2019. *Estimates of Seabird Bycatch in Commercial Fisheries off the East Coast of the United States from 2015-2016*. NOAA Technical Memorandum NMFS-NE-252. Woods Hole, Massachusetts. 27 pp.

Simmons, A.M., K.N. Horn, M. Warnecke, and J.A. Simmons. 2016. "Broadband Noise Exposure Does Not Affect Hearing Sensitivity in Big Brown Bats (*Eptesicus fuscus*)." *Journal of Experimental Biology*, Vol. 219: 1031-1040.

Sjollema, A.L., J.E. Gates, R.H. Hilderbrand, and J. Sherwell. 2014. "Offshore activity of bats along the Mid-Atlantic coast." *Northeastern Naturalist* 21(2):154–163.

Skov, H., S. Heinanen, T. Norman, R.M. Ward, S. Mendez-Roldan, and I. Ellis. 2018. *ORJIP Bird Collision and Avoidance Study*. Final report. The Carbon Trust. United Kingdom. April 2018.

Smith, A., and S. McWilliams. 2016. "Bat Activity During Autumn Relates to Atmospheric Conditions: Implications for Coastal Wind Energy Development." Journal of Mammalogy, Vol. 97(6), 1565-1577.

Smith, C.R., Rowles, T.K., Hart, L.B., Townsend, F.I., Wells, R.S., Zolman, E.S., Balmer, B.C., Quigley, B., Ivnacic, M., McKercher, W., Tumlin, M.C., Mullin, K.D., Adams, J.D., Wu, Q., McFee, W., Collier, T.K., and Schwacke, L.H. 2017. "Slow Recovery of Barataria Bay Dolphin Health Following the Deepwater Horizon Oil Spill (2013–2014), with Evidence of Persistent Lung Disease and Impaired Stress Response." *Endangered Species Research* 33:127–142.

Smith, J., M. Lowry, C. Champion, and I. Suthers. 2016. "A Designed Artificial Reef is Among the Most Productive Marine Fish Habitats: New Metrics to Address 'Production Versus Attraction'." *Marine Biology* 163:188. Accessed: April 16, 2022. Retrieved from: https://doi.org/10.1007/s00227-016-2967-y

Snoek, R., R. de Swart, K. Didderen, W. Lengkeek, and M. Teunis. 2016. *Potential Effects of Electromagnetic Fields in the Dutch North Sea. Phase 1 – Desk Study*. Final Report submitted to Rijkswaterstaat Water, Verkeer en Leefmgeving. Accessed February 24, 2022. Retrieved from: https://www.buwa.nl/fileadmin/buwa_upload/Bureau_Waardenburg_rapporten/16-101_BuWareport_potential_effects_of_electromagnetic_fields_in_the_dutch_north_sea.pdf

Southall, B.J., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. "Marine mammal noise exposure criteria: Initial scientific recommendations." *Aquatic Mammals* 33(44):411-521.

Stabile, Frank A., Gregory J. Watkins-Colwell, Jon A. Moore, Michael Vecchione, and Edward H. Burtt Jr. 2017. "Observations of Passerines and a Falcon from a Research Vessel in the Western North Atlantic Ocean." The Wilson Journal of Ornithology 129, no. 2: 349-353. Accessed: September 6, 2022. Retrieved from: https://www.jstor.org/stable/pdf/26429799.pdf

Stantec (Stantec Consulting Services). 2016. Long-Term Bat Monitoring on Islands, Offshore Structures, and Coastal Sites in the Gulf of Maine, Mid-Atlantic, and Great Lakes—Final Report. Prepared for the U.S. Department of Energy. Accessed: March 16, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/Stantec-2016-Bat-Monitoring.pdf

Sullivan, L., Brosnan, T., Rowles, T.K., Schwacke, L., Simeone, C., and Collier, T.K. 2019. *Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals.* NOAA Technical Memorandum NMFS-OPR-62. Accessed: February 20, 2022. https://repository.library.noaa.gov/view/noaa/22425

Takeshita, R., Sullivan, L., Smith, C., Collier, T., Hall, A., Brosnan, T., Rowles, T., and Schwacke, L. 2017. "The *Deepwater Horizon* Oil Spill Marine Mammal Injury Assessment." *Endangered Species Research* 33:96– 106.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. "A Review of Potential Impacts of Submarine Cables on the Marine Environment: Knowledge Gaps, Recommendations, and Future Directions." *Renewable and Sustainable Energy Reviews* 96:380–391. Accessed: February 24, 2022. Retrieved from: https://hal.archives-ouvertes.fr/hal-02405630/document

