OCS Study
BOEM 2019-036

National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf

U.S. Department of the Interior
Bureau of Ocean Energy Management
Office Renewable Energy Programs
www.boem.gov

OCS Study
BOEM 2019-036

National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf

May 2019

Prepared under BOEM Contract 140M0118F0035
by

Avanti Corporation
Industrial Economics, Inc.

Published by

U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

DISCLAIMER

Study concept, oversight, and funding were provided by the US Department of the Interior, Bureau of Ocean Energy Management (BOEM) under Contract Number140M0118F0035. This report has been technically reviewed by BOEM, and it has been approved for publication. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the US Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

REPORT AVAILABILITY

To download a PDF file of this report, go to the US Department of the Interior, Bureau of Ocean Energy Management website at www.boem.gov/Environmental-Studies-EnvData/, click on the link for the Environmental Studies Program Information System (ESPIS), and search on 2019-036.

CITATION

Bureau of Ocean Energy Management (BOEM). 2019. National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf. US Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study 2019- 036.

ABOUT THE COVER

Photo: Turbine at Block Island Wind Farm offshore Block Island, RI.

EXECUTIVE SUMMARY

This document is intended to be a living document that will be revised and adapted through its use to include updated information and to incorporate new activities or effects not currently identified.

The Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) define cumulative effects as, “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.” (40 CFR §1508.7) Accordingly, NEPA requires agencies to consider not only the incremental direct and indirect effects of a particular action on environmental resources, but also the cumulative effects of the action that occur in combination with other actions. The purpose of the cumulative effects analysis is to ensure that the decision maker fully considers the consequences of the proposed action (CEQ 1997).

CEQ’s guidance for evaluating cumulative effects as part of NEPA analyses specifies the need to include all relevant past, present, and reasonably foreseeable future actions and to focus on truly meaningful effects. Agencies are charged with developing action- or activity-specific cumulative impacts scenarios in accordance with this general guidance. Considering expected growth in renewable energy projects offshore from Maine to Virginia, the purpose of this document is to establish a common cumulative impacts scenario framework for use in NEPA analyses for offshore wind activities on the North Atlantic Outer Continental Shelf (OCS). This will enable efficient and effective identification of relevant actions for the cumulative effects analyses, and the development of consistent, succinct NEPA documents that demonstrate sound logic for cumulative effects findings.

This document provides the following guidance to establish cumulative impact scenarios for future renewable energy projects in the North Atlantic OCS:

- **Identifies the important cause-and-effect relationships between renewable energy projects and potentially affected resources**. BOEM refers to these relationships in terms of the Impact Producing Factors (IPFs) generated by these activities that directly or indirectly affect physical, biological, economic, or cultural resources. Based on these IPFs, this document identifies the relevant affected resources that should be considered in the cumulative impacts analysis.
- **Identifies the types of actions and activities to include in the cumulative impacts scenario**. This document identifies multiple types of actions and activities (including federal, non-federal and private actions) that may affect the same physical, biological, economic, or cultural resources as the renewable energy actions that should therefore be considered in terms of the collective effects. These “cumulative actions and activities” may generate the same IPFs as renewable energy or affect the same resources in other ways (i.e., via different IPFs).
- **Identifies past, present, and reasonably foreseeable actions and activities in the North Atlantic OCS to consider in future NEPA cumulative impact scenarios**. Chapter 3 of this document provides activity-specific overviews of activity levels and locations, presenting information in tables and maps where possible. This information may be used as a starting point for cumulative effects analyses for future renewable energy projects. This information reflects the state of knowledge as of March 2019; future analyses will therefore require some additional research to ensure the cumulative impacts scenario is current.
- **Provides guidance on and information sources for identifying relevant past, present, and reasonably foreseeable actions for each action/activity**. Cumulative impact scenarios for renewable energy projects will be location-specific and will therefore require some additional research regarding the specific actions and activities to be included (e.g., amount of vessel traffic or extent of dredging and presence of disposal sites). Chapter 2 of this document defines resource-specific spatial boundaries that identify the area over which relevant actions and

activities may affect a given resource. The action and activity-specific sections of Chapter 3 then direct analysts to the best available information sources to identify and quantify the relevant actions and activities.

Chapter 1 of this document provides an overview of the categories of activities and affected resources relevant to cumulative impacts scenarios of renewable energy projects. Chapter 2 describes the logic for the guidance regarding which activities to include in future cumulative impacts scenarios. Chapter 3 links actions and activities to IPFs (which define cause-and-effect relationships between actions/activities and environmental resources). Chapter 4 links the IPFs to affected resources. While the document attempts to describe the full suite of potentially relevant activities, IPFs, and resources likely to be appropriate for NEPA reviews of offshore wind energy projects, it may not match every future project. As such, site-specific conditions need to be considered for each evaluation.

CONTENTS

Tables

Figures

ACRONYMS

AIS	Automatic Identification System
AOI	Area of Interest
ASAP	Atlantic Sand Assessment Project
BOEM	Bureau of Ocean Energy Management
BTS	Bureau of Transportation Statistics
BTTS	Bourne Tidal Test Site
CFR	Code of Federal Regulations
CLIA	Cruise Lines International Association
COP	Construction and Operations Plan
CVOW	Coastal Virginia Offshore Wind
CZMA	Coastal Zone Management Act
DoD	Department of Defense
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EM	Electromagnetic
EMF	Electromagnetic Field
EPA	Environmental Protection Agency
GSFC	Goddard Space Flight Center
G&G	Geological & Geophysical
HRG	High-resolution Geophysical
HVDC	High voltage direct current
IPCC	Intergovernmental Panel on Climate Change
IPF	Impact-producing Factor
LME	Large Marine Ecosystem
LNG	Liquefied Natural Gas
MARAD	Maritime Administration
MMP	Marine Minerals Program
MPRSA	Marine Protection, Research, and Sanctuaries Act
MW	Megawatt
NASA	National Aeronautics and Space Administration
NASCA	North American Submarine Cable Association
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NROC	Northeast Regional Council on Oceans
NPDES	National Pollutant and Discharge Elimination System
NOAA	National Oceanic and Atmospheric Administration
O&M	Operation and Maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OPAREA	Operating Area
OREC	Offshore Renewable Energy Credit
OWF	Offshore Wind Farm
PONYNJ	Port Authority of New York and New Jersey
PPA	Power Purchase Agreement
SAP	Site Assessment Plan
SHPO	State Historical Preservation Office
SML	Surface Mixed Layer
TSHD	Trailing Suction Hopper Dredger

TSS	Traffic Separation Scheme
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
WEA	Wind Energy Area
WLA	Wind Lease Area
WNW	West-Northwest
WTG	Wind Turbine Generator

1. INTRODUCTION

This document is intended to be a living document that will be revised and adapted through its use to include updated information and to incorporate new activities or effects not currently identified.

The Bureau of Ocean Energy Management (BOEM) anticipates having to prepare several environmental assessments (EAs) and environmental impact statements (EISs) for renewable energy leasing and projects proposed offshore Maine to Virginia. The objective of this project is to provide supporting documentation that can be used in multiple EAs and EISs considering wind energy leasing, construction and operations plans (COPs), and general activities plans (GAPs) in areas offshore Maine to Virginia. To improve efficiency and consistency amongst these documents, BOEM has identified certain sections that will be similar across these documents. One section so identified is the cumulative impacts scenario.

Several activities were performed to develop the cumulative impacts scenario:

- Identification and descriptions of impact-producing factors (IPFs) associated with past, present, and reasonably foreseeable future actions occurring within the area of interest (AOI) with which offshore wind energy project IPFs could potentially have overlapping impacts.
- Development of the methodology for determining which past, present, and reasonably foreseeable future actions and their associated IPFs and activities in the North and Mid-Atlantic should be included in the cumulative impacts scenario. The methodology addresses:
    - criteria for including future actions (e.g., what makes it reasonably foreseeable);
    - determinations for which other past, present, and reasonably foreseeable future actions could BOEM's future proposed actions add to, subtract from, or synergistically interact with; and
    - temporal and spatial bounds utilized.

Categories of cumulative activities and other relevant factors addressed in this document include:

- other wind energy development activities such as site characterization surveys, site assessment activities, and construction, operation, and decommissioning of wind energy facilities;
- hydrokinetic projects;
- undersea transmission lines, gas pipelines and other submarine cables (e.g., telecommunications);
- marine minerals extraction;
- dredged material ocean disposal;
- military ranges and civilian space program uses;
- marine transportation, navigation, and traffic;
- fisheries use and management;
- oil and gas surveys and extraction; and
- climate change.

Although climate change is not an action, its reach touches nearly all actions included above. Climate change is altering the baseline against which the impacts of human actions are measured. It is included in this list as an action and has IPFs that interact with those of Outer Continental Shelf (OCS) wind development to potentially affect resources discussed in this document. It is described as an action in Chapter 3 and its interactions and impacts are discussed in Chapter 4.

The IPFs of these cumulative activities were identified; those with which offshore wind IPFs could interact were the focus of the descriptions of the impacts of these activities on potentially affected resources. These resources include:

Physical Resources

- Acoustic Environment
- Air Quality
- Minerals Resources
- Water Quality

Biological Resources

- Birds and Bats
- Coastal Habitats
- Benthic Communities
- Fish Resources; Essential Fish Habitat (EFH); Threatened and Endangered Fish (T&E Fish)
- Marine Mammals
- Sea Turtles
- Areas of Special Concern

Socioeconomic and Cultural Resources

- Demographics, Employment, Economic Resources, and Environmental Justice
- Cultural and Historic Resources
- Visual Resources
- Tourism and Recreation
- Commercial/Recreational Fisheries
- Land Use and Infrastructure
- Marine Transportation, Navigation, and Traffic
- Military Range Complexes and Civilian Space Program Uses
- Energy Production and Distribution

2. METHODOLOGY FOR SELECTING PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIVITIES

2.1 DEFINITIONS OF KEY TERMS

Cumulative Actions and Activities: Actions and activities relevant to this report include industrial or commercial undertakings that use or exploit natural or social resources and which result in impact-producing factors (IPFs). A particular action or activity may result in multiple IPFs.

Impact Producing Factors (IPF): IPFs identify the cause-and-effect relationships between actions (e.g., a wind energy project) and relevant physical, biological, economic, or cultural resources. They define the particular ways in which an action or activity affects a given resource. It is common that multiple IPFs affect the same resource.

Impacts: Impacts are the positive or negative effects that result from the interaction between a resource and an IPF.

Resources: The physical, biological, economic, or cultural resources affected by IPFs that result from cumulative actions and activities.

2.2 CONCEPTUAL FRAMEWORK OF ACTIONS, IPFS, AND RESOURCE INTERACTIONS

The framework for the presentation of the information provided in Chapters 3 and 4 is provided below to guide the reader in understanding the relationships and interactions we describe in these chapters. The conceptual framework illustrates the integration of impacts from offshore wind energy development IPFs into the totality of stressors that a resource faces from multiple actions and related IPFs.

The relationship between relevant cumulative actions, IPFs that result from these actions, and resources that are affected, is complex. This is because actions typically result in multiple IPFs, and multiple IPFs may affect the same resource. This report separates these concepts into two descriptive chapters: Chapter 3 describes relevant past, present, and reasonably foreseeable future actions and the IPFs that result from those actions. Chapter 4 describes the resources that may be affected by offshore wind energy projects, the IPFs that affect those resources, and the cumulative actions and activities that result in those IPFs.

The general relationship between cumulative activities and actions, IPFs that result from them, and resources, is depicted in Figure 2-1 using commercial and recreational fisheries as an example. Here, the reader can see that wind energy development and fisheries result in a number of IPFs, some of which overlap. Some of these IPFs in turn affect the same resources, showing a cumulative impact on that resource.

Figure 2-2 provides more detail, as is presented in Chapter 3 of this document. Here, the activity of commercial and recreational fisheries is depicted as resulting in six primary IPFs, including accidental releases (fuel from vessels), air emissions (from vessels), traffic, noise, gear utilization (entanglement), and bycatch. Some of these IPFs overlap with IPFs that may result from offshore wind energy projects (primarily those that are associated with vessel use).

Figure 2-1. Example: IPFs and Affected Resources Associated with the Cumulative Actions and Activities

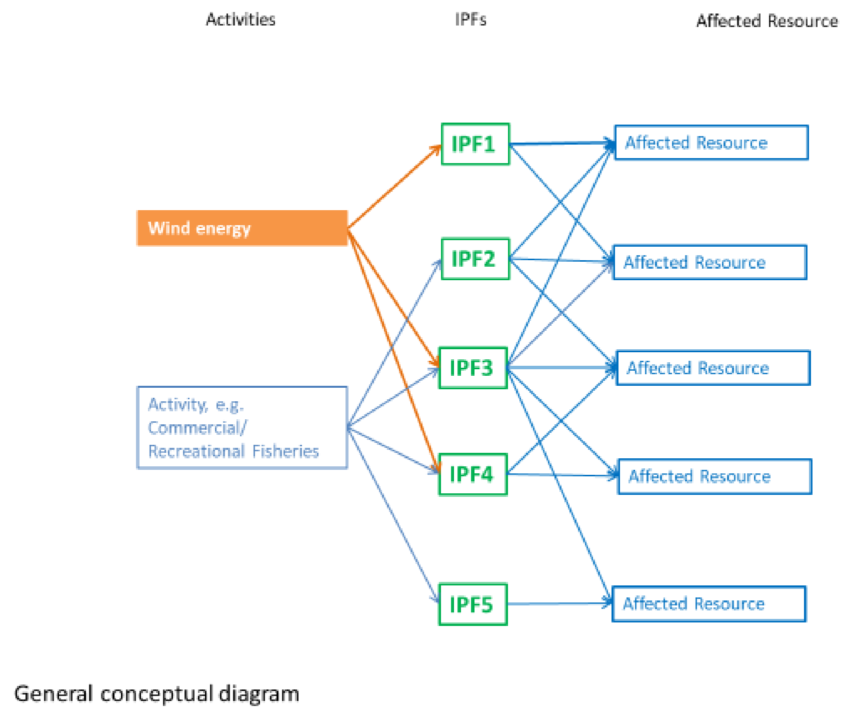


Figure 2-2. Interactions of Overlapping IPFs

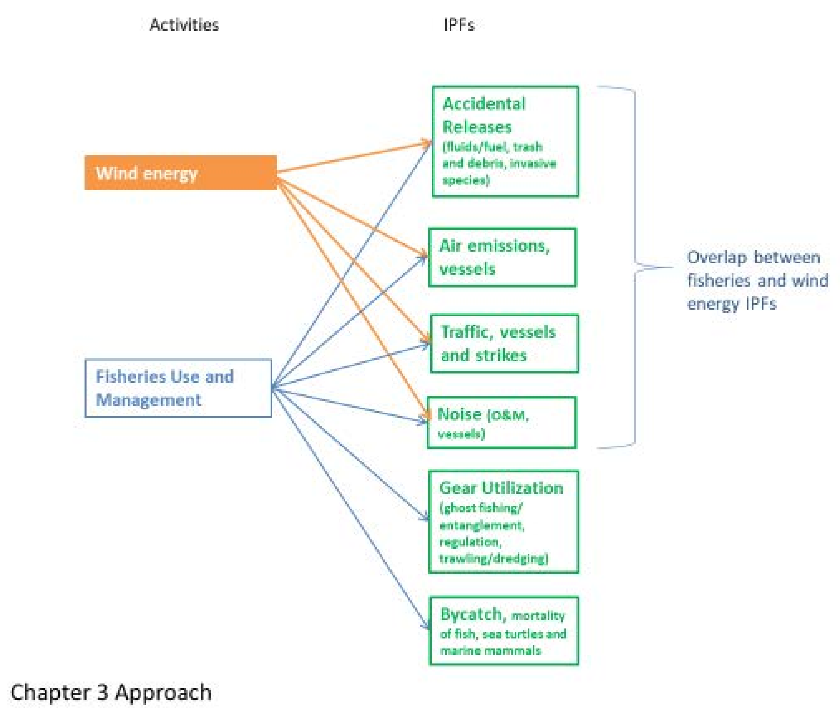
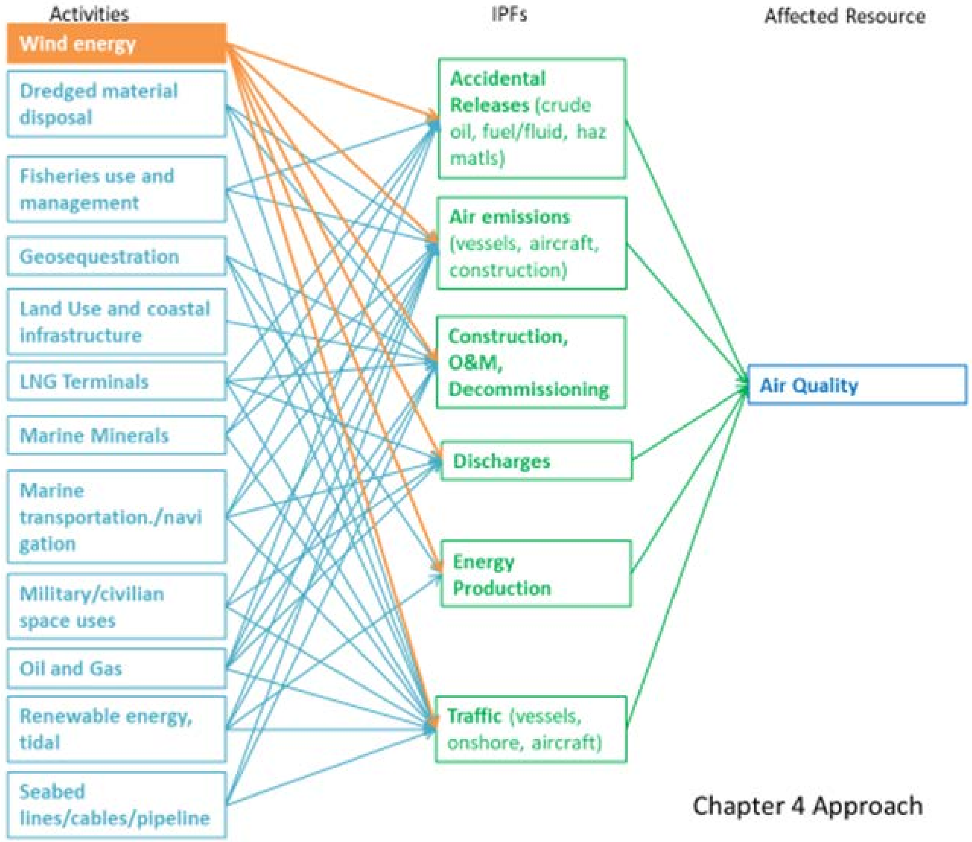


Figure 2-3 describes impacts from the perspective of an affected resource, as is described in Chapter 4 of this document. As shown, the resource Air Quality is affected by multiple IPFs. These IPFs result from a number of actions and activities.

It is this level at which the impacts of offshore wind energy development for one resource are integrated into the overall constellation of IPFs to which a resource is exposed from all of the actions of the cumulative impact scenario.