TetraTech (Tetra Tech, Inc.). 2012. *Pre-Construction Avian and Bat Assessment: 2009-2011, Block Island Wind Farm, Rhode Island State Waters.* Accessed: March 16, 2022. Retrieved from: https://offshore windhub.org/sites/default/files/resources/deepwater_9-27-2012_biwfbitserappendixo.pdf

Thomsen, F., A.B. Gill, M. Kosecka, M. Andersson, M. André, S. Degraer, T. Folegot, J. Gabriel, A. Judd, T. Neumann, A. Norro, D. Risch, P. Sigray, D. Wood, and B. Wilson. 2015. MaRVEN – *Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy*. RTD- KI-NA-27-738-EN-N. Final Study Report. Brussels, Belgium: European Commission. Accessed: January 28, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/Marven-Report-2015.pdf

Todd, V.L.G., I.B. Todd, J.C. Gardiner, E.C.N. Morrin, N.A. MacPherson, N.A. DiMarzio, and F. Thomsen. 2015. "A Review of Impacts on Marine Dredging Activities on Marine Mammals." *ICES Journal of Marine Science* 72(2):328-340.

Tomás, J., R. Guitart, R. Mateo, and J.A. Raga. 2002. "Marine Debris Ingestion in Loggerhead Turtles, *Caretta*, from the Western Mediterranean." *Marine Pollution Bulletin* 44:211-216.

Tournadre, J., 2014. "Anthropogenic Pressure on the Open Ocean: The Growth of Ship Traffic Revealed by Altimeter Data Analysis." *Geophysical Research Letters* 41(22):7924-7932. Accessed: July 13, 2022. Retrieved from: https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2014GL061786

Town of Barnstable. 2010. T*own of Barnstable Comprehensive Plan 2010: Seven Villages – One Community*. Accessed: December 2021. Retrieved from: https://town.barnstable.ma.us/Departments/ComprehensivePlanning/pageview.asp?file=Plans_and_Documents%5CLocal-Comprehensive-Plan-2010.html&title=Local%20Comprehensive%20Plan%202010&exp=Plans_and_Documents

Town of Barnstable. 2018. *Town of Barnstable Open Space and Recreation Plan*. Accessed January 2022. Retrieved from: https://tobweb.town.barnstable.ma.us/Departments/planninganddevelopment/Plans_and_Projects/Open-Space-and-Recreation-Plan-2018-Update.pdf?tm=1/4/2022%2011:22:41%20AM

Town of Barnstable. 2021. *Zoning Map of the Town of Barnstable, Massachusetts*. Amended February 4, 2021. Accessed: December 2021. Retrieved from: https://www.town.barnstable.ma.us/Departments/GIS/Zoning_Maps/Town-wide-Zoning-Map.pdf?tm=12/30/2021%202:09:02%20PM

Town of Barnstable. 2022. GIS Property Maps. Accessed: May 2022. Retrieved from: https://gis.townofbarnstable.us/Html5Viewer/Index.html?viewer=propertymaps

Turner, G.G., D.M. Reeder, and J.T.H. Coleman. 2011. "A Five-Year Assessment of the Mortality and Geographic Spread of White-Nose Syndrome in North American Bats and a Look to the Future." Bat Research News, Vol. 52, no.2: 13-27.

U.S. Energy Information Administration. 2014. "Oil Tanker Sizes Range from General Purpose to Ultra-Large Crude Carriers on AFRA Scale." September 16, 2014. Accessed: March 2, 2020. Retrieved from: https://www.eia.gov/todayinenergy/detail.php?id=17991

U.S. Energy Information Administration. 2019. Table P5B. Primary Production Estimates, Renewable and Total Energy, in Trillion BTU, Ranked by State, 2018. State Energy Data 2018.

U.S. Navy (U.S. Department of the Navy). 2018. *Hawaii-Southern California Training and Testing EIS/OEIS*. Accessed: July 13, 2022. Retrieved from: https://www.hstteis.com/Documents/2018-Hawaii-Southern-California-Training-and-Testing-Final-EIS-OEIS/Final-EIS-OEIS

USDA (U.S. Department of Agriculture). 2006. *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.* U.S. Department of Agriculture Handbook 296. Natural Resources Conservation Service. Accessed: January 25, 2022. Retrieved from: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050898.pdf

USEPA (U.S. Environmental Protection Agency). 2000. *Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras*. Office of Water. EPA-822-R-00-012. Accessed: December 15, 2021. Retrieved from: https://nepis.epa.gov/Exe/ZyPDF.cgi/20003HYA.PDF?Dockey=20003HYA.PDF