Figure 2-3. Multiplicity of Interactions



The past, present, and reasonably foreseeable future actions that populate the cumulative impacts scenario were identified through an examination of a body of NEPA reviews of offshore activities. IPFs related to those actions were identified and compared to the IPFs of offshore wind energy development. Where an overlap of IPFs occurred, the action and IPFs were included in this cumulative impact scenario.

2.3 DESCRIPTION OF IPFS

Based on review of the IPFs evaluated in BOEM and other Agency EISs, this document presents a list of offshore activities and the IPFs associated with them. The list represents the result of the analysis of IPFs from offshore wind development activities that intersect with the IPFs of other offshore activities and actions.

The list of actions, activities, and IPFs were extracted to create a spreadsheet that contains the source, action, activity, and IPFs for:

- dredge material ocean disposal;

- fisheries use and management;
- land use and coastal infrastructure;
- marine minerals extraction;
- marine transportation, navigation, and traffic;
- military ranges and civilian space program uses;
- oil and gas surveys and extraction;
- renewable energy – wind;
- submarine cables, lines and pipelines; and
- climate change.

IPFs are described by a primary, categorical name, e.g., “Accidental releases.” Primary IPFs are all related to actions/activities that result in an environmental impact. Sub-IPF descriptions provide additional descriptive detail. Sub-IPFs were created to clarify the various pathways by which an IPF may result in impacts. Sub-IPFs may include qualifiers such as: (a) the IPF source, e.g., vessels, aircraft, structures; (b) the IPF location, e.g., onshore/offshore, above water/underwater; or (c) the nature of the IPF, e.g., crude oil, invasive species, explosives. A primary IPF may have no, any, or all of the three types of sub-IPFs described above associated with it.

For example, accidental releases include fuels or hazardous materials leaks, invasive species, suspended sediments, or trash. The impacts of these various materials affect resources in different ways. Similarly, accidental releases from different sources, e.g., vessels and structures have differing pathways by which the IPF will affect resources, i.e., from a mobile source with a release that could occur anywhere and could be widely distributed versus impacts from a known, fixed point such as would occur from a structure.

The complete list of IPFs and their descriptions are presented in Table 2-1. IPFs and sub-IPFs for the actions and activities covered in this document are presented in Table 2-2.

Table 2-1. IPFs Addressed in This Analysis

IPF	Description
Accidental releases • Crude oil • Fuel/fluids/hazmat • Fuel/fluids/hazmat, structures • Invasive species • Suspended sediments • Trash and debris	Refers to unanticipated release or spills of a fluid or other substance into receiving waters, which can affect water quality and associated resources. Can occur from a stationary source (e.g., oil and gas or renewable energy structures), or a mobile source (e.g., vessels). Accidental releases are distinct from discharges as discharges are authorized, typically operational effluents controlled through permit systems.
Air emissions • Aircraft • Onshore • Structures • Structures, generators • Vessels	Refers to the release of gaseous or particulate pollutants into the atmosphere from stationary sources, vessels, vehicles, or aircraft, which can affect air quality and associated resources. Can occur both on and offshore.

Table 2-1. IPFs Addressed in This Analysis

IPF	Description
Anchoring • Bottom-founded structures	Includes both anchoring of a vessel involved in wind energy development or a structure to the sea bottom by use of an anchor or mooring, which can cause alterations to the seafloor from the anchor or anchor chain sweep. Offshore structures (e.g., wind energy, tidal energy, or military use buoys or towers) may also be secured on the seafloor through the use of gravity-based weighted structures (i.e., bottom-founded structures). Does not refer to designated anchorage areas for marine transportation, all of which are far from wind energy lease or planning areas.
Beach restoration • Improved coastal/dune habitat	Refers to renourishment and restoration activities at coastal beaches. Beach renourishment is a process involving replacing sand lost through erosion or drift to improve coastal beach habitat. This can be associated with offshore dredging activities and marine minerals management to supply the sand and gravel used in beach restoration.
Bycatch • Bird/fish/sea turtle/marine mammals	Refers to the incidental capture of non-target species such as dolphins, marine turtles, and seabirds during fishing activity, generally trawling or long-line fishing operations. This is most often associated with commercial and recreational fishing.
Demolition, structure removal • Explosives • Shock wave	Refers to removal and demolition of offshore structures. Most commonly associated with oil and gas development and military activities, but possible in decommissioning of wind energy structures. Demolition implies the use of explosives in structure removal. However, water cutting jets also can be used in structure removals and lack explosive/shock wave impacts.
Discharges • Onshore point source and non-point sources • Structures • Vessels • Drilling, water column • Drilling, sedimentation and burial • Drilling, vessels	Generally, refers to routine *permitted* operational effluent discharges to receiving waters. There can be numerous types of vessel and structure discharges, such as bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, seawater cooling system effluent, etc. These discharges are generally restricted to uncontaminated or properly treated effluents that may have best management practice or numeric pollutant concentration limitations imposed through Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permits or U.S. Coast Guard (USCG) regulations. Commercial fishing vessels, however, generally are exempt from coverage under NPDES permits with the exception of ballast water.
Electromagnetic fields	Power transmission cables and other sources can produce electromagnetic fields (EMFs) that could affect some benthic organisms. The scientific literature provides some evidence of faunal responses to EMF by marine invertebrates, including crustaceans and mollusks (Taormina et al. 2018; Normandeau et al. 2011).

Table 2-1. IPFs Addressed in This Analysis

IPF	Description
Energy generation, energy security	Refers to the generation of electricity and its provision of reliable energy sources as compared with other energy sources (energy security). Associated with renewable energy development operations.
Energy stressors/devices/lasers • EM devices, high energy lasers	Refers to effects of high energy lasers and electromagnetic devices that may affect biota. Primarily associated with military uses and civilian space programs.
Gear utilization • Bottom trawls, bycatch/benthic disruption • Ghost fishing, entanglement • Midwater trawls, bycatch/overfishing • Dredging	Refers to entanglement and benthic disruptions that may affect biota. Primarily associated with commercial and recreational fishing activities, but also may be associated with marine minerals extraction and military uses. Some gear utilization IPFs (bottom trawls, dredging) seriously impact benthic communities through disruption or destruction of the seabed. Their impacts are similar in nature but much greater in extent and severity than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation.
Guidance/fiber optic wires, entanglement	Refers to the entanglement of fishing nets (“gear”) in guidance or control wires used in military activities offshore (BOEM 2018a).
Ingestion • Expended materials	Refers to the ingestion by biota of non-natural materials, especially materials expended and discarded by military operations.
Land disturbance • Erosion and sedimentation • Onshore construction • Onshore, land use changes	Refers to types of land disturbances, including erosion and sedimentation, onshore construction, and land use changes associated with residential, commercial, or industrial development. Associated with a wide range of land-based activities, port development, oil and gas development, and renewable energy development.
Light • Vessels, above water • Vessels, underwater • Structures, onshore • Vessels or offshore structures, above water • Vessels or offshore structures, underwater	Refers to the presence of light above the water, onshore, as well as underwater. Commonly associated with oil and gas development activities, but also associated with offshore wind development and activities that utilize offshore vessels.
New cable emplacement/ maintenance	Refers to disturbances associated with installing new offshore submarine cables commonly associated with transmission/ telecommunications and offshore wind energy. Benthic impacts are similar but less than pipeline entrenchment primarily due to the size differences between transmission/telecommunication cables. These are distinct from impacts of bottom trawling.

Table 2-1. IPFs Addressed in This Analysis

IPF	Description
Noise • Aircraft • Demolition/structure removal • Drilling • Explosives, weapons • G&G • O&M • Offshore • Onshore • Pier and infrastructure development • Pile driving • Sonar • Trenching • Turbines • Vessels	Refers to noise from various sources. Commonly associated with construction activities, geophysical and geotechnical surveys, naval testing and training, and vessel traffic. May be impulsive, e.g., pile driving or weapons detonation, or may be broad spectrum and continuous, e.g., cumulative noise from marine transportation vessels. May also be from natural sources, e.g., wind and wave action.
Pipeline trenching	Refers to water and benthic disturbances associated with installing new pipelines.
Port utilization • Expansion • Maintenance, dredging	Refers to effects associated with port activity and maintenance. Includes activities related to port expansion and construction from increased economic activity and maintenance dredging or dredging to deepen channels for larger vessels.
Presence of structures • Allisions • Presence of structures, entanglement, gear loss/damage • Fish aggregation • Habitat creation • Migration disturbances • Navigation hazard • Onshore • Onshore, space use conflicts • Offshore, space use conflicts • Scour protection • Viewshed • Disturbed hydraulics and hydrologic regimes • Habitat creation, fish aggregation • Seabed alterations • Towers • Transmission cable infrastructure • Turbine strikes, birds/bats	Refers to effects associated with onshore or offshore structures other than construction-related effects, including entanglement, space-use conflicts, turbine strikes, physical or light-related viewshed impacts, habitat creation and fish aggregation, and scour protection. Associated with any structure fixed to the seafloor but in this context generally refers to renewable energy development.
Regulated fishing effort	Refers to limits or controls on commercial and recreational fishing activities.

Table 2-1. IPFs Addressed in This Analysis

IPF	Description
Resource exploitation • Overfishing • Prey/predator removal	Refers to changes to the sustainability status of fisheries as a result of commercial or recreational fishing activities (including shellfish).
Seabed profile alterations	Refers to physical modifications of the seabed and local sediment environment caused by removal of sedimentary material associated with marine minerals (sand and gravel) extraction; distinct from maintenance dredging of operational ship channels.
Sediment deposition and burial	Refers to the deposition of dredged materials at approved offshore dredge spoil disposal sites or to discharges of drilling muds and drill cuttings from oil and gas development or geotechnical survey activity. Can also be associated with construction-related activities that have benthic interactions, e.g., setting anchors or submarine cable emplacement.
Traffic • Aircraft • Onshore • Vessel strikes, sea turtles and marine mammals • Vessels • Vessels, collisions	Refers to marine and onshore vessel and vehicle congestion, including vessel strikes of sea turtles and marine mammals, collisions, and allisions.
Climate Change • Warming and sea level rise, storm severity/frequency • Ocean acidification • Warming and sea level rise, altered habitat/ecology • Warming and sea level rise, altered migration patterns • Warming and sea level rise, disease frequency • Warming and sea level rise, property/infrastructure damage • Warming and sea level rise, protective measures (barriers, seawalls) • Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Warming and sea level rise refers to the effects associated with climate change, storm severity/frequency, and sea level rise. Ocean acidification refers to the effects associated with the decreasing pH of seawater from rising levels of atmospheric CO_2.

Table 2-2. Primary IPFs and Associated Sub-IPFs Addressed in This Analysis

Climate change
Warming and sea level rise, altered habitat/ecology
Warming and sea level rise, altered migration patterns
Warming and sea level rise, disease frequency
Warming and sea level rise, property/infrastructure damage
Warming and sea level rise, protective measures (barriers, seawalls)
Warming and sea level rise, storm severity/frequency
Warming and sea level rise, storm severity/frequency, sediment erosion, deposition
Ocean acidification
Dredged material ocean disposal
Accidental releases, fuel/fluids/hazmat
Accidental releases, trash and debris
Air emissions, vessels
Beach restoration, improved coastal/dune habitat
Discharges, vessels
Noise, vessels
Port utilization, maintenance, dredging
Sediment deposition and burial
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Marine transportation, navigation and traffic
Accidental releases, fuel/fluids/hazmat
Accidental releases, invasive species
Accidental releases, trash and debris
Air emissions, vessels
Discharges, vessels
Noise, vessels
Port utilization, expansion
Port utilization, maintenance, dredging
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Light, vessels, above water
Light, vessels, underwater
Fisheries use and management
Accidental releases, fuel/fluids/hazmat
Accidental releases, invasive species
Accidental releases, trash and debris
Air emissions, vessels
Bycatch, bird/fish/sea turtle/marine mammals
Discharges, vessels
Gear utilization, bottom trawls, bycatch/benthic disruption
Gear utilization, ghost fishing, entanglement
Gear utilization, midwater trawls, bycatch/overfishing
Noise, O&M
Noise, vessels
Regulated fishing effort
Resource exploitation, overfishing
Resource exploitation, prey/predator removal
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Light, vessels, above water
Light, vessels, underwater

Table 2-2. Primary IPFs and Associated Sub-IPFs Addressed in This Analysis

Land use and coastal infrastructure
Accidental releases, fuel/fluids/hazmat
Air emissions, onshore
Discharges, onshore point source and non-point sources
Land disturbance
Land disturbance, erosion and sedimentation
Land disturbance, onshore, land use changes
Noise, pier and infrastructure development
Presence of structures, viewshed
Traffic, onshore
Traffic, vessels
Light, structures, onshore
Marine minerals extraction
Accidental releases, fuel/fluids/hazmat, vessels
Accidental releases, trash and debris
Discharges, vessels
Gear utilization, dredging
Noise, O&M
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Military ranges and civilian space program uses
Accidental releases, fuel/fluids/hazmat
Accidental releases, trash and debris
Air emissions, aircraft
Air emissions, vessels
Anchoring, bottom founded structures
Demolition/structure removal
Discharges, vessels
Energy stressors/devices/lasers, EM devices, high energy lasers
Gear utilization, dredging
Guidance/fiber optic wires, entanglement
Ingestion, expended materials
Noise
Noise, aircraft
Noise, explosives, weapons
Noise, pile driving
Noise, sonar
Noise, vessels
Presence of structures
Presence of structures, onshore
Traffic, aircraft
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Submarine transmission lines, pipelines, cables and infrastructure
Accidental releases, fuel/fluids/hazmat
Accidental releases, trash and debris
Air emissions, vessels
Discharges, vessels
Electromagnetic fields
New cable emplacement/ maintenance
Noise
Noise, vessels

Table 2-2. Primary IPFs and Associated Sub-IPFs Addressed in This Analysis

Presence of structures, entanglement, gear loss/damage
Presence of structures, onshore
Presence of structures, transmission cable infrastructure
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Oil and gas surveys and extraction
Accidental releases, crude oil
Accidental releases, fuel/fluids/hazmat
Accidental releases, fuel/fluids/hazmat, structures
Accidental releases, trash and debris
Air emissions, aircraft
Air emissions, onshore
Air emissions, structures
Air emissions, vessels
Anchoring
Demolition/structure removal
Demolition/structure removal, explosives
Demolition/structure removal, shock wave
Discharges, drilling, sedimentation and burial
Discharges, drilling, vessels
Discharges, drilling, water column
Discharges, onshore point source and non-point sources
Discharges, structures
Discharges, vessels
Land disturbance, onshore construction
Noise, aircraft
Noise, demolition/structure removal
Noise, drilling
Noise, G&G
Noise, O&M
Noise, offshore
Noise, onshore
Noise, trenching
Noise, vessels
Pipeline trenching
Port utilization, expansion
Presence of structures, offshore, space use conflicts
Presence of structures, onshore, space use conflicts
Traffic, aircraft
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Light, vessels or offshore structures, above water
Light, structures, onshore
Light, vessels or offshore structures, underwater
Renewable energy development, wind
Accidental releases, fuel/fluids/hazmat
Accidental releases, fuel/fluids/hazmat, structures
Accidental releases, suspended sediments
Accidental releases, trash and debris
Air emissions
Air emissions, aircraft
Air emissions, onshore

Table 2-2. Primary IPFs and Associated Sub-IPFs Addressed in This Analysis

Air emissions, structures, generators
Air emissions, vessels
Anchoring, bottom founded structures
Discharges, onshore point source and non-point sources
Discharges, structures
Discharges, vessels
Electromagnetic fields
Energy generation, energy security
Light, vessels, above water
Light, structures, above water
Light, structures, onshore
New cable emplacement and maintenance
Noise
Noise, aircraft
Noise, G&G
Noise, O&M
Noise, pile driving
Noise, turbines
Noise, vessels
Port utilization, expansion
Presence of structures
Presence of structures, allisions
Presence of structures, entanglement, gear loss/damage
Presence of structures, fish aggregation
Presence of structures, habitat creation
Presence of structures, migration disturbances
Presence of structures, navigation hazard
Presence of structures, offshore, space use conflicts
Presence of structures, onshore
Presence of structures, seabed alterations
Presence of structures, towers
Presence of structures, transmission cable infrastructure
Presence of structures, turbine strikes, birds/bats
Presence of structures, viewshed
Traffic, vessel strikes, sea turtles and marine mammals
Traffic, vessels
Traffic, vessels, collisions
LNG facilities
Accidental releases, fuel/fluids/hazmat
Accidental releases, fuel/fluids/hazmat, structures
Accidental releases, trash and debris
Air emissions, structures
Air emissions, vessels
Discharges, structures
Discharges, vessels
Noise, construction/installation
Noise, O&M
Presence of structures
Traffic, vessels
Renewable energy development, tidal
Accidental releases, fuel/fluids/hazmat
Accidental releases, trash and debris

Table 2-2. Primary IPFs and Associated Sub-IPFs Addressed in This Analysis

Air emissions, vessels
Anchoring, bottom-founded structures
Discharges, vessels
Electromagnetic fields
Energy generation, energy security
New cable emplacement/maintenance
Noise, vessels
Presence of structures, disturbed hydraulics/hydrologic regimes
Presence of structures, fish aggregation
Presence of structures, habitat creation
Presence of structures, migration disturbances
Presence of structures, navigation hazard
Presence of structures, transmission cable infrastructure
Presence of structures, seabed alterations
Presence of structures, offshore space use conflicts
Traffic, vessels
Traffic, vessel strikes, sea turtles and marine mammals
Geosequestration
Accidental releases, fuel/fluids/hazmat
Accidental releases, fuel/fluids/hazmat, structures
Accidental releases, trash and debris
Air emissions, aircraft
Air emissions, structures
Air emissions, vessels
Discharges, drilling, sedimentation and burial
Light, structures, above water
Light, structures, underwater
Light, vessels, above water
Noise, construction/installation
Noise, O&M
Pipeline trenching
Presence of structures

2.4 GUIDELINES FOR SPATIAL BOUNDARIES FOR THE CUMULATIVE IMPACTS SCENARIO

Based on 40 CFR 1508.7, cumulative impacts are the incremental effects of a proposed action on resources when added to other past, present, or reasonably foreseeable future actions that affect those same resources, regardless of which agency or person undertakes the actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a given period. EPA guidance states that “Geographic boundaries and time periods used in cumulative impact analysis should be based on all resources of concern and all of the actions that may contribute, along with the project effects, to cumulative impacts. Generally, the scope of analysis will be broader than the scope of analysis used in assessing direct or indirect effects” (EPA 1999).

This section discusses the spatial boundaries that should be considered to determine resource-specific cumulative impacts due to direct and indirect impacts associated with a proposed action. The analysis area for cumulative impacts varies for each resource is shown in Table 2-3. For example, BOEM uses a localized geographic scope to evaluate cumulative impacts for resources that are fixed in nature (i.e., their location is stationary such as benthic and archaeological resources), or for resources where impacts from a proposed action would only occur in waters in and around the proposed Project area (e.g., water quality).

However, given the migratory nature of marine mammals, sea turtles, fisheries resources, and birds, for example, the cumulative impact analysis area for these resources includes a much broader area. This table provides available guidance, examples, and data to inform a decision about the geographic scope for consideration in a cumulative impacts analysis.

Table 2-3. Cumulative Impacts Scenario Action- and Resource-Specific Geographic Analysis Areas

Resource	Cumulative Impact Scenario Geographic Analysis Boundaries
Acoustic Environment	Based on review of Tougaard (2009) for seals and porpoises and Stamieszkin (nd) for whales, cumulative impact scenarios for turbine installation and operation should consider sound sources within a 2 km radius of the project. Underwater noise was recorded from three different types of wind turbines in Denmark and Sweden during normal operation. Wind turbine noise was only measurable above ambient noise at frequencies below 500 Hz. The 1/3-octave noise levels were compared with audiograms of harbor seals and harbor porpoises. Maximum 1/3-octave levels were in the range 106–126 dB re 1 μPa rms. Audibility was low for harbor porpoises extending 20–70 m from the foundation, whereas audibility for harbor seals ranged from less than 100 m to several kilometers. Behavioral reactions of porpoises appear unlikely except if they are very close to the foundations. Behavioral reactions from seals cannot be excluded up to distances of a few hundred meters. It is unlikely that the noise reaches dangerous levels at any distance and is considered incapable of masking acoustic communication by seals and porpoises. (Tougaard 2009) Data from Stamieszkin (nd): Source — Sound pressure (dB re uPa) — Distance (m) Pile driving — approx. 200 — 1 Drilling — approx. 120 — 115-259 Dredging — approx. 140 — 200 A review paper concluded that North Atlantic right whales may respond to wind turbine operational noise at distances up to a few kilometers away, in a quiet habitat (Madsen et al. 2006 as cited in Stamieszkin). Construction and decommissioning noise comes from machines and vessels, pile-driving, explosions and installation of wind turbines. Measurements carried out by the German Federal Ministry of Environment on two platforms reached peak levels of 193 dB at 400 m from the pile (North Sea) and 196 dB at 300 m (Baltic Sea). Nedwell et al. (2004) as cited in Gill (2005) reports peaks up to 260 dB in foundation construction and 178 dB in cable lying at 100 m from the sound source. These high sound levels may cause permanent or temporary damage to the acoustics systems of animals in the vicinity of the construction site (Gill 2005; Koeller et al. 2006). However, there is not enough scientific knowledge to determine the maximum thresholds permitted for certain effects (Koeller et al. 2006; Thomsen et al. 2006). Close collaboration between physicists, engineers and biologists is necessary to get relevant information and obtain standardization of the measurement procedures in offshore developments (Koeller et al. 2006). The measurements from FINO-1 at 400 m from the source revealed maximum peaks of 180 dB (Thomsen et al. 2006). The measurements carried out during construction of North Hoyle wind farm in UK indicate that: • The peak noise of pile hammering at 5m depth was 260 dB and at 10 m depth was 262 dB; • There were no preferential directions for propagation of noise;

Table 2-3. Cumulative Impacts Scenario Action- and Resource-Specific Geographic Analysis Areas

Resource	Cumulative Impact Scenario Geographic Analysis Boundaries
Acoustic Environment (cont'd)	• The behavior of marine mammals and fish could be influenced several kms away from the turbine (Nedwell et al, 2004; Thomsen et al, 2006). **Calculated Ranges for Avoidance Distance for Different Marine Species** **Species** / **Distance** Salmon: 1,400 m Cod: 5,500 m Dab: 100 m Bottlenose dolphin: 4,600 m Harbour porpoise: 1,400 m Harbour seal: 2,000 m The National Oceanic and Atmospheric Administration (NOAA) Cetacean & Sound Mapping tool uses environmental descriptors and the distribution, density, and acoustic characteristics of human activities within U.S. waters to develop first-order estimates of their contribution to ambient noise levels at multiple frequencies, depths and spatial/temporal scales.
Air Quality	The Clean Air Act covers emissions of air pollutants that occur up to 25 nautical miles from shore. The air shed of each area potentially impacted by the proposed project, including the lease area, the on-land construction areas, and the mustering port(s) provides sufficient buffer and captures any possible impacts. Ozone, as a regional pollutant, is an exception, and while the impacts on ozone formation are expected to be negligible, a full review of cumulative impacts on regional ozone development is needed.
Areas of Special Concern	EFH and sensitive areas of concern are identified by NOAA's Fisheries Habitat Conservation Division under Magnuson-Stevens Act consultation during the permitting process. Areas can include fishery nursery and foraging habitats and hard bottom areas affected by transmission lines.
Birds and Bats	Birds that occur on the Atlantic OCS may migrate the entire eastern seaboard. Therefore, all activities occurring in their migratory range have the potential to contribute impacts. For bats, the cumulative impacts scenario includes the U.S. East Coast to capture migratory species. Bat interaction with turbines more than 25 km (13.5 nm) from shore are not likely. On-land construction areas and port activities that may impact bats should be considered. Northern long-eared bats and other cave bats are not expected to occur on the OCS. Tree bats are long distance migrants whose range includes the majority of the coast from Florida to northern Quebec. They have been documented traversing open ocean but use of offshore habitats is thought to be limited to spring and fall migration. Bats have been recorded in the Atlantic as far offshore as 21.9 km (11.8 nm) during spring (Mar-June) and fall (Aug-Oct) months. Historical, anecdotal information also supports these findings with sightings occurring between Aug – Oct and as far offshore as 16 km (8.6 nm). (BOEM 2013a)

Table 2-3. Cumulative Impacts Scenario Action- and Resource-Specific Geographic Analysis Areas

Resource	Cumulative Impact Scenario Geographic Analysis Boundaries
Benthic Communities and Habitat	A ten-mile radius around the project area accounts for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. While sediment transport beyond 10 miles is possible, sediment transport related to proposed-project activities is likely to be on a smaller spatial scale than 10 miles. Maximum extent of the 10 mg/L sediment contour was estimated just under 10 miles for dredging (BOEM 2018a)
Coastal Habitats	The coastal habitat impacted by any project is defined by the Coastal Zone Management Plan of the closest state, neighboring state(s), and any state where onshore activity (including transmission lines or port facilities) are located.
Commercial and Recreational Fisheries	Key factors to be considered include the extent to which (1) the presence of structures may affect the ability of commercial fishing vessels to operate in the vicinity of the wind project, and (2) vessel traffic related to the wind project would affect regional fishing vessel traffic. Kirkpatrick et al., (2017) selected a one nautical mile spatial boundary around a wind farm to identify potential recreational fishing vessels that may potentially be impacted. One industry representative indicated at a public meeting the need for a buffer area of <10 miles during construction, which was expected for approximately one week per turbine, but there would be no fishing restrictions per se (BOEM 2016-040). In contrast, USCG required a 500-foot exclusion zone during construction for each turbine while activities were occurring.
Cultural, Historical, and Archaeological Resources	Programmatic Agreements with the coastal State Historic Preservation Offices (SHPOs) stipulate the area for consideration as: 1. The depth and breadth of the seabed potentially impacted by proposed seafloor/ bottom-disturbing activities associated with the activities; 2. The onshore viewshed from which lighted structures would be visible; and 3. The depth and breadth and viewshed of onshore locations where transmission cables or pipelines come ashore until they connect to existing power grid structures (not specified for Massachusetts/Rhode Island). In addition, Delaware, Maryland, New Jersey, and Virginia stipulate that any areas on land used for staging the offshore work are included.
Energy Production and Distribution	Because of the wide range of types and locations of energy production and distribution elements, the analysis of cumulative impacts on this resource should consider the entire area off the Atlantic coast from Maine to Virginia. The factors that are most likely to have cumulative impacts on energy production and distribution are vessel traffic (traffic IPF) and the presence of structures (presence of structures IPF) in proposed projects. The social and environmental beneficial impacts of OCS wind energy production also are considerations.
Finfish, EFH, Threatened and Endangered Fish, and Invertebrates	The Scotian Shelf, Northeast Shelf, and Southeast Shelf large marine ecosystems (LMEs) that include or are immediately adjacent to proposed activities are likely to capture the majority of the range for most species in this group.[a]
Land Use and Coastal Infrastructure	Offshore wind energy development activities have the potential to affect onshore land use and coastal infrastructure, particularly due to onshore construction activities, port modifications, and cable landings that may occur as part of these actions, as well as in the event of accidental releases. Onshore development, land use, and infrastructure/ port development are highly localized and zoning and planning rules should be examined on a site-specific basis. Offshore wind projects are likely to involve new or upgraded cable landing facilities to connect generating units (i.e., turbines) to onshore electricity transmission infrastructure. Atlantic states have a variety of definitions for their respective coastal zones and development based on their CZM plans (https://coast.noaa.gov/czm/media/StateCZBoundaries.pdf).

Table 2-3. Cumulative Impacts Scenario Action- and Resource-Specific Geographic Analysis Areas

Resource	Cumulative Impact Scenario Geographic Analysis Boundaries
Marine Mammals	Marine mammals generally migrate throughout the entire eastern seaboard. The Scotian Shelf, Northeast Shelf, and Southeast Shelf LMEs are likely to capture the majority of the movement range for most species in this group. Therefore, all activities occurring in their migratory range have the potential to contribute impacts. Note: seasonal restrictions imposed on activities may reduce or negate impacts.
Marine Minerals	The area of impact from marine minerals collection does not extend much beyond the actual dredging footprint. Recovery of the benthic community is expected after a few years (BOEM 2013c).
Marine Transportation, Navigation, and Traffic	The area surrounding any ports supporting construction and O&M must be included. In addition, existing marine traffic and any proposed alterations to that traffic are contributing factors. U.S. territorial waters extend 12 nm off the coast and vessels are required by the USCG to have an operating automatic identification system tracking their movement within this boundary. Certain exceptions apply, such as for military vessels and smaller vessel sizes and types.
Military Ranges & Civilian Space Program Use	The DoD Siting Clearinghouse requires formal review for any energy generation or transmission projects >199-ft above ground level and provides informal review prior to filing with the Dept of Transportation for all other projects. However, DoD does not have a go/no go threshold on height or distance of projects that might impact military operations (www.acq.osd.mil/dodsc). For comparison, France uses a 30-km (16.2 nm) buffer for radar and low-level flight training. The United Kingdom recommends against siting turbines within 2 nm of a helicopter main route (due to wake turbulence) or within 9 nm of an oil platform.
Pelagic Communities	Directed field studies of the impact on pelagic communities is limited. Where fishing or bottom trawling are limited around wind structures, greater biodiversity occurs than in unprotected areas. However, alien species also may be transported and take hold as well (Slavik et al. 2017). Brostrom (2008) reports modeling and idealized numerical efforts predict a wind speed of 5-10 m/s may generate upwelling/downwelling velocities exceeding 1 m/day and suggested this upwelling would most likely strongly influence the local ecosystem. Where fishing or bottom trawling are limited around wind structures, greater biodiversity occurs than in unprotected areas, although alien species also occur (Slavik et al. 2017). However, hydroacoustic records did not show any wind farm effects on the distribution of pelagic fish (Floeter 2017). The applicability of these North Sea study to potential impacts in Atlantic waters off the U.S. east coast is not known.
Physical Oceanography	MMS (2007) assessed the impacts of OCS wind energy development on the physical oceanography in the Atlantic region, including technology testing, site characterization, construction/installation, operations, and decommissioning phases and concluded impacts would produce • a very slight reduction in current energy from support structure drag • a decrease in wave height near support structures caused by wave interception and downwind of the facility caused by a decreased wind energy • an increase wave height and current energy from structure removal during decommissioning to return the system to its pre-development condition. In all phases, impacts would be negligible or small in magnitude; limited locally to the immediate vicinity of the facility; very difficult or not measurable outside the vicinity of the support; and with the exception of the operational phase, temporary. BOEM concluded no mitigation measures would be required because wind energy

Table 2-3. Cumulative Impacts Scenario Action- and Resource-Specific Geographic Analysis Areas

Resource	Cumulative Impact Scenario Geographic Analysis Boundaries
Physical Oceanography (cont'd)	development would have no measurable impacts on currents or waves beyond the immediate vicinity of associated structures. Offshore Massachusetts, BOEM's review (2012c) of leasing and site assessment impacts provided descriptive current and wave data to provide context for the surrounding physical environment and concluded impacts would, at worst, be minor, localized, and temporary. BOEM (2016c) eliminated discussions on physical oceanography in the review of potential impacts of leasing and site assessment actions offshore New York. Discussions of physical oceanography were not included in leasing and site assessment actions for the Mid-Atlantic (2014b) nor for Vineyard Wind (BOEM 2018a) that covered all phases of OCS wind energy development. A field study in the North Sea conducted about 100 miles northwest of Bremerhaven found vertical mixing is increased within the OWFs, leading to a doming of the thermocline and a subsequent transport of nutrients into the surface mixed layer. This empirical finding is consistent with modeling exercises that projected increased vertical mixing from wind farm foundation structures (Floeter 2017). This finding is also consistent with modeling and idealized numerical experiments that predict a wind speed of 5–10 m/s may generate upwelling/downwelling velocities exceeding 1 m/day. The author concluded upwelling is most likely to strongly influence the local ecosystem (Brostrom, 2008).
Sea Turtles	Sea turtles that occur on the Atlantic OCS may migrate the entire eastern seaboard, with Atlantic nesting sites located mainly on southern beaches from North Carolina through Florida. Differing species' nesting times occur throughout the year. Therefore, all activities occurring in their migratory range have the potential to contribute impacts.
Seabed Cables/Pipelines/ Telecommunications Lines	At a distance of 100 m from transmission lines, DC magnetic fields are reduced to background (along and above the seabed). However, migrant species are likely to encounter multiple cables during migration (Normandeau et al. 2011). During the dredging works for the creation of the sand base and upper core, the turbidity will locally and temporarily change. Model results show that the background value in the region of 4 mg/l will not be exceeded for more than 20% of the dredging time for a scenario with one trailing suction hopper dredger (TSHD) of 10,000 m^3. For a scenario with 2 TSHD of 5,000 m^3, involving more frequent dredging and dumping, the background value of 4 mg/l will not be exceeded for more than 30% of the time. The dredging activity causes the highest turbidity. The dredging plume is higher in concentration but smaller in size for the scenario with 2 TSHD. The dredging plume contour is more than 1,300 m long and moves over a distance of up to 2.5 km. Compared to turbidity concentrations during natural storms, this is a small negative effect, with temporary habitat disturbance of the benthic fauna, fish and marine mammals (Sarah 2014).
Demographics, Employment, Economic Resources, and Environmental Justice	The relevant geographic areas for socioeconomics will vary by project, but will be influenced by: the specific fishing industries that are active, the onshore development area, and the type of development anticipated from the action. Disadvantaged communities that may rely on affected industries should be considered.
Terrestrial and Coastal Fauna	Onshore construction will have a direct impact on local fauna and the size and location will determine the area of consideration. As one example, a ½-mile buffer around all land areas that would be disturbed was used in the Vineyard Wind draft EIS (BOEM 2018a), although it also noted that the resources in that area generally tended to have limited geographic ranges and the ½-mile buffer may not be applicable to other areas of the U.S. east coast.

Table 2-3. Cumulative Impacts Scenario Action- and Resource-Specific Geographic Analysis Areas

Resource	Cumulative Impact Scenario Geographic Analysis Boundaries
Tourism and Recreation	Should include the entire footprint of the proposed project (including land use and coastal infrastructure areas), plus the visual resources and recreational fisheries analysis areas.
Visual Resources	Visual resources include the aesthetic, perceptual, and experiential aspects of any objects and features that make landscapes and seascapes distinctive as well as key observation points. Impacts to visual resources are highly site-specific and can depend on the number of viewers as well as the perception of impacts by different viewers. Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in nighttime views, and may be a major focus of visual attention at distances of up to 10 mi (16 km) (Argonne 2018). The New York Master Plan suggests that visual impacts greater than 14.9 mi (>24km) are likely to be not significant (Ecology and Environment 2017)
Water Quality	Ten-mile radius around the development area, the cable corridor, and vessel approach routes to port facilities that may be used by the proposed Project. This area would account for some transport of water masses (BOEM 2018a). The CZMP and state water quality standards of each coastal state also may define mixing zones.

[a] LMEs are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and are used by NOAA as the basis for ecosystem-based management. The Scotian Shelf LME is bordered to the north by the Laurentian Channel and to the south by the southern edge of the Scotian Shelf at the Fundian Channel (Northeast Channel); it contains the St. Lawrence Estuary. The Northeast Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. The Southeast Shelf LME extends from the Straits of Florida to Cape Hatteras, North Carolina. These LMEs extend from the coastline offshore to the shelf break (at ~100 to 200 m depth).

3. CUMULATIVE IMPACTS SCENARIO

3.1 RENEWABLE ENERGY – OFFSHORE WIND

3.1.1 Description of Action and Activities

Offshore wind energy development projects involve several phases: site characterization surveys, site assessment activities, construction/installation, operation and maintenance (O&M), and decommissioning. This section describes the wind energy development activities being conducted in BOEM lease areas that should be considered in the cumulative impacts scenario.

Under the renewable energy regulations, the issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision-making process and occurs over several years with varying impacts. The process follows the following general steps:

- **Lease Issuance** – BOEM issues a commercial wind energy lease which gives the lessee exclusive right to seek BOEM approval for the development of the lease area. Surveys to gather information in support of seeking approval are reasonably foreseeable at this stage.
- **Site Assessment Plan (SAP) Approval** – BOEM assumes every lessee will plan to install one or more meteorological buoys and/or towers for site assessment purposes. The lessee has one year after lease execution to submit a SAP if installing site assessment facilities is proposed. The SAP contains a detailed proposal for the construction and/or installation of meteorological towers or buoys. BOEM must approve the SAP before site assessment activities begin. After SAP approval, the lessee must complete the site characterization and site assessment activities needed to support a Construction and Operation Plan (COP) during the five-year assessment term.
- **Construction and Operation Plan Approval** – Six months prior to the end of the five-year assessment term, the lessee submits a COP that contains a detailed plan for the construction and operation of a wind energy project on the lease area. COP approval triggers a project-specific NEPA document. After completion of the NEPA document, BOEM may approve, approve with modification, or disapprove a lessee’s COP. If approved, the lessee is allowed to construct and operate wind turbine generators and associated facilities for the operations term of the lease (typically 25 years) (BOEM, 2016a).

3.1.1.1 Site Characterization Studies

Site characterization activities consist of geological and geophysical (G&G) surveys, including high-resolution geophysical (HRG), geotechnical/sub bottom sampling, and biological surveys to determine shallow hazards, archaeological, geological, geotechnical, and biological resources. A lessee is required to provide the results of these surveys with its SAP or COP.

3.1.1.2 Site Assessment Activities

Site assessment involves data collection and evaluation of meteorological conditions, such as wind resources, from meteorological structures (towers and/or buoys). Meteorological towers most often consist of a mast and data collection devices mounted on a platform supported by one or multiple pilings. The mast may be either a monopole or lattice (similar to a radio tower). A deck would be supported by a single 10-ft diameter monopole, tripod, or a steel jacket with three to four 36-inch-diameter piles. The monopole or piles are driven anywhere from 25 to 100 feet (ft) into the seafloor (BOEM, 2012a). Buoys can be used as an alternative or in addition to towers for wind, wave, and current data collection. Meteorological buoys are typically anchored at fixed locations and may be moved within the lease area. The buoy types most likely used for offshore wind data collection are discus-shaped, boat-shaped, and spar buoys (BOEM 2013b).