USEPA (U.S. Environmental Protection Agency). 2021. "AVoided Emissions and geneRation Tool (AVERT)." Accessed: February 2022. Retrieved from: https://www.epa.gov/avert

USEPA (U.S. Environmental Protection Agency). 2021a. *National Coastal Condition Assessment: A Collaborative Survey of the Nation's Estuaries and Great Lakes Nearshore Waters*. EPA 841-R-21-001. Accessed: January 5, 2022. Retrieved from: https://www.epa.gov/system/files/documents/2021-09/nccareport_final_2021-09-01.pdf

USEPA (U.S. Environmental Protection Agency). 2021b. *U.S. EPA National Coastal Condition Assessment 2015*. Accessed: January 5, 2022. Retrieved from: https://coastalcondition.epa.gov/?&view=indicator&studypop=e&subpop=epa+region+1&label=none&condition=good&diff=1v3

USEPA (U.S. Environmental Protection Agency). 2022. "Nonattainment Areas for Criteria Pollutants (Green Book)." Accessed: February 2022. Retrieved from: https://www.epa.gov/green-book

USFWS (U.S. Fish and Wildlife Service). 2011. "Bald Eagle Management Guidelines and Conservation Measures: Bald Eagle Natural History and Sensitivity to Human Activity Information."

USFWS (U.S. Fish and Wildlife Service). 2022. *White Nose Syndrome: The Devastating Disease of Hibernating Bats in North America.* Updated March 2022. Accessed: March 16, 2022. Retrieved from: https://www.whitenosesyndrome.org/mmedia-education/white-nose-syndrome-fact-sheet-june-2018

USGS (U.S. Geological Survey). 2018. "Turbidity and Water." Accessed: December 15, 2021. Retrieved from: https://www.usgs.gov/special-topics/water-science-school/science/turbidity-and-water

USGS (United States Geological Survey). 2020. "Science in Your Watershed, Locate Your Watershed." Accessed: March 28, 2022. Retrieved from: https://water.usgs.gov/wsc/cat/01090002.html

Vanasse Hangen Brustlin, Inc. 2010. *New Bedford 2020: A City Master Plan*. Accessed: January 28, 2022. Retrieved from: http://s3.amazonaws.com/newbedford-ma/wp-content/uploads/sites/46/20191219215710/NewBedford2020_ACityMasterPlan_2010.pdf

Vanderlaan, A.S.M., and C.T. Taggart. 2007. "Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed." *Marine Mammal Science* 23(1):144-156. Accessed: July 13, 2022. Retrieved from: https://www.phys.ocean.dal.ca/~taggart/Publications/Vanderlaan_Taggart_MarMamSci-23_2007.pdf

Vargo, S., P. Lutz, D. Odell, E. Van Vleet, and G. Bossart. 1986. *Study of the Effects of Oil on Marine Turtles. Volume 2. Technical Report.* Final Report prepared for the Minerals Management Service (MMS). OCS Study MMS 86-0070. Accessed: February 24, 2022. Retrieved from: http://www.seaturtle.org/PDF/VargoS_1986a_MMSTechReport.pdf

Vegter, A.C., M. Barletta, C. Beck, J. Borrero, H. Burton, M.L. Campbell, M.F. Costa, M. Eriksen, C. Eriksson, A. Estrades, K.V.K. Gilardi, B.D. Hardesty, J.A. Ivar do Sul, J.L. Lavers, B. Lazar, L. Lebreton, W.J. Nichols, C.A. Ribic, P.G. Ryan, Q.A. Schuyler, S.D.A. Smith, H. Takada, K.A. Townsend, C.C.C. Wabnitz, C. Wilcox, L.C. Young, and M. Hamann. 2014. "Global Research Priorities to Mitigate Plastic Pollution Impacts on Marine Wildlife." *Endangered Species Research* 25:225-247.

Veit, R.R., H. F. Goyert, T.P. White, M. Martin, L.L. Manne, and A. Gilbert. 2015. *Pelagic Seabirds off the East Coast of the United States 2008-2013*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study BOEM 2015-024. Accessed: April 15, 2022. Retrieved from: https://tethys.pnnl.gov/sites/default/files/publications/Veit-et-al-2015.pdf

Veit, Richard R., Timothy P. White, Simon A. Perkins, and Shannon Curley. 2016. *Abundance and Distribution of Seabirds off Southeastern Massachusetts, 2011-2015: Final Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Sterling, Virginia. OCS Study BOEM 2016-067. Accessed: April 15, 2022. Retrieved from: https://www.boem.gov/RI-MA-Seabirds/