3.1.1.3 Construction and Operation of Offshore Wind Facilities

Offshore wind projects are made up of wind turbine generator (WTG) foundations, scour protection, electrical service platforms, offshore export cable corridors, and inter-array cables. WTG foundations construction consists either of monopiles or jackets, both with a transition piece (TP). A monopile is a single, hollow steel cylinder that is secured to the seabed. The jacket design consists of three to four piles supporting a large lattice jacket structure. The TPs in both designs contain a secondary structure for mounting the WTG, a boat landing, internal and external platform, and various electrical equipment needed during installation and operation. Scour protection involves removing sediment from around the foundation by hydrodynamic forces and surrounding it with stone or rock so it can withstand increased seabed drag created by the presence of the foundation. Offshore wind farms are connected to onshore electrical grids by seabed transmission lines. The export cables are buried about 1.5 to 2.5 m beneath the seafloor.

3.1.2 Current Activity

BOEM currently has 15 active commercial leases and one active research lease offshore the U.S. East Coast, which are in varying stages of development, and all but one of these is in the North Atlantic. Currently, the Block Island Wind Farm is the only operating offshore wind facility on the U.S. East Coast. It consists of five turbines located off the southeast coast of Block Island, Rhode Island. Commercial operations started in December 2016 and the project is expected to operate for 25 years. In addition to Block Island, for lessees that have submitted SAPs, site assessment activities also are considered in this cumulative impacts analysis (Table 3-1).

Table 3-1. Cumulative Effects Projects - Site Assessment Activities

Lease Number	State	Company Name	Initial Date SAP Received	Date SAP Approved	Date Deployed or to be Deployed	Facility Description
OCS-A 0482	DE	GSOE I, LLC	-*	NA*	TBD	One met buoy
OCS-A 0483	VA	Dominion Energy Services, Inc.	5/2014	10/12/2017	Q2 2019	One met buoy
OCS-A 0486	RI & MA	Deepwater Wind New England, LLC	4/1/2016	10/12/2017	TBD	One met buoy
OCS-A 0487	RI & MA	Deepwater Wind New England, LLC	-	NA	TBD	TBD
OCS-A 0490	MD	US Wind, Inc.	11/23/2015	3/22/2018	8/2018	One met tower
OCS-A 0497	VA	Virginia Department of Mines, Minerals and Energy/Dominion Energy Services, Inc.	12/2014**	NA	March-October 2020	One wave/current buoy
OCS-A 0498	NJ	OceanWind LLC	9/15/2017	5/16/2018	8/20/18	Two met buoys
OCS-A 0499	NJ	EDF Renewables Development, Inc.	-	NA	TBD	TBD
OCS-A 0500	MA	Bay State Wind	12/20/16	6/29/17	7/10/17	Two met buoys
OCS-A 0501	MA	Vineyard Wind LLC	3/31/17	5/10/18	5/22/18	Two met buoys
OCS-A 0512	NY	Equinor Wind US, LLC	6/18/2018	NA	TBD	Two met buoys and one wave buoy
OCS-A 0519	DE	Skipjack Offshore Energy, LLC	5/24/2019	NA	TBD	One met buoy
OCS-A 0520	MA	Equinor Wind US, LLC	-	NA	TBD	TBD
OCS-A 0521	MA	Mayflower Wind Energy, LLC	-	NA	TBD	TBD
OCS-A 0522	MA	Vineyard Wind, LLC	-	NA	TBD	TBD

* Note: Site assessment activities will take place outside of the lease area.

** Note: a Research Activities Plan is submitted lieu of a Site Assessment Plan (SAP).

3.1.3 Reasonably Foreseeable Future Activities

For the purposes of the cumulative effects analysis, BOEM assumes site characterization surveys on all existing leases during the life of the proposed project will occur. The following describes the assumptions for survey and sampling activities:

- Site characterization would likely take place in the first three years following execution of the lease (based on the fact that a lessee would likely complete the majority of site characterization prior to installing a meteorological tower and/or buoy, which would leave approximately two years for site assessment).

- Lessees would likely survey most or all of the proposed lease area during the 5-year site assessment term to collect required geophysical information for siting of a meteorological tower and/or buoys and commercial facilities (wind turbines). The surveys may be completed in phases, with the meteorological tower and buoy areas likely to be surveyed first.
- The lessee would likely survey most or all OCS blocks in the traffic separation scheme (TSS) buffer zone since cable may be buried in the buffer zone area (although no site assessment structure placement would be allowed in the TSS buffer zone).
- Lessees would not use air guns, which are typically used for deep penetration two-dimensional or three-dimensional exploratory seismic surveys to determine the location, extent, and properties of oil and gas resources (BOEM 2016c).

Table 3-2 describes the typical site characterization surveys, the types of equipment and/or method used, and which resources the survey information would be used to inform (BOEM 2016c).

Table 3-2. Site Characterization Survey Assumptions

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

[a] 30 CFR § 585.610(b) and 30 CFR § 585.626(a)(1)
[b] 30 CFR § 585.626(a) and 30 CFR § 585.610–585.611
[c] 30 CFR § 585.610(b)(1) and 30 CFR § 585.626(a)(4)
[d] 30 CFR § 585.610(b)(4) and 30 CFR § 585.616(a)(2)
[e] 30 CFR § 585.610(b)(5) and 30 CFR § 585.626(a)(3)

A SAP describes the activities (e.g., installation of meteorological towers and buoys) a lessee plans to perform for the assessment of the wind resources and ocean conditions of its commercial lease. BOEM assumes that, for each leasehold[1] projected: 0-1 meteorological towers, 1-2 buoys, or a combination, would be constructed or deployed (BOEM, 2012a). Table 3-3 presents the projected activity for Atlantic coastal states as of January 2012. Table 3-4 presents the vessel trips associated with those projected activities.

Table 3-3. Projected Site Characterization and Site Assessment Activities

Wind Energy Area (WEA)	Leaseholds	Site Characterization Activities		Site Assessment Activities	
		HRG Surveys* (max nm/hours)	Sub-bottom Sampling	Meteorological Towers	Meteorological Buoys
New Jersey	7	31,100/6,900	900 – 2,500	7	14
Delaware	1	9,300/2,100	300 – 700	0	1
Maryland	2	7,100/1,600	200 – 600	2	4
Virginia	3	12,600/2,800	400 – 1,000	3	6
Massachusetts	5	63,500/14,100	668 -2,700	5	10
New York	1	-	-	1	2

* For HRG surveys, the scenario assumes a vessel speed of 4.5 knots and 10-hour days (daylight hours minus transit time to and from the site).

Table 3-4. Total Vessel Trips Associated with Site Characterization and Assessment Activities

Wind Energy Area (WEA)	Site Characterization Activities	Site Assessment Activities
Mid-Atlantic (NJ, DE, MD, VA)	3,300 – 6,400	1,750 – 5,630
Massachusetts	2,588 – 4,800	220 – 1,700
New York	200 – 600	150 – 400

For purposes of the cumulative analysis, potential future offshore wind construction activities are classified based on their stage in the leasing and permitting process, the quantity of information BOEM has about the activity, and the economic viability of the activity. Table 3-5 sets forth the tiers of activity and the analytical approach BOEM is using for each tier. While BOEM only considers Tier 1 and Tier 2 activities to be reasonably foreseeable future actions under 40 CFR §1508.7, BOEM believes that given the nature and scope of any proposed action, it is prudent at the COP stage to analyze more speculative potential activities within its jurisdiction. Such analysis is commensurate with the level of detail of BOEM’s knowledge and in full acknowledgement of uncertainties regarding the nature and scope of the activities and the resulting potential for cumulative impacts.

Offshore wind leasing activities on the U.S. East Coast are summarized in Table 3-5, with details for activity in each lease area provided in Table 3-6. Tier 1 projects that have an approved permit or plan include the Coastal Virginia Offshore Wind (CVOW) Project, and the proposed Atlantic City Wind Farm. The South Fork Wind Farm, Vineyard Wind, and Bay State Wind have submitted COPs to BOEM and are considered Tier 2 projects.

[1] A commercial lease gives a lessee the exclusive right to subsequently seek BOEM approval for the development of the leasehold, i.e., a specific area over which BOEM has granted development rights to a specific lessee. The lease itself does not grant the lessee the right to construct any facilities, but only authorizes the lessee to use the leased area to develop its plans. The lessee then must submit its plans to BOEM for approval before the lessee can move on to the next stage of project development.

The proposed Bay State Wind project has recently become a Tier 2 project with the submission of a COP. This project is a designated Fixing America's Surface Transportation (FAST-41) Act project.[2] The proposed Revolution Wind Farm is considered a Tier 3 project as it has secured a 400 MW Power Purchase Agreement (PPA) with the State of Rhode Island and a 200 MW PPA with the State of Connecticut, but the project has not yet submitted a COP to BOEM. In addition, the Skipjack Wind Farm and the U.S. Wind project offshore Maryland are considered Tier 3 projects as they were awarded Offshore Renewable Energy Credits (OREC) from the state of Maryland.

Proposed offshore wind projects are assumed to include similar components such as wind turbines, collection cable systems, cable corridors, offshore substations, and onshore interconnection facilities. It is further assumed that potential offshore wind projects will employ the similar construction, operation, and decommissioning activities.

[2] PPAs and ORECs are binding commitments with state agencies to construct and operate offshore wind. PPAs are a commitment from a utility or state to purchase power produced at a specific offshore wind facility, while ORECs are credits or certificates awarded from the state to the offshore wind developer that facilitate financing for proposed offshore wind projects. FAST-41 is a federal program designed to streamline federal environmental review and authorization for covered infrastructure projects. Proposed projects that have signed PPAs, ORECs, or are designated FAST-41 projects are more likely to be constructed and have more project specific information available.

Table 3-5. Tiers for Offshore Wind Construction Activities[3]

Tier	Stage of Permitting/Assessment	CEA / Approach	Offshore Wind Project Stage				Lease Area/Project
			COP	**PPA/ OREC**	**FAST-41**	**Lease Award**	
Tier 1	Approved – The project has an approved permit or plan (e.g. construction and operations plan).	Primarily quantitative (calculation of potential project impacts is possible in most cases)	Approved	Possible	Possible	Yes	• Coastal Virginia Offshore Wind (CVOW) (OCS-A 0497)
Tier 2	Advanced – The project has a submitted permit application or plan, or the submission of a permit application or plan is anticipated in the summer of 2019.	Primarily quantitative (calculation of potential project impacts is possible in most cases)	Submitted	Possible	Possible	Yes	• South Fork Wind Farm (MA) (OCS-A 0486) • U.S. Wind (MD) (OCS-A 0490) • Ocean Wind (NJ) (OCS-A 0498) • Bay State Wind (MA) (OCS-A 0500) • Empire Wind (NY) (OCS-A 0512) • Skipjack Wind (DE) (OCS-A 0519) • Vineyard Wind (MA) (OCS-A 0501)
Tier 3	Preliminary—no submitted permit or plan, but the project has been awarded a PPA/ OREC and/or is a designated FAST-41 project.	Quantitative based on information available, and Qualitative	Not submitted	Possible	Possible	Yes	• Revolution Wind (MA) (OCS-A 0486)

[3] Call areas and Wind Energy Areas (WEAs) that have no proposed sale notice (PSN) or final sale notice (FSN) and unsolicited requests are highly speculative, do not have sufficient project information available to even conduct a meaningful qualitative analysis, and are therefore not considered. Call areas and WEAs that have no PSN or FSN along the East Coast include the New York Bight Call Area offshore New York; the Wilmington West Wind Energy and Wilmington East Wind Energy Areas offshore North Carolina; and the Grand Strand, Winyah, Cape Romain, and Charleston Call Areas offshore South Carolina. In addition to the offshore wind projects identified, BOEM received an unsolicited lease request in 2016 for a proposed offshore wind farm that greatly overlaps with Fairways South and for cumulative impacts consideration is included in the New York Bight. If BOEM decides to move forward with this application, it will issue a public notice to determine whether or not there is competitive interest in bidding for a lease. To date, no public notice has been issued and the project is not considered reasonably foreseeable.

Table 3-5. Tiers for Offshore Wind Construction Activities[3]

Tier	Stage of Permitting/Assessment	CEA / Approach	Offshore Wind Project Stage				Lease Area/Project
			COP	PPA/ OREC	FAST-41	Lease Award	
Tier 4	Very Preliminary – The project has an active lease with BOEM and the adjacent state(s) have made commitments to the procurement of offshore wind energy.	Qualitative	Not submitted	No	No	Yes	• GSOE I, LLC (DE) (OCS-A 0482) • Atlantic Shores Offshore Wind, LLC (NJ) (OCS-A 0499) • Vineyard Wind, LLC (MA) (OCS-A 501, Southern Portion) • Equinor Wind US, LLC (NY) (OCS-A 520) • Mayflower Wind Energy, LLC (MA) (OCS-A-521) • Vineyard Wind, LLC (MA) (OCS-A 522) • Sunrise Wind (RI/MA) (Portions of OCS-A 0487 and OCS-A 0500) • Maine Aqua Ventus Project (ME)
Tier 5	Active leases and identified lease areas that have moved towards auction through the announcement of a proposed sale notice or final sale notice.	Qualitative	Not submitted	No	No	Yes or lease areas identified through sale notice	• Virginia Electric and Power Company (OCS-A 0486) • Kitty Hawk Offshore Wind (NC) (OCS-A 0508)

Table 3-6. Offshore Wind Leasing Activities in the U.S. East Coast as of June 2019

Project Tier	Lease Number	States	Project/Company Name	Construction Date	Operations Date	Facility Description	BOEM Permitting Stage	PPA/OREC Status
Tier 1	OCS-A 0497	Virginia	Coastal Virginia Offshore Wind (CVOW) (Virginia Electric and Power Company/Orsted)	2020	2022	12 MW, two WTGs	Research Activities Plan approved, Revised RAP pending approval	VA State Corp Commission approval, 11/02/18
Tier 2	OCS-A 0486	Rhode Island	South Fork Wind Farm (Deepwater ONE) / Deepwater Wind New England, LLC	2021	2022	130 MW, up to 15 WTGs	COP submitted June 2018	PPA signed 20-year with the Long Island Power Authority in 2017
	OCS-A 0490	Maryland	U.S. Wind (MD)	2021	2022	250 MW, 32 WTGs	Lease granted, COP anticipated Summer 2019	OREC awarded by State of Maryland
	OCS-A 0498	New Jersey	Ocean Wind (NJ)	2022	2024	1,100 MW	Lease granted, COP anticipated Summer 2019	No PPAs signed to date
	OCS-A 0500	Massachusetts	Bay State Wind LLC	Q4 2022	Q3 2023	110 WTGs. Two export cables landing in Somerset, MA with power going to Brayton Point	COP submitted March 2019	No PPAs signed to date.
	OCS-A 0501	Massachusetts	Vineyard Wind/Vineyard Power	2019	2021	800 MW, 106 WTG positions	COP submitted December 2017	PPA signed with MA electric distribution companies, 08/01/2018
	OCS-A 0512	New York	Empire Wind / Equinor, LLC	2022	2024	1,000 – 1,500 MW	Lease granted, COP anticipated 2019	No PPAs signed to date

Table 3-6. Offshore Wind Leasing Activities in the U.S. East Coast as of June 2019

Project Tier	Lease Number	States	Project/Company Name	Construction Date	Operations Date	Facility Description	BOEM Permitting Stage	PPA/OREC Status
	OCS-A 0519 (formerly OCS-A 0482)	Delaware	Skipjack Wind Farm/Deepwater Wind	2021	2022	120 MW, 15 WTGs	Lease granted, COP submitted April 2019	OREC awarded by State of Maryland
Tier 3	OCS-A 0486	Rhode Island	Revolution Wind / Deepwater Wind New England, LLC	2022	2023	600 MW, 50 WTGs	SAP approved, COP in progress	PPA signed with the State of Rhode Island for 400 MW and the State of Connecticut for 200 MW
Tier 4	OCS-A 0482	Delaware	GSOE I, LLC	TBD	TBD	TBD	Lease granted	No PPAs signed to date.
	OCS-A 0499	New Jersey	U.S. Wind (NJ)	TBD	TBD	TBD	Lease granted	No PPAs signed to date
	OCS-A 501	Massachusetts	Vineyard Wind, LLC	TBD	TBD	TBD	Lease granted	No PPAs signed to date
	OCS-A 0520	Massachusetts	Equinor Wind US, LLC	TBD	TBD	TBD	Lease granted	No PPAs signed to date
	OCS-A 0521	Massachusetts	Mayflower Wind Energy, LLC	TBD	TBD	TBD	Lease granted	No PPAs signed to date
	OCS-A 0522	Massachusetts	Vineyard Wind, LLC	TBD	TBD	TBD	Lease granted	No PPAs signed to date
	Portions of OCA-A 0487 and OCS-A 0500	Rhode Island/ Massachusetts	Sunrise Wind, Orsted U.S. Offshore Wind	TBD	TBD	TBD	Lease granted	No PPAs signed to date
	NA (located in state waters)	Maine	University of Maine Aqua Ventus Project (floating wind turbines)	2021	Late 2021	12 MW, 2 WTGs	NA (located in state waters).[a]	PPA being evaluated by the Maine Public Utilities Commission
Tier 5	OCS-A 0483	Virginia	Virginia Electric and Power Company	TBD	TBD	TBD	Lease granted, SAP approved	No PPAs signed to date
	OCS-A 0508	North Carolina	Kitty Hawk Offshore Wind/Avangrid	TBD	TBD	TBD	Lease granted	No PPAs signed to date

3.1.4 Impact-Producing Factors Associated with Offshore Wind Energy

Potential impact-producing factors from offshore wind energy are provided in the following table.

Table 3-7. Offshore Wind Energy Development Impact Producing Factors

Activity	Impact Producing Factors (IPF)
Accidental releases	fuel/fluids/hazmat fuel/fluids/hazmat, structures suspended sediments trash and debris
Air emissions	onshore structures, generators vessels
Anchoring	bottom-founded structures
Discharges	onshore point source and non-point sources, structures vessels
Electromagnetic fields	
Energy generation/security	
Light	vessels or offshore structures, above water vessels, above water
New cable emplacement/maintenance	
Noise	aircraft G&G O&M pile driving turbines vessels
Port Utilization	expansion
Presence of structures	allisions entanglement, gear loss/damage fish aggregation habitat creation migration disturbances navigation hazard onshore seabed alterations offshore, space use conflicts towers transmission cable infrastructure turbine strikes, birds/bats viewshed
Traffic	aircraft vessels vessels, collisions

Microclimates

In reviewing potential IPFs for OCS wind energy generation, consideration was given to a potential IPF that is particular to wind turbines – their potential microclimate effects. Although a demonstrated effect, studies of the nature and magnitude of microclimate impacts are sparse. A graphic example of the effect is shown in Figure 3-1, which shows the turbulence field behind the Horns Rev 1 offshore wind turbines (Watts 2011). Unique meteorological conditions resulted in the wind turbines creating condensation (i.e. clouds) from very humid air close to its condensation point. The air is cooled by the wind turbine as it removes energy from the air and condensation creates the turbulence pattern behind the turbines. The conditions necessary for this

Figure 3-1. Condensation in the Turbulence Field of Wind Energy Turbines

Photograph: Christian Steiness

visual effect to occur are rare, with this effect only having been documented as occurring twice in the 17 years of ongoing operation (Hasager *et al.* 2017).

Effects data in the public domain appear to be only from onshore studies. In 2010 Roy and Traiteur examined data from a meteorological field campaign that showed wind farms can affect near-surface air temperatures, reducing daytime temperatures about 2-3.5 degrees C and elevated nighttime temperatures about 0.5 degrees C near the turbines (the height and distance downwind of the data tower were not provided). This effect was replicated in a modeling effort and results indicated the effect was from enhanced vertical mixing due to turbulence generated by wind turbine rotors.

Another effect that has been observed (Dybas and Knoss, 2018) is that a wake effect from upwind wind farms can reduce the energy production of downwind neighbor turbines. Turbine wakes may extend up to 25 miles, potentially spanning multiple state and county jurisdictions. Using publicly available data on monthly energy generation and dominant wind direction, the researchers modeled the wake effect on a pair of West Texas wind farms, using a third wind farm as a control. They found wind speed reductions due to the establishment of an upwind farm reduced power generation at the downwind farm by 5 percent between 2011 and 2015, an estimated revenue loss of around $3.7 million.

Another effect that can be either macro- or microclimate in nature is ice formation on rotor blades. This can occur at a macro level due to meteorological icing but can also occur at temperatures above freezing due to the cooling and condensation effect of wind turbines (see Figure 3-1). Bredesen (2017) provided a risk analysis of ice throws from rotor blades, with the primary focus of health and safety. Theoretical modeling provided a maximum throw distance of 1.5x(D+H) or about 1,100 feet. However, ice debris only has been found at 68% of the maximum throw distance (i.e., about 750 feet). Bredesen went on to calculate risk probability isopleths for serious injury or death around a turbine. Some consideration may be warranted with respect to awareness of this phenomenon for recreational fishermen who may frequent these marine structures, which serve as fish attractants, under weather conditions that could create ice throws.

Electromagnetic Fields

Another consideration in IPFs particular to offshore wind energy generation is the consideration of electromagnetic fields (EMF) generated by submarine transmission cables. Numerous species are sensitive to magnetic fields; sensitivity is highly variable even at an interspecies level. It appears the magnetic field strength of subsea cables is above the limit of detectability for sensitive species and below that for others. Impacts are difficult to characterize, e.g., attractive and repulsive to different species and at different power levels and often confounded by seabed alterations and impacts from cable burial. Representative data on EMF strength surrounding seabed cables, in microTesla (uT), for two offshore wind energy projects are as follows:

***South Fork*:**

Cable Rating	138 kV			
Horizontal Distance (Seabed)	0’	25’	50’	75’
Magnetic Field, uT	0.30	0.18	0.05	0.02

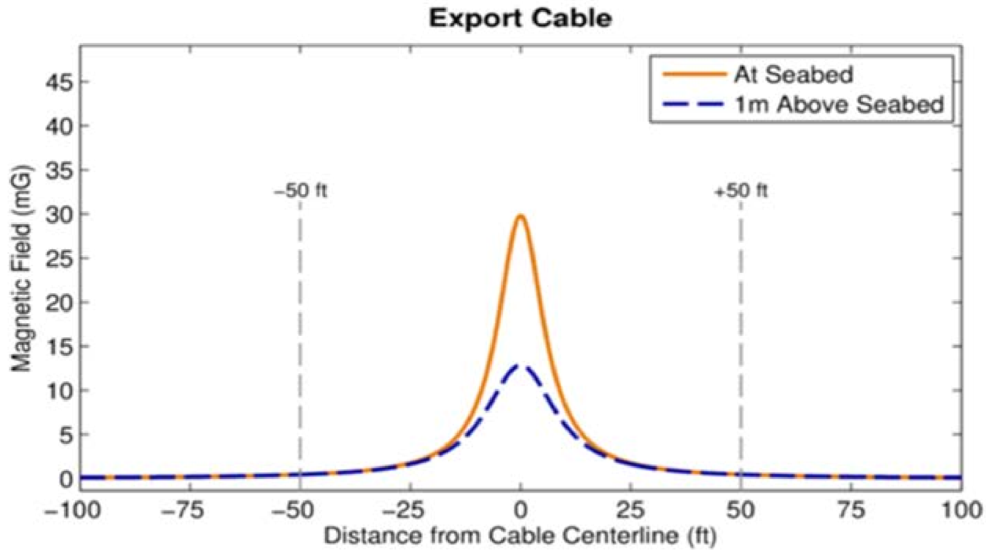
Block Island:

Cable Rating	34.5 kV		
Horizontal Distance (Seabed)	0’	6’	40’
Magnetic Field, uT	2.2	0.60	0.05

Normandeau et al. (2011) compiled field measurement and modeling data for 10 seabed transmission cables. Because many of the projects they reviewed involved single 3-core cables buried in varying depths, they created tables (Appendix Tables B-2 and B-9 through B-12 of their study) that can be used to estimate the magnetic field of AC in future projects with similar arrangements. Because the magnetic field scales linearly with line current, the tables can be used to predict the AC magnetic field at locations along and above the seabed for a cable with a known line current and a burial depth of 0.5 m, 1 m, 1.5 m, or 2 m. Similarly, another set of tables in Normandeau et al. 2011 (Appendix Tables B-7 and B-8) can be used to estimate the magnetic field of DC cables in future projects with similar arrangements to predict the DC magnetic field at locations along and above the seabed for a cable with a known line current and a burial depth of 1 m and cable separations of 0.5 m and 1 m.

Modeling of EMF strength was performed for the Deepwater Wind South Fork Wind Farm and showed a steep decline in field strength with distance from both export and inter-array. Graphical results are shown in Figure 3-2 (Exponent Engineering 2018). Magnetic field strength in the figure below is shown in milliGauss (mG), where 1 uT = 10 mG. To provide some context, the earth’s magnetic field strength (NOAA, 2019) off

Figure 3-2. Modeled EMF Field Strength for the South Fork Wind Farm Export Cable



Source: Exponent Engineering, 2018

the Atlantic coast of the U.S. ranges from approximately 51.6 uT in the Gulf of Maine to 50.6 uT near the New York Bight, to 49.9 uT off the mouth of the Chesapeake Bay[4]. From Figure 3-2, the maximum magnetic field strength directly over the cable at the surface of the seabed is about 60% that of the magnetic field strength of the earth, while at 1 meter above the seabed it decreased to about 25% that of the earth's magnetic field strength. At 50 feet laterally in either direction from the cable, the magnetic field strength declined to about 2% that of the earth's magnetic field strength.

BOEM (2018d) demonstrated that behavioral responses occur in lobsters and skates exposed to EMF from a subsea high voltage direct current (HVDC) cable. Studied behaviors included; total distance traveled, speed of movement, height from the seabed, and proportion of large turns. The effects on behavior were more strongly detected in skates than lobsters. The responses to cable EMF produced subtle but significant changes in the movement and distribution of lobsters and skates within an enclosure space placed above a subsea power cable. Although behavioral changes occurred, both species made full use of their enclosures and the EMF did not present a barrier to their movement.

For lobster tests, the EMF of the HVDC cable operated at a constant power of 330 MW, corresponding to 1,175 amps and a maximal magnetic field of 65.3 μT. During tests on skates, the cable power varied at 0, 100, and 330 MW, corresponding to 16, 345 and 1,175 amps, and magnetic fields of 51.6, 55.3 and 65.3 μT. The study also found the HVDC cables had an AC component to the EMF complicating their interpretation of skate responses. The AC electric field was well within the range of electric field levels known to attract benthic elasmobranchs (i.e., 0.5 to 1000 μV/m).

The results of the study implied there is a low likelihood of significant biological impact associated with a single cable operating at a constant 330 MW or less. The authors noted two cases where their findings may not hold: (1) cables carrying more than 330 MW, which may create an avoidance behavior; and (2) cables that carry a varying power load, which may interfere with the learning behavior of organisms that need consistency to recognize that EMF from subsea cables are not a potential source of food and not expend energy unproductively. This study also found EMF from HVDC cables varied spatially along the length of the cable as a consequence of cable properties and burial depth. If skates encountered higher intensity fields,

[4] Based on NOAA's National Centers for Environmental Information World Magnetic Map model magnetic field strength calculator https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml#igrfwmm Accessed 03/20/19

it may lead to some level of avoidance behavior that would only present a potential impact if avoidance led to higher net energetic costs or avoidance of areas important in the life history of the species.

3.2 Renewable Energy – Other (Tidal/Wave/Hydrokinetic)

3.2.1 Description of Action and Activities

Current hydrokinetic energy technologies depend on the horizontal movements of river currents and ocean currents (tidal and stream) to drive a generator that converts mechanical power into electrical power. Current energy devices are often rotating machines that can be compared to wind turbines – a rotor spins in response to the movements of water currents. The rotor may have an open design like a wind turbine or may be enclosed in a duct that channels the flow. Further, the rotor may be characterized by conventional "propeller-type" blades or helical blades.

The extraction of energy from ocean currents requires a location that has strong, steady currents. The only ocean current that has these characteristics on the OCS is the Florida Current, located off the eastern coast of North America. Therefore, the analysis of ocean current energy capture technologies would be limited to impacts associated with the geographic area of the Florida Current in waters deeper than 100 m (328 ft).

3.2.2 Current Activity

The majority of marine and hydrokinetic power projects are pilot or test sites. Tidal energy projects that are in operation include:

- The Bourne Tidal Test Site (BTTS) located in the Cape Cod Canal near Bourne, Massachusetts, is a testing platform for tidal turbines that was installed in late 2017 by the Marine Renewable Energy Collaborative (MRECo). The BTTS offers a test platform for tidal turbines (MRECo 2018).
- Cobscook Bay Tidal Project, located in Maine, is a FERC-licensed tidal project that began operations in 2012. The project owner, Ocean Power Energy Company, has informed FERC that it will not apply for relicensing and removal and site restoration activities are anticipated to be conducted prior to its current license expiration date in January 2022.

3.2.3 Reasonably Foreseeable Future Activities

One tidal energy project that has been proposed should be monitored to determine if it merits inclusion in the reasonably foreseeable future cumulative impact scenario. The Muskeget Channel Tidal Test Site/ Edgartown-Nantucket Tidal Energy Power Plant Project is located in Muskeget Channel between Martha's Vineyard and Nantucket. The Town of Edgartown proposed the project to be developed in two phases: a pilot 1.5 MW project, followed by deployment of a 10 to 15 MW project. The Town of Edgartown had submitted a FERC pilot project license application, but a license was not awarded due to an incomplete application. While some site assessment studies have been conducted, additional studies and permitting must be completed prior to deployment of either the pilot project, or the full 10 to 15 MW project (MRECo 2017). The project does not currently hold a preliminary permit or a pilot project license from FERC.

FERC awarded a preliminary permit in 2016 to the Western Passage Tidal Energy Project, a proposed tidal energy site in the Western Passage (Tethys 2018). The preliminary permit allows developers to study a project but does not authorize construction. The project is located in U.S. waters very near the Canadian-U.S. border. It is located in a sheltered, sound-side passage and very unlikely to interact with wind energy development, so has not been considered to be a reasonably foreseeable future activity for the purposes of wind energy development in the North Atlantic.

Other tidal projects that are not considered reasonably foreseeable for the purpose of this analysis include the FERC-licensed New York Roosevelt Island Tidal Project, which is located in the East River and not likely to contribute to cumulative impacts of offshore wind energy development, and the Cape and Islands Tidal Project, which was proposed for Vineyard Sound but does not appear to be moving forward.

Currently, there are no impacts expected in the cumulative impacts scenario from tidal renewable energy development, and thus no interaction with any wind energy development IPFs. Until a reasonably foreseeable action, e.g., permitting or approval of a proposed construction plan for a tidal energy project is issued, tidal renewable energy development does not need to be included in cumulative impact analyses for wind energy development in the North and Mid-Atlantic. Therefore, in Chapter 4 of this document, tidal renewable energy is not discussed.

3.2.4 Impact-Producing Factors Associated with Tidal Energy

Potential IPFs of tidal energy projects that could overlap with offshore wind energy development include:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, trash and debris
- Air emissions, vessels
- Anchoring, bottom-founded structures
- Discharges, vessels
- Electromagnetic fields
- Energy generation, energy security
- New cable emplacement/maintenance
- Noise, vessels
- Presence of structures, disturbed hydraulics/hydrologic regimes
- Presence of structures, fish aggregation
- Presence of structures, habitat creation
- Presence of structures, migration disturbances
- Presence of structures, navigation hazard
- Presence of structures, transmission cable infrastructure
- Presence of structures, seabed alterations
- Presence of structures, offshore space use conflicts
- Traffic, vessels
- Traffic, vessel strikes, sea turtles and marine mammals.

The IPFs of tidal renewable energy, other than those that overlap with offshore wind energy development IPFs, include anchoring of bottom founded structures and disturbed hydraulic and hydrologic regimes from the presence of structures.

3.3 MARINE MINERALS

3.3.1 Description of Actions and Activities

Section 8(k) of the OCS Lands Act (OCSLA) and its 1994 amendments, provide BOEM the authority to negotiate an agreement for the use of OCS sand, gravel, and shell resources for shore protection and beach or coastal restoration. Using offshore sand for beach replenishment has occurred off the Atlantic coast for decades (Table 3-8). However, storms Katrina and Sandy brought into high relief the national importance of coastal remediation and resiliency measures. Coastal erosion and storm damage seriously affected the sustainability of coastal ecosystems and economies. These two storms presented multiple challenges for tourism and coastal development, marine transportation, fisheries, energy development, and both defense and strategic infrastructure.

Table 3-8. Minerals Mining Lease Activity, Maine through Virginia, 1998-Present

State	Lease No	Project ID	Status	Initiation Date	Original Authorized Vol (cy)	Total Vol w/ Amendments (cy)	Borrow Area
VA	OCS-VA-1996	Dam Neck Naval Facility	Complete	5/15/1996	808,600	808,600	Borrow Area B, Borrow Area BB
MD	OCS-MD-1998	Assateague	Complete	7/30/1998	134,000	134,000	Great Gull Bank A
VA	OCS-A-0452	Sandbridge Beach	Complete	4/21/1998	1,875,000	1,875,000	Borrow Area A, Borrow Area B
MD	OCS-MD-2003	Assateague	Complete	9/28/2001	1,800,000	1,800,000	Great Gull Bank B
MD	OCS-A-0456	Assateague	Complete	9/17/2001	100,000	100,000	Great Gull Bank C
VA	OCS-A-0457	Sandbridge Beach	Complete	3/26/2002	1,500,000	2,000,000	Borrow Area B, Borrow Area BB
VA	OCS-VA-2003	Dam Neck Naval Facility	Complete	9/26/2003	700,000	700,000	Borrow Area B, Borrow Area BB
VA	OCA-A-00467	Sandbridge Beach	Complete	5/15/2007	2,000,000	2,100,000	Borrow Area A, Borrow Area B
VA	OCS-A-0480	Wallops Island	Complete	8/3/2011	3,200,000	3,500,000	Sub Area A-1, Sub Area A-2
VA	OCS-A-0485	Sandbridge Beach	Complete	10/11/2012	2,000,000	2,200,000	Borrow Area A, Borrow Area B1, Borrow Area B2
VA	OCS-A-0492	Dam Neck Naval Annex	Complete	7/13/2013	700,000	700,000	Borrow Area A, Borrow Area B
NJ	OCS-A-0505	Long Beach Island	Active	7/1/2014	7,000,000	10,000,000	D2 Borrow Area
VA	OCS-A-0494	Wallops Island	Complete	11/14/2013	1,000,000	1,000,000	Sub Area A-1, Sub Area A-2

Marine mineral activities on the OCS typically include the performance of G&G surveys and dredging of sediment for use in beach nourishment and wetland restoration projects. G&G surveys may occur (1) prior to leasing during the initial sand resource exploration phase, which may include surveys to map the sediment or clear the area for cultural or environmental resources; or (2) on-lease for the purpose of borrow area monitoring, before and after dredging and construction.

Dredging of OCS resources is typically performed using either a hopper dredge or a cutterhead dredge. The hopper dredge suctions the material into the hull of the dredge and brings it closer to the project area where the dredge then connects to a pipeline, that is either floating or travels along the seabed, to pump the material onshore. The Cutterhead dredge pumps material directly to the project area or onto a scow to be transferred closer to the project area.

3.3.2 Current Activity

BOEM currently has active leases for OCS sand resources along the Atlantic and Gulf of Mexico coasts. Table 3-9 lists the currently active negotiated agreements, and pending requests, from Maine to Virginia.

Table 3-9. BOEM Marine Minerals Program – Requests and Active Leases (December 2018) in the Cumulative Study Area

Current Active Agreement/ Request	State	Applicant (s)	Request date	Project Area	Volume Requested (Cubic Yards)	Borrow Area Location
Active Negotiated Agreements	NJ	Long Beach Island, Barnegat Inlet to Little Egg Harbor Inlet, NJ (Amendment)	7/1/2014	Harvey Cedars, Surf City, Long Beach Township, Ship Bottom, and Beach Haven	10,000,000	Borrow Area D2
Current Request	VA	Norfolk District and City of Virginia Beach, VA	11/20/2017	5 mi shoreline Sandbridge Beach	2,200,000	Sandbridge Shoal

Source: BOEM 2018

There also is current leasing activity along the Atlantic coast from North Carolina to Florida. As of December 2018, there are four active lease agreements on the OCS offshore of Florida and one offshore the Myrtle Beach area of South Carolina. There is one current lease request from Carteret County, North Carolina to nourish the Bogue Banks beaches, which are located southwest of Cape Hatteras, more than 250 km from the Virginia/North Carolina border.

3.3.3 Reasonably Foreseeable Future Activities

Following Hurricane Sandy, response efforts among the Atlantic coastal states and the federal government have shifted to a more proactive, regional approach to coastal resilience. BOEM and 13 coastal Atlantic states entered into cooperative agreements to perform research that will improve resilience planning efforts by finding areas for future G&G surveys to confirm previously identified resources and locate new areas of sand resources. BOEM is funding a similar effort in the Gulf of Mexico as part of an effort to create a national offshore sand inventory.

BOEM is also supporting an initiative, the Atlantic Sand Assessment Project (ASAP), using approximately $6.2 million for G&G surveys in 2015 for areas 3 to 8 nautical miles offshore, from Massachusetts to Miami, Florida. BOEM sought to find and delineate new potential OCS sand resources for potential use in coastal restoration projects. BOEM supported more detailed surveys in 2016 and 2017 in specific areas offshore New York, New Jersey, and Delaware to estimate the volumes and the extent of potential new sand resources.