Vilela, R., C. Burger C, A. Diederichs A, F. E. Bachl FE, L. Szostek L, A. Freund A, A. Braasch A, J. Bellebaum J, B. Beckers B, W. Piper, W and G. Nehls. G. 2021. "Use of an INLA Latent Gaussian Modeling Approach to Assess Bird Population Changes Due to the Development of Offshore Wind Farms." *Frontiers in Marine Science*. 8:701332. doi: 10.3389/fmars.2021.701332. Accessed: June 20, 2022. Retrieved from: https://www.frontiersin.org/articles/10.3389/fmars.2021.701332/full

Vlietstra, L.S. 2008. *Common and roseate tern exposure to the Massachusetts Maritime Academy wind turbine: 2006 and 2007*. Report to the Massachusetts Division of Fisheries and Wildlife, Natural Heritage Program, Westborough, MA. In Burger, J.C., G.L. Niles, J. Newman, G. Forcey, and L. Vliestra. 2011. Risk evaluation for federally listed (roseate tern, Piping Plover) or candidate (Red Knot) bird species in offshore waters: A first step for managing the potential impacts of wind facility development on the Atlantic Outer Continental Shelf in Normandeau Associates, Inc. 2011. New insights and new tools regarding risk to roseate terns, Piping Plovers, and Red Knots from wind facility operations on the Atlantic Outer Continental Shelf. A Final Report for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Report No. BOEMRE 048-2011. Contract No. M08PC20060.

Walker, M.M., C.E. Diebel, and J.L. Kirschvink. 2003. "Detection and Use of the Earth's Magnetic Field by Aquatic Vertebrates." In *Sensory Processing in Aquatic Environments,* edited by S.P. Collin and N.J. Marshall, pp. 53-74. New York: Springer-Verlag.

Wang, J., X. Zou, W. Yu, D. Zhang, and T. Wang. 2019. "Effects of Established Offshore Wind Farms on Energy Flow of Coastal Ecosystems: A Case Study of the Rudong Offshore Wind Farms in China." *Ocean & Coastal Management*, 171: 111-118. Accessed: September 6, 2022. Retrieved from: https://kd.nsfc.gov.cn/paperDownload/ZD25281935.pdf

Watts, Bryan D. 2010. Wind and Waterbirds: Establishing Sustainable Mortality Limits within the Atlantic Flyway. Center for Conservation Biology Technical Report Series, CCBTR-10-15. College of William and Mary/Virginia Commonwealth University, Williamsburg, VA. 43 pp. Accessed: April 15, 2022. Retrieved from: https://www.ccbbirds.org/wp-content/uploads/2013/12/ccbtr-10-05_Watts-Wind-and-waterbirds-Establishing-sustainable-mortality-limits-within-the-Atlantic-Flyway.pdf

Weilgart, L.S. 2018. *The Impact of Ocean Noise Pollution on Fish and Invertebrates*. Wadenswill, Switzerland: Ocean Care and Dalhousie University. Accessed: January 28, 2022. Retrieved from: https://www.oceancare.org/wp-content/uploads/2017/10/OceanNoise_FishInvertebrates_May2018.pdf

Werner, S., A. Budziak, J. van Franeker, F. Galgani, G. Hanke, T. Maes, M. Matiddi, P. Nilsson, L. Oosterbaan, E. Priestland, R. Thompson, J. Veiga, and T. Vlachogianni. 2016. *Harm Caused* *by Marine Litter.* MSFD GES TG Marine Litter–Thematic Report; JRC Technical report; EUR 28317 EN. Chilworth, Southampton, UK: Xodus Group. doi:10.2788/690366.

Whitaker, J.O., Jr. 1998. “Life History and Roost Switching in Six Summer Colonies of Eastern Pipistrelles in Buildings.” Journal of Mammalogy, Vol. 79, no.2: 651-659.

White, T.P., and R.R. Veit. 2020. “Spatial Ecology of Long-tailed Ducks and White-winged Scoters Wintering on Nantucket Shoals.” Ecosphere 11(1):e03002. 10.1002/ecs2.3002. Accessed: April 15, 2022. Retrieved from: https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1002/ecs2.3002

Winship, A.J., B.P. Kinlan, T.P. White, J.B. Leirness, and J. Christensen. 2018. *Modeling At-Sea Density of Marine Birds to Support Atlantic Marine Renewable Energy Planning: Final Report*. OCS Study BOEM 2018-010. Sterling, VA. 67 pp. Accessed: April 15, 2022. Retrieved from: https://coastalscience.noaa.gov/data_reports/modeling-at-sea-density-of-marine-birds-to-support-atlantic-marine-renewable-energy-planning-final-report/

This page is intentionally blank.