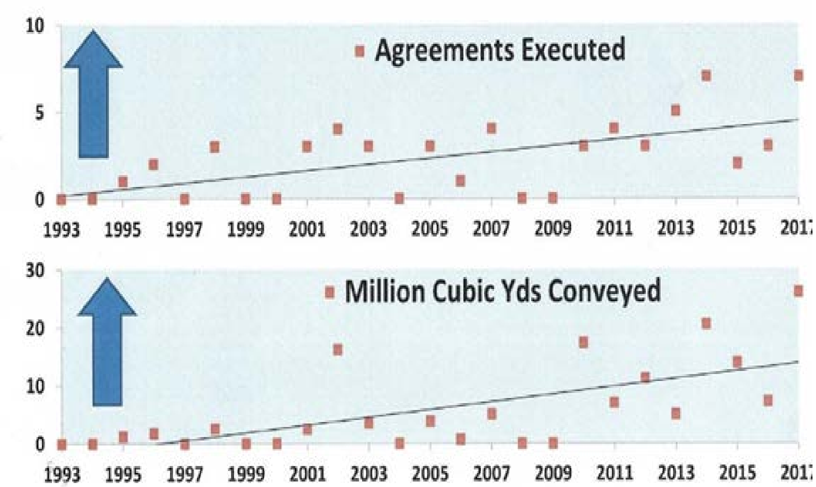
BOEM evaluated potential impacts from G&G surveys to map OCS sand resources and included several mitigation measures to minimize effects on environmental resources and historic properties: no air guns were used; no dredging was conducted; a marine archaeologist ensured sample locations avoided potential submerged cultural resources such as shipwrecks; and certified biological observers were onboard during all survey work to detect the presence of sea turtles and whales to implement avoidance and stoppage measures as necessary.

ASAP will provide several benefits:

- G&G data from the inventory are compiled in a central Marine Minerals Information System that will eventually share the data through public data portals, e.g., MarineCadastre.gov and the Mid-Atlantic Ocean Data Portal.
- The inventory will help local communities recover more quickly after a hurricane or nor'easter that requires emergency coastal restoration.
- The inventory will help avoid conflicts with other potential uses, such as submarine fiber optic, electric transmission lines, and pipelines.
- The inventory will allow early coordination with other economic sectors, e.g., fisheries or recreation, to avoid or minimize potential adverse impacts.

Nationally, in terms of both the annual number of requests for negotiated agreements and the annual volumes of dredge material removed (Knorr, 2017), the trends show very moderate increases over the past 25 years (Figure 3-3). Assessments of potential interactions with sand mining within the AOI of this document, however, must consider future sand extraction activity within the 25-year time frame of the cumulative impacts scenario.

Figure 3-3. OCS Sand Activity, 1993-2017



Hurricane Sandy triggered numerous emergency management responses, e.g., multiple restorations for U.S. Army Corps of Engineers (USACE) coastal storm risk management projects. These federal projects require using OCS sediment resources to support their short- and long-term needs. Additionally, many non-federal beach nourishment projects pursue Atlantic OCS sand resources for locally-funded efforts. Thus, there appears to be both a short-term and long-term need for utilizing OCS sand resources.

Past and currently known future sand mining activities from Maine to Virginia for 2012 through 2020 are shown in Table 3-10. The data indicate annual volumes of dredged material to be 3.1 million cubic yards for 2012 to 2013; 1.5 million cubic yards for 2014 through 2-16; and 410,000 cubic yards for 2017-2020. BOEM's Marine Minerals Program (MMP) anticipates continued interest in OCS sand and gravel resources from New Jersey and Virginia and new interest from New York and Delaware for sand for beach and dune restoration projects. For the purposes of the cumulative impact scenario, minerals mining activity is expected to be increasing.

The G&G activities associated with finding these resources will contribute no significant impact to the cumulative impacts scenario. However, sand dredging operations have the potential to interact with wind energy development activities under limited circumstances. Direct interactions may occur only within limited spatial and temporal conditions. Both project-level dredging activities and wind energy construction and installation activities are usually relatively short-term efforts−one or two years.

The likelihood of dredging for a series of projects resulting in longer-term impacts, however, is possible. Also, the direct impacts arising from seafloor disturbances have relatively limited potential for spatial interactions, on the order of kilometers. The interactions most likely to occur with wind energy development projects will occur from seafloor disturbances that affect mobile populations, e.g., certain demersal fishes, sea turtles, or marine mammals, which could be exposed to the seabed impacts of both dredging and wind energy structure construction and installation.

Table 3-10. Projected Sand Borrow Projects, Maine-Virginia

Year	State	Volume, yd3
2012-2013	VA	3,200,000
	VA	1,000,000
	VA	2,000,000
	Total	6,200,000
	Annual	3.100,000
2014-2016	DE	360,000
	DE	480,000
	MD	800,000
	VA	806,000
	VA	2,000,000
	Total	4.446,000
	Annual	1,482,000
2017-2020	DE	360,000
	DE	480,000
	MD	800,000
	Total	1,640,000
	Annual	410,000

Source: BOEM, 2014a

3.3.4 Impact-Producing Factors Associated with Marine Mineral Activities

IPFs of OCS marine minerals mining that may overlap with impact producing factors associated with offshore wind energy development include:

- Accidental releases, fuel/fluids/hazmat, vessels
- Accidental releases, trash and debris
- Discharges, vessels
- Noise, O&M
- Traffic, vessel strikes, sea turtles and marine mammals
- Traffic, vessels.

OCS minerals mining IPFs that do not overlap with offshore wind energy includes:

- Gear utilization.

3.4 DREDGED MATERIAL OCEAN DISPOSAL

3.4.1 Description of Actions and Activities

Prior to 1972, ocean dumping in ocean waters of the U.S. was unregulated and included materials such as petroleum products, acid chemical wastes and other industrial wastes, and heavy metals in industrial wastes; organic chemical wastes; contaminated and uncontaminated dredged material; sewage sludge; construction and demolition debris; and containers of radioactive wastes. The Marine Protection, Research and Sanctuaries Act (MPRSA) was enacted in 1972 and regulated the dumping of materials into the marine environment and implemented the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. Four agencies have responsibilities under MPRSA: EPA has primary authority for regulating ocean disposal of all materials except dredged materials; USACE and EPA share responsibilities for regulating ocean disposal of dredged material, USCG maintains surveillance of ocean dumping, and NOAA is responsible for certain long-range research efforts. Currently, the vast majority of material disposed in the ocean is uncontaminated sediment (dredged material).

3.4.2 Current Activities

EPA Regional offices are responsible for designating and managing ocean disposal sites. USACE issues permits for ocean disposal sites and all ocean sites for the disposal of dredged material are permitted or authorized under MPRSA. There are 11 active projects and 12 inactive/closed projects identified in the South Atlantic coast (North Carolina to Florida), and 15 active projects and four inactive/closed projects identified in the North Atlantic coast (Virginia to Maine) (Table 3-11; USACE 2018c). Between 1976 and 2016, 3,273 dredged material disposal events occurred at 125 disposal sites (Ocean Disposal Database 2018).

Table 3-11. Ocean (Dredge Material) Disposal Sites, Maine through Virginia

Site ID	Status	Usage	Disposal Volume, yd^3	Disposal Area, nmi^2
Historic Area Remediation Site, NY	Active	1999-2016 1997- *	79,958,000	16 15.7*
Dam Neck, VA	Active	1981-2015 1988- *	22,000,877	8.0
Massachusetts Bay, MA	Active	1976-2016 1993-2016*	15,555,133	3.1 4.6*
Rhode Island Sound, RI	Active	2003-2015 2005-2015*	7,622,546	1.0 1.0*
Portland, ME	Active	1979-2016 1987- *	5.596,236	1.0*
Shark River, NJ	Active	2002-2006 1990-2006*	4,285,000	0.6 0.6*
Cape Arundel, ME	Active	1976-2016	1,333,329	0.048
Norfolk, VA	Active	2013-2014 1993-2014	1,249,908	50 50.26*
East Rockaway Inlet, Long Island, NY	Active	1976-2010 1990- *	105,800	0.81
Fire Island Inlet, Long Island, NY	Active	1990- *		1.09*
Jones Inlet, Long Island, NY	Active	1990- *		1.19*
Rockaway Inlet, Long Island, NY	Active	1990- *		0.38*
Absecon Inlet, NJ		1990- *		0.28*
Manasquan, NJ		1990- *		0.11*
Cold Spring Inlet, NJ		1990- *		0.13*
Mud Dump, NY	Inactive	1974-1997	124,503,123	2.2*
Barnegat Inlet, NJ	Inactive	1999-2008	1,573,600	0.0*
Axel Carlson Reef, NJ	Inactive	2005-2008	1,120,800	3.0
St. Helena Island, ME	Inactive	1977-1984	134,200	0.0

Sources: USACE Ocean Disposal Database. Sources: USACE (2018c). Environmental Laboratory, U.S. Army Engineer Research and Development Center. Map. Accessed 10/18-18.
*EPA data from interactive Ocean Dumping: Disposal Sites and Vessel Disposals Map

Legacy ocean disposal sites have a potential to be problematic with respect to seafloor disturbances of contaminated sediments for leases offshore New York/New Jersey. There are two discontinued chemical waste dumping sites that may potentially be of concern. One is a 12.3 square mile site used for acid wastes. This site's closest border is located less than 3 miles SW of the New York Lease Area, in which four Statoil Wind LLC lease blocks are located, and approximately 4 miles north of the New York Bight Call Area. A second discontinued dumpsite, a 6.6 square mile site designated as a chemical waste dump site, received municipal sludge. This site is located approximately 7 miles WNW from the western edge of the New York Lease Area (Figure 3-4; MARCO 2018).

Figure 3-4. Legacy Dumping Sites Offshore New York/New Jersey

Source: Mid-Atlantic Ocean Data Portal. Accessed 10-15-18.

3.4.3 Reasonably Foreseeable Future Activities

Because ocean disposal currently consists of dredged material disposal, the activity level of ocean disposal directly follows dredge spoil generation. Although the national trend has been a gradual increase in dredge spoil generation, in the North and Mid-Atlantic region, dredge material disposal appears to be decreasing or remaining stable (see Section 3.3, above, for details).

3.4.4 Impact Producing Factors

Potential impact producing factors of dredged material ocean disposal that may interact with those for wind energy development include:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, trash and debris
- Air emissions, vessels
- Discharges, vessels
- Noise, vessels
- Traffic, vessel strikes, sea turtles and marine mammals
- Traffic, vessels.

Dredged material ocean disposal IPFs that will not materially overlap wind energy development include:

- Beach restoration, improved coastal/dune habitat
- Port utilization, maintenance, dredging
- Sediment deposition and burial.

3.5 MILITARY RANGES AND CIVILIAN SPACE PROGRAM USES

3.5.1 Description of Activities

There are numerous areas off the Atlantic Coast where military and space program activities are occurring. Military activities occurring in the North and Mid-Atlantic coastal area from Maine to Virginia include various testing, training, and operational missions conducted by the U.S. Navy (Navy), Marine Corps, the U.S. Air Force (Air Force), and Special Operations Forces among others. Military vessels use surface and subsea areas for training and testing activities. Military aircraft test and train within special use airspace overlying the coast and in offshore warning areas.

With respect to the OCS area, the following mission readiness activities are occurring (Secretary of Defense 2017):

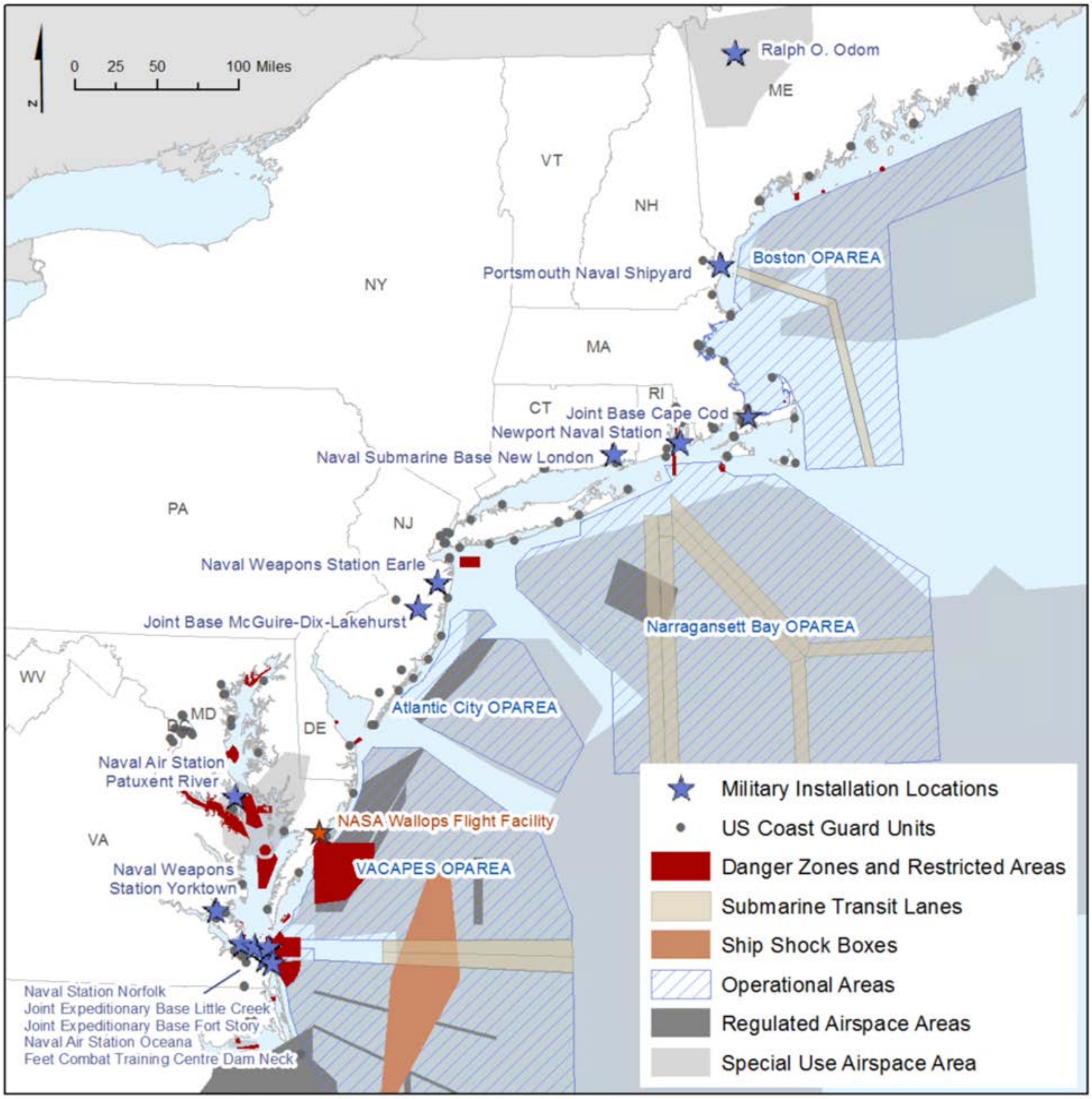
- Navy use of airspace, sea surface, sub-surface and seafloor of the OCS for events ranging from instrument equipment testing to live-fire exercises;
- Air Force flight training and systems testing; and
- Marine Corps amphibious warfare training.

The Navy, USCG, Air Force and Air National Guard are also responsible for search and rescue missions on the Atlantic coast, which may involve the use of low flying aircraft and helicopters offshore. The Navy, the USCG, Air Force, and other military entities also operate onshore facilities along this portion of the Atlantic coast, which often support offshore activities. Major onshore installations are shown on the map in Figure 3-5. In addition to the 12 facilities shown on the map, there are a number of USCG stations along the Atlantic coast.

Areas where training and testing of military platforms, tactics, munitions, explosives, and electronic warfare systems occur are designated as “range complexes,” which provide controlled environments where military ship, submarine, and aircraft crews can train in realistic conditions while safely deconflicting with non-military activities, such as civilian shipping and aircraft. However, these are not areas over which the Navy has exclusive control. In cases where naval vessels and aircraft conduct operations that are not compatible with commercial or recreational activities, they are confined to Operating Areas (OPAREAs) away from commercially used waterways and inside Special Use Airspaces (SUA). Hazardous operations are communicated to all vessels and operators by use of Notices-to-Mariners issued by the USCG and Notices-to-Airmen issued by the FAA. Figure 3-5 illustrates OPAREAs and SUAs along the Atlantic coast from Maine to Virginia.

In addition, the National Aeronautics and Space Administration’s (NASA’s) Goddard Space Flight Center’s (GSFC’s) Wallops Flight Facility (Wallops) is located on Virginia’s eastern shore. GSFC owns and operates the launch range at Wallops. This facility is used to conduct science, technology, and educational flight projects aboard rockets, balloons, and unmanned aerial vehicles, using Atlantic waters for operations (NASA 2018). Since 2006, launches from Wallops have grown in number and importance to the Nation’s space and national defense priorities and programs. Wallops is one of the Nation’s few launch ranges to support medium to large vehicle class satellite launches (BOEM 2014a), and NASA’s only rocket launch range (NASA 2018). In 2018, the range had six suborbital and three orbital rocket launches scheduled (NASA 2018). NASA has designated downrange danger zones and has identified patterns for recent debris cones from rocket tests that represent hazards for surface activities after such tests. There also are restricted areas for rocket testing, satellite launches, and other range mission activities (BOEM 2014a).

Figure 3-5. Military uses of North and Mid-Atlantic Region



Source: Department of Defense, USGS

As illustrated in Figure 3-5, the various types of offshore areas used by the military include (Mid-Atlantic Ocean Data Portal 2018):

- **Danger Zones and Restricted areas**: The Code of Federal Regulations (CFR) defines a Danger Zone as, "A defined water area (or areas) used for target practice, bombing, rocket firing, or other especially hazardous operations, normally for the armed forces. The danger zones may be closed to the public on a full-time or intermittent basis, as stated in the regulations." The CFR defines a Restricted Area as, "A defined water area for the purpose of prohibiting or limiting public access to the area. Restricted areas generally provide security for Government property and/or protection to the public from the risks of damage or injury arising from the Government's use of that area."

- **Submarine Transit**: Areas where submarines may navigate underwater, including transit corridors designated for submarine travel.
- **Ship Shock Boxes**: A location, which is not considered a Military Range, where ship shock trials (explosives are detonated underwater against surface ships) can be conducted by Naval Sea System Command on new classes of Navy ships.
- **Operating Areas**: The bounded area in which national defense training exercises and system qualification tests are routinely conducted.
- **Regulated Airspace**: Regulated airspace areas depict the Air Traffic Control Assigned Airspace and Airspace Corridor areas.
- **Special Use Airspace**: Limitations may be imposed upon aircraft operations that are not a part of the airspace activities. Special use airspace includes any associated underlying surface and subsurface training areas.

3.5.2 Past and Present Activities

As shown above in Figure 3-5, there are multiple military and civilian space facilities along the Atlantic coast from Maine to Virginia. Military entities operating out of these facilities conduct activities in the offshore region from Maine to Virginia. Table 3-12 summarizes these activities.

Table 3-12. Existing Activity Occurring Offshore from Maine to Virginia

Activity	Description	Area of Activity
U.S. Navy Atlantic Fleet Training and Testing	Training activities and research, development, testing, and evaluation activities (also referred to as "military readiness activities"). These military readiness activities include the use of active sonar and explosives within existing range complexes and testing ranges.	High seas areas located in the Atlantic Ocean along the eastern coast of North America, at Navy pier side locations, within port transit channels, near civilian ports, and in bays, harbors, and inshore waterways (e.g., lower Chesapeake Bay)
Training Conducted by U.S. Army Vessels from Joint Base Langley-Eustis	The Army conducts approximately 10 surface-to-surface gunnery training events per year in the Virginia Capes Range Complex, which generally includes firing approximately 2,400 rounds (.50 caliber) from a Landing Craft Utility vessel at floating, plastic drum targets that are recovered after use.	Virginia Capes Range Complex (Warning Area 50), Hampton, Virginia
U.S. Coast Guard Activities	USCG performs maritime humanitarian, law enforcement, and safety services in estuarine, coastal, and offshore waters. Training and mission activities include boat and ship exercises; fixed-wing aircraft and helicopter activities; gunnery, including munitions and other expendables such as signal flares and marine markers; and the use of high frequency and ultra-high frequency sonar detection systems.	U.S. Coast Guard District 1 (Maine to New York) and District 5 (New Jersey to North Carolina)
National Aeronautics and Space Administration	NASA has designated downrange danger zones and restricted areas that include hazard and debris areas from rocket tests, satellite launches, and other range mission activities.	Offshore from Wallops Flight Facility, Virginia

Source: Navy 2018.

3.5.3 Reasonably Foreseeable Future Activities

In the near term, it is likely that the level of military activity will remain relatively stable in this region. Military activities in at-sea training ranges have remained steady over the past 10 years (NRPB 2015). However, a recent report on Sustainable Ranges (Secretary of Defense 2017) indicated that fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. Thus, there is some uncertainty and it is difficult to predict the levels of military use of the range complexes in the future.

Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility.

3.5.4 Impact-Producing Factors Associated with Military Uses and Civilian Space Program Uses

The following reasonably foreseeable impacts of military uses in the North Atlantic that may overlap with offshore wind energy development IPFs include the following:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, trash and debris
- Air emissions, aircraft
- Air emissions, vessels
- Anchoring, bottom founded structures
- Discharges, vessels
- Noise, aircraft
- Noise, pile driving
- Noise, vessels
- Presence of structures, offshore
- Presence of structures, onshore
- Traffic, aircraft
- Traffic, vessel strikes, sea turtles and marine mammals
- Traffic, vessels.

Additional IPFs from military activities that may not overlap with offshore wind energy IPFs include:

- Demolition/structure removal
- Energy stressors/devices/lasers, EM devices, high energy lasers
- Gear utilization, dredging
- Guidance/fiber optic wires, entanglement
- Ingestion, expended materials
- Noise, explosives, weapons
- Noise, sonar.

3.6 Marine Transportation, Navigation, and Traffic

3.6.1 Description of Action and Activities

Marine transportation in the North and Mid-Atlantic region is diverse, with vessels originating from numerous ports and private harbors within the North and Mid-Atlantic, as well as elsewhere in the U.S and internationally. Commercial traffic in the North and Mid-Atlantic includes commercial fishing, passenger vessels (e.g., cruise ships, ferries), cargo, tug/barge, liquid tanker, military or military training, research, dredging/underwater/diving operations, and search-and-rescue vessels. Recreational traffic includes pleasure, sailing, charter, recreational fishing, and high-speed craft (USCG 2007). Additional discussions of commercial and recreational fishing activities are presented in Section 3.7.

Shipping fairways, traffic lanes, anchorage areas, separation, danger, and safety/security zones, and other navigational features designated to provide safe access routes to and from U.S. North and Mid-Atlantic ports are illustrated in Figure 3-6. Data layers of these navigational features are available in the Northeast Ocean Data portal, a data clearinghouse maintained by the Northeast Regional Council on the Oceans (NROC). The portal includes data for the North and Mid-Atlantic regions.

3.6.2 Past and Present Activities

Commercial transit routes are numerous and varied, as illustrated with Automatic Identification System (AIS) data from 2017 (Figure 3-7). AIS data also are available in the NROC Northeast Ocean Data portal. Frequent routes are apparent closer to shore and approaching larger ports.

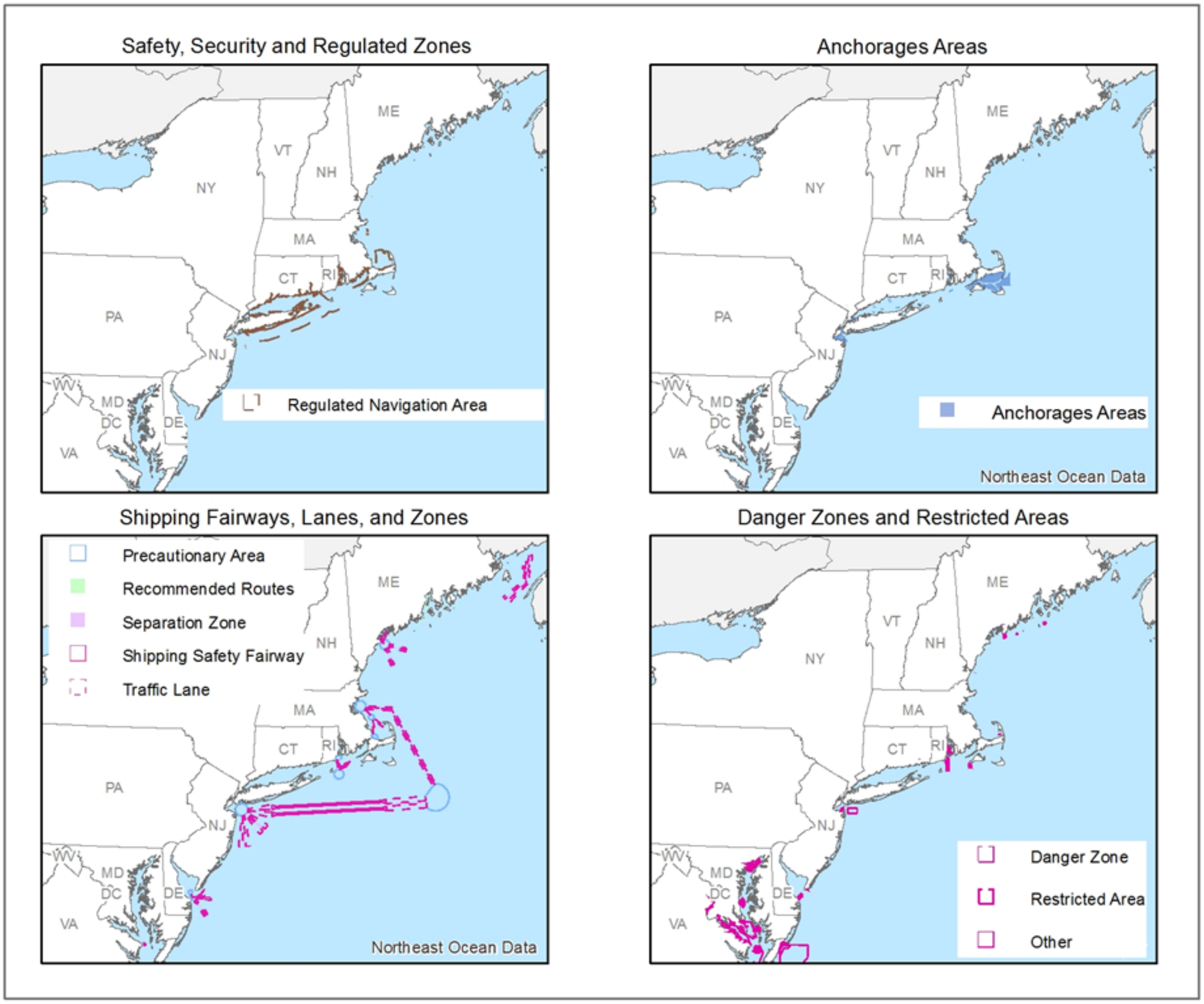
In 2015, more than 12,000 commercial vessel calls were made at ports and terminals in the North Atlantic (Table 3-13). The busiest in the region were New York and New Jersey, Hampton Roads (Virginia), Baltimore, and Delaware River ports. (Section 3.13, Land Use and Coastal Infrastructure, provides additional information on ports.) Container, tanker, and roll-on/roll-off (ro-ro) vessels were the most common. Ferries also are common in North Atlantic waters, carrying approximately 62 million passengers and 5 million vehicles in 2015 (McFadden et al. 2017). Vessel call volume remained relatively steady from 2006 to 2015, with no discernible trend, as illustrated in Table 3-14 for all ports and terminals in the North Atlantic and in Figure 3-8 for the four busiest North Atlantic ports and terminals.

Recreational vessels frequently use North Atlantic waters for activities such as fishing, viewing (e.g., whale watching), scuba diving, and swimming. Figure 3-9 illustrates locations of Northeast recreational boat trips by activity, as reported by participants in the 2012 Northeast Recreational Boater Survey (Starbuck and Lipsky 2012). Unlike commercial vessels, the locations of recreational vessels are not regularly tracked; therefore, there is less locational information on recreational vessel trips compared to commercial trips. However, National Marine Fisheries Service (NMFS) conducts surveys of recreational fishermen for decades that includes relevant data on the numbers and types of fishing trips (e.g., party, charter, rental, and private boat trips) to inland waters, territorial seas, and federal OCS waters.

Exhaust emissions from vessels travelling off the North Atlantic coast are governed by the International Maritime Organization (IMO) air pollution rules, which created an Emission Control Area (ECA). The current North American ECA extends 200 nautical miles off the coast of the U.S. and Canada (EPA 2010). The EPA and USCG jointly and cooperatively enforce the limits. Within the North American ECA, vessels have limits on sulfur oxide and nitrous oxide emissions as well as being prohibited from emitting ozone depleting substances (EPA 2010). The North American ECA became enforceable in August 2012 with fuel sulfur standards of 0.1 percent (mass-on-mass) as of 2015 (Congressional Research Service 2018). Nitrous oxide limits are determined by vessel speed (EPA 2010).

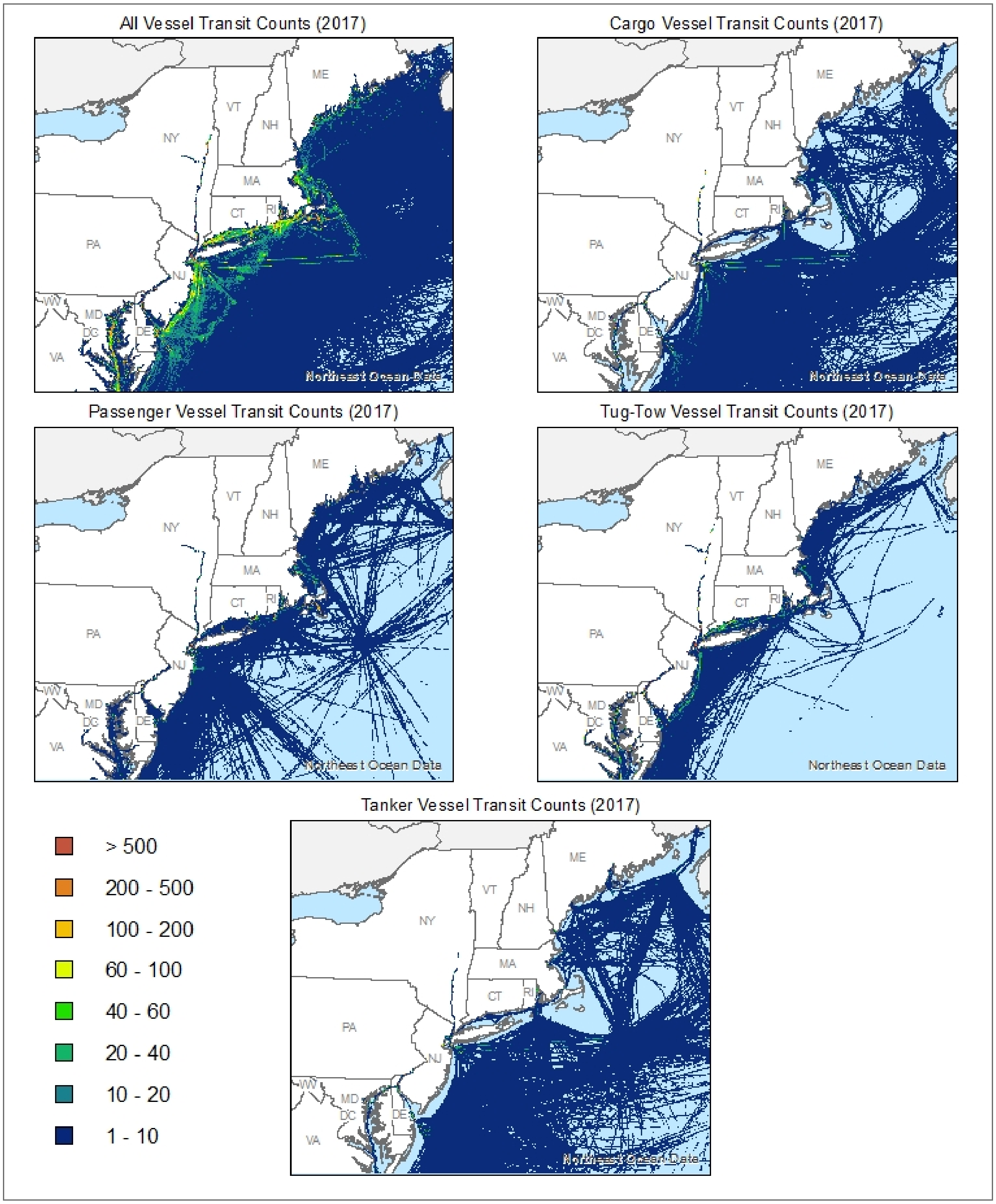
Vessels are able to store multiple types of fuel onboard so operators may switch from higher emitting fuels to lower emitting fuels when entering the ECA (EPA 2010). Operators also may opt to install “scrubbing” technology instead of changing fuels (EPA 2010).

Figure 3-6. Designated Navigation Features of the North Atlantic



Source: NRPB 2018

Figure 3-7. 2015 Commercial Vessel Transit Counts in The North Atlantic



Source: NRPB 2018

Table 3-13. 2015 Vessel Calls in Selected Ports and Terminals in the North Atlantic

Port	Grand Total	Container	Dry Bulk	Gas	General Cargo	RO-RO	Tanker
Baltimore, MD	1,826	413	349	0	188	772	104
Boston, MA	544	158	63	2	3	91	227
Bridgeport, CT	1	0	0	0	0	0	1
Bucksport, ME	17	0	0	0	0	0	17
Cove Point, MD	4	0	0	4	0	0	0
Davisville, RI	177	0	0	0	0	177	0
Delaware River Ports	1,222	118	230	82	202	6	584
Everett, MA	12	0	0	4	0	0	8
Fall River, MA	25	0	12	0	13	0	0
Hampton Roads, VA	1,957	1,227	444	18	79	123	66
New Haven, CT	121	0	37	0	13	0	71
New London, CT	22	0	19	0	2	0	1
New York and New Jersey	4,547	2,238	280	1	161	466	1,401
Newport, RI	0	0	0	0	0	0	0
Philadelphia, PA	895	319	69	0	285	119	103
Port Jefferson, NY	5	0	0	0	0	0	5
Portland, ME	227	20	9	0	36	12	150
Portsmouth, NH	96	0	21	2	8	0	65
Providence, RI	185	0	50	0	4	22	109
Richmond, VA	0	0	0	0	0	0	0
Searsport, ME	76	0	9	0	19	0	48
Wilmington, DE	370	102	84	0	89	70	25
Grand Total	**12,329**	**4,595**	**1,676**	**113**	**1,102**	**1,858**	**2,985**

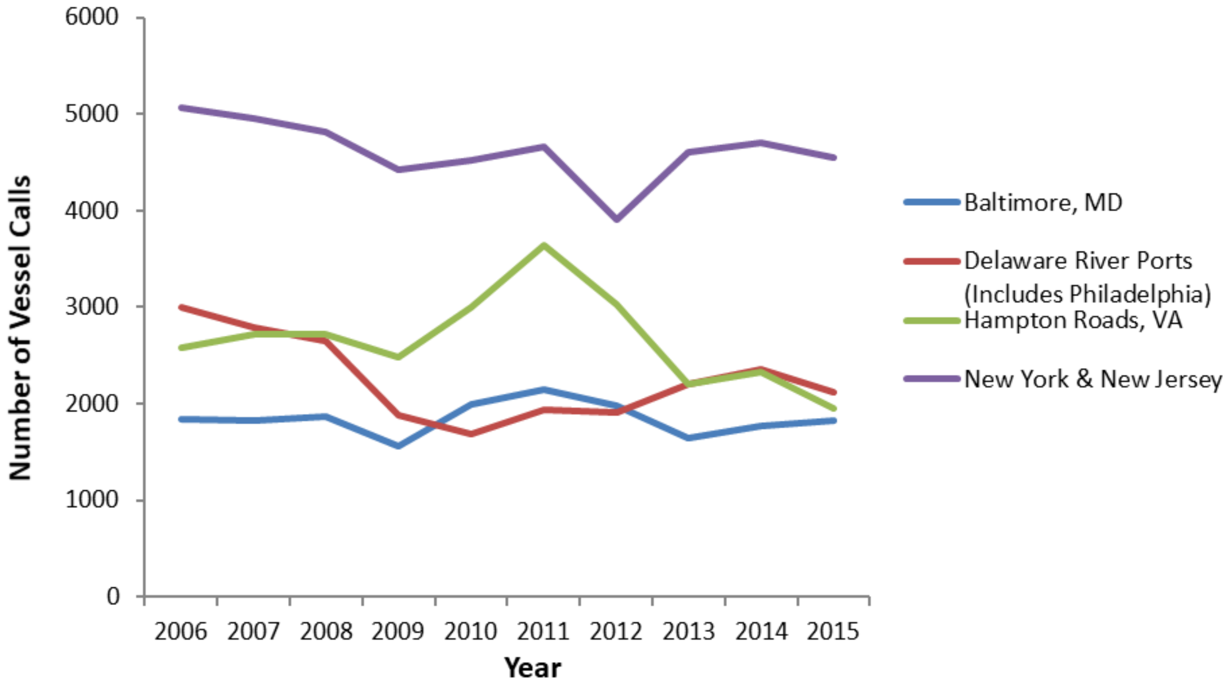
Source: MARAD 2018

Table 3-14. Vessel Calls in Selected Ports in the North and Mid-Atlantic, 2006-2015

Port	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Baltimore, MD	1840	1821	1863	1561	1995	2144	1977	1644	1764	1826
Boston, MA	459	543	546	520	584	602	490	528	565	544
Bridgeport, CT	NR	NR	NR	NR	NR	NR	NR	0	1	1
Bucksport, ME	NR	NR	NR	1	1	11	12	12	19	17
Cove Point, MD	NR	NR	NR	NR	NR	NR	NR	2	2	4
Davisville, RI	71	58	44	40	45	54	56	0	0	177
Delaware River Ports*	3005	2793	2653	1876	1680	1934	1907	2207	2361	2117
Everett, MA	NR	NR	NR	NR	NR	NR	NR	0	8	12
Fall River, MA	NR	NR	NR	NR	NR	NR	NR	30	46	25
Hampton Roads, VA	2577	2724	2724	2489	2994	3637	3033	2205	2326	1957
New Haven, CT	200	170	98	5	73	129	102	93	114	121
New London, CT	NR	NR	NR	NR	12	17	21	19	23	22
New York & New Jersey	5061	4960	4820	4429	4526	4660	3905	4605	4709	4547
Newport, RI	NR	NR	NR	NR	NR	NR	NR	3	3	0
Port Jefferson, NY	NR	NR	NR	NR	NR	NR	NR	6	3	5
Portland, ME	383	276	351	387	314	245	231	243	241	227
Portsmouth, NH	132	91	89	100	83	91	70	82	103	96
Providence, RI	190	26	7	2	172	179	155	186	189	185
Richmond, VA	NR	NR	NR	NR	NR	NR	NR	1	1	0
Searsport, ME	19	50	99	91	100	112	101	78	81	76
Wilmington, DE	402	353	350	296	341	370	337	354	365	370
Grand Total	14,339	13,865	13,644	11,797	12,920	14,185	12,397	12,298	12,924	12,329

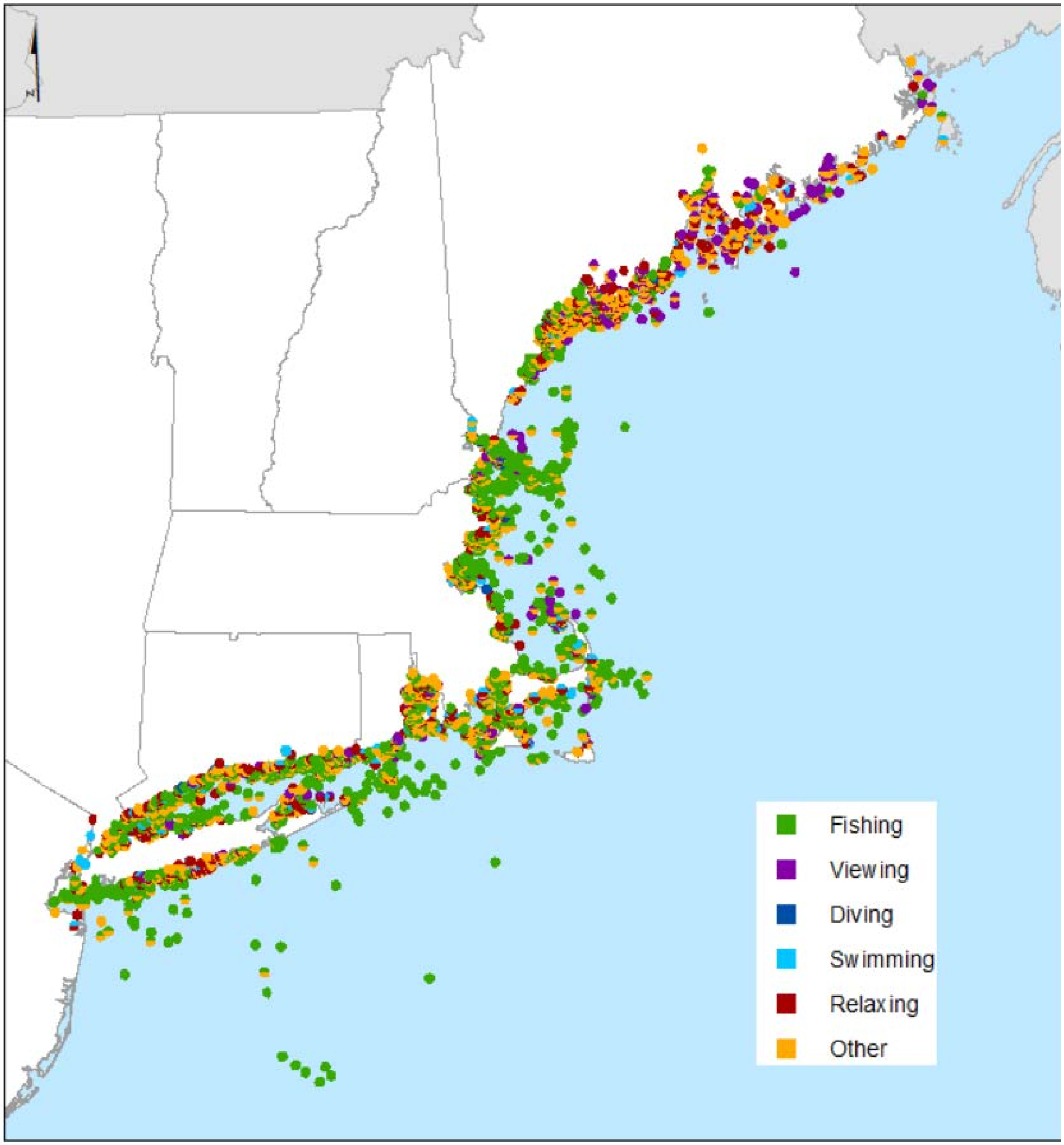
*Includes Philadelphia
NR = Not reported
Source: MARAD 2018

Figure 3-8. Vessel Calls at the Four Busiest Ports in the North Atlantic, 2006-2015



Source: MARAD 2018

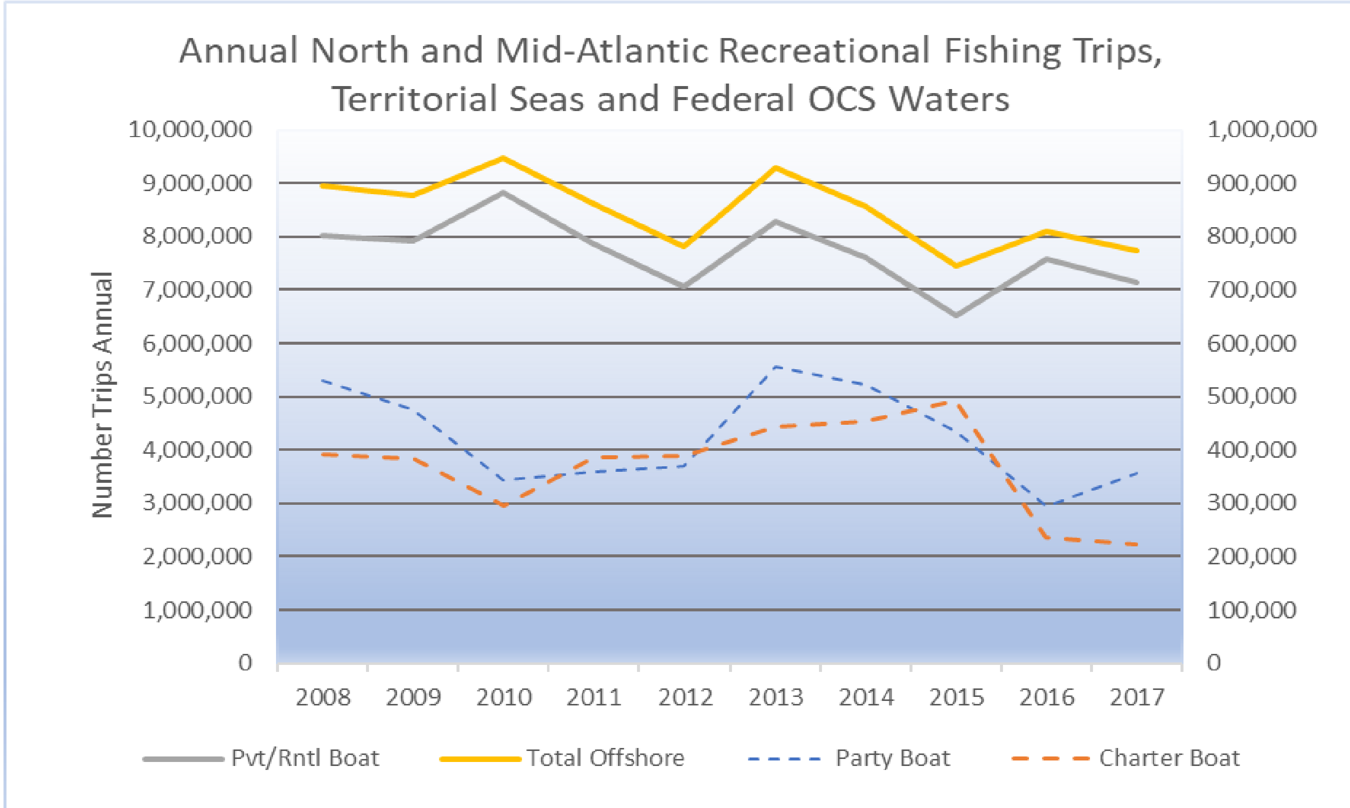
Figure 3-9. 2012 Recreational Boating Destinations by Activity Type



Source: Starbuck and Lipsky 2012

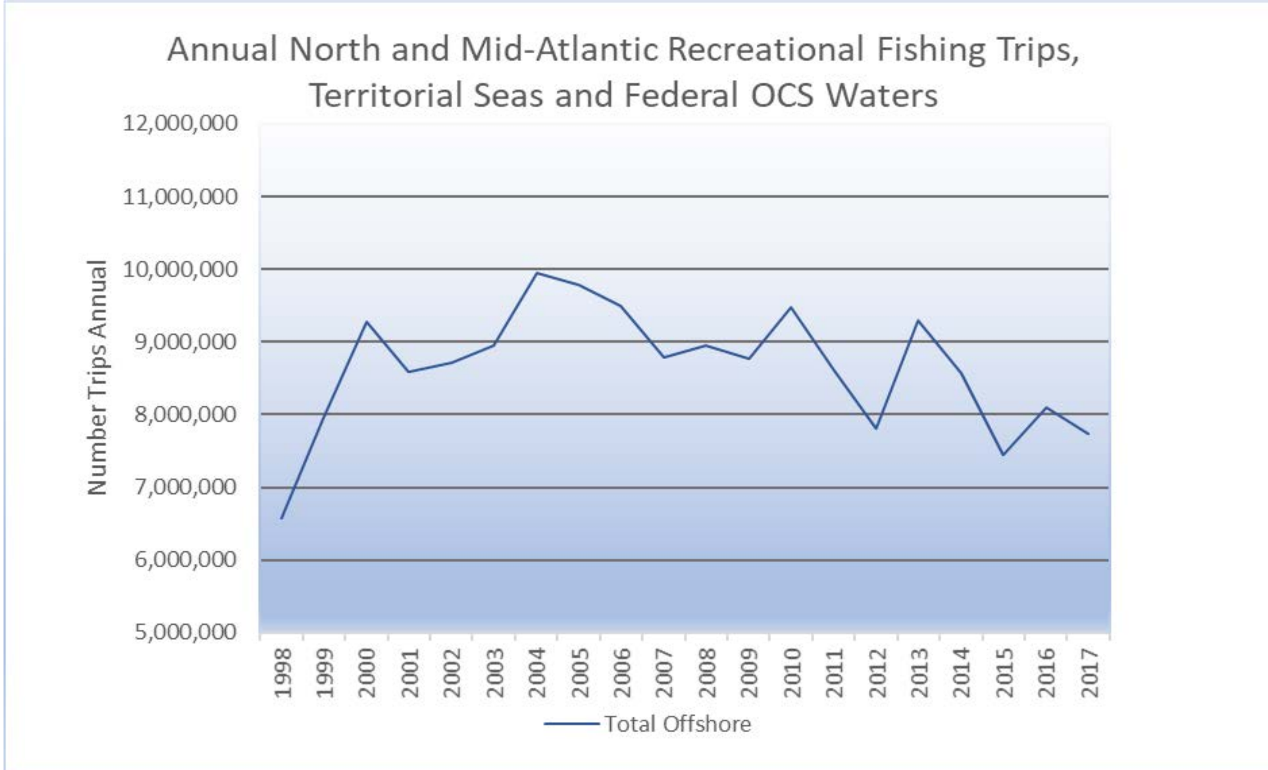
Trend data were compiled from NMFS recreational fishing data for offshore waters (territorial seas and federal OCS waters) for the period 2008 to 2017. Data included recreational fishing trips for the North and Mid-Atlantic states (the five coastal New England states, New York, New Jersey, Delaware, Maryland, and Virginia). The results are shown in Figure 3-10.

Figure 3-10. Recreational Fishing Trips, North and Mid-Atlantic States, 2008 to 2017



These trend data indicate recreational fishing trips appear to be in a gradual decline, approximately a reduction of 13% over the 10-year period. However, there is considerable variation in the 10-year time series that may confound any reliable determination. Therefore, a 20-year time series was analyzed; for total recreational fishing effort. Data are presented in Figure 3-11, below. Although there is a high level of variability, some is explained as a reflection of general economic conditions, e.g., a nearly 20% decline from 9.5 million trips in 2010 to 7.8 million trips in 2012. Some variations are not so easily explained, e.g., a 20% rebound of effort in 2013 to 9.3 million trips followed by a 20% decline by 2015. The considerable variability in these data notwithstanding, this additional analysis appears to confirm a gradual, persistent decline in recreational fishing effort in the North and Mid-Atlantic regions since 2004.

Figure 3-11. Recreational Fishing Trips, North and Mid-Atlantic States, 1998 to 2017



3.6.3 Reasonably Foreseeable Future Activities

Certain types of vessel traffic have increased in recent years and may continue to increase in the foreseeable future. Ferry use has recently increased. For example, between 2017 and 2018, New York City planned to add 10 new ferry terminals and 19 new vessels to support a total of 4.6 million annual passenger trips (McFadden et al. 2017). The cruise industry has also recently expanded, with a 16% increase in expenditures from 2010 to 2014 (CLIA 2015). Global vessel fuel standards determined by the IMO are scheduled to become more stringent in 2020 falling to 0.5 percent. These fuel standards are still less stringent than the requirement for the North American ECA (Congressional Research Service 2018). Certain vessels also were exempt from nitrous oxide requirements until 2025 (USCG 2014).

Ports such as the Port of New York and New Jersey and Boston Harbor have recently or will soon undertake deepening efforts to accommodate the deeper-draft vessels now transiting the recently expanded Panama Canal locks. It is expected that these deepening efforts will bring larger vessels to these deepened ports (PANYNJ 2016, USACE 2018b). (Additional information on ports is provided in Section 3.13, Land Use and Coastal Infrastructure.)

Since the canal opened in 1914, the size of ships that could transit the canal was determined by the canal lock chambers (length of 965 feet and width of 106 feet), "Panamax" vessels, which has a ship capacity of about 4,500 TEUs (cargo containers, twenty-foot equivalent units). The Panama Canal Authority built a larger set of chambers (length of 1,401 feet and width of 180 feet), completed in 2016, to accommodate larger "New-" or "Neo-Panamax" vessels that have a capacity of 12,000 TEU. The cargo shipping industry is trending towards these bigger ships because of economies of scale for vessel construction and operations (Le 2013).

Port facilities are not the only maritime operations that are adapting to larger ships. As ships get bigger, tugs and their gear, e.g., winches and braking capacity, have to increase as well (Workboat, 2016). Also, as the large container ships transiting world trade routes grow even larger, they hold down the cost of ocean shipping, but also raise concerns among vessel operators, insurers, and regulators about the potential for catastrophic accidents (WSJ 2015).

Although the data do not show reliable trends in the number of vessel calls at ports and terminals in the North and Mid-Atlantic from 2006 to 2015 (Table 3-14 and Figure 3-8), the data suggest that, with the few exceptions as noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016).

3.6.4 Impact-Producing Factors Associated with Marine Transportation, Navigation, and Traffic

Marine transportation, navigation, and traffic may result in the following impacts, which are also potential IPFs for wind energy:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, trash and debris
- Air emissions, vessels
- Discharges, vessels
- Light, vessels, above water
- Light, vessels, underwater
- Noise, vessels
- Port utilization, expansion
- Traffic, vessel strikes, sea turtles and marine mammals
- Traffic, vessels.

Marine transportation, navigation, and traffic IPFs that do not materially overlap with offshore wind energy include:

- Accidental releases, invasive species and
- Port utilization, maintenance, dredging.

3.7 FISHERIES USE AND MANAGEMENT

3.7.1 Description of Action and Activities

In order to provide context for a cumulative impacts scenario, this section provides information on the past, present and reasonably foreseeable future activities related to fisheries use and management of both commercial and recreational fisheries. These activities can contribute to cumulative impacts on resources affected by a proposed offshore wind energy project. This section summarizes and briefly highlights what, where, and how much activity related to fisheries use and management is occurring in the area offshore of the Atlantic coast from Maine to Virginia.

The North and Mid-Atlantic supports regionally and nationally important commercial and recreational fisheries. Commercial fisheries refers to fishing in which the fish that are caught, either in whole or in part, are intended to enter commerce through sale, barter or trade. Recreational fisheries include fishing for sport or pleasure either on private or for-hire vessels. Recreational fisheries catch may be released or retained for personal consumption but cannot be sold for profit. Impacts from commercial and recreational fisheries depend on the status of the species fished, fishing methods, and the magnitude of takings.

Commercial Fisheries

Guided by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1976, NMFS works to ensure sustainable practices for fisheries around the country. NMFS partners with regional fishery management councils to predict the abundance of fish stocks, set catch limits, and promulgate and ensure adherence to regulations. For fisheries occurring off the Atlantic coast offshore of Maine to Virginia, these councils include the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC), the South Atlantic Fishery Management Council (SAFMC), and the Atlantic States Marine Fisheries Commission (ASMFC).

In addition to regulations stemming from the MSA, many fisheries are subject to additional regulations resulting from the protection of species under the Endangered Species Act (ESA) of 1973 or the Marine Mammal Protection Act (MMPA) of 1972. NMFS is responsible for recovering protected marine species such as sea turtles and Atlantic salmon among others, including minimizing the extent to which they are incidentally caught as bycatch in other fisheries. Within state waters, various departments have authority to regulate fisheries; some towns and cities manage nearshore shellfisheries activity within their boundaries.

The main commercial fishing gear used in commercial fishing off the Atlantic coast offshore of Maine to Virginia are pots/traps, dredges, trawls, longlines (bottom and pelagic), gillnets, purse seines, and pound nets. Exhibit 3-15 lists the types of gear utilized in the various fisheries occurring in the Atlantic. Utilization of mobile bottom tending gears such as bottom trawls and dredges are most likely to contribute to cumulative impacts on sediments and benthic habitats (BOEM 2018a). Impacts resulting from gear utilization depend on factors such as gear type and habitat vulnerability (ICES 2000; NRC 2002).

Table 3-16 provides information on the peak harvest seasons and general area fished by species, for managed fisheries in the greater Atlantic region.

Table 3-15. Gear Utilization by Target Species

Relevant Target Species	Longlines (Pelagic)	Longlines (Bottom)	Trawls	Dredges	Gillnets	Pound Nets	Purse Seines	Traps/ Pots
Lobster				✓				✓
Oysters				✓				
Scallops				✓				
Clams				✓				
Mussels				✓				
Crabs			✓	✓				✓
Tuna	✓				✓		✓	
Swordfish	✓				✓			
Other billfish	✓							
Bluefish						✓		
Catfish						✓		
Menhaden						✓		
Flounder		✓	✓		✓	✓		
Sharks		✓			✓			
Halibut		✓						
Other Groundfish (Cod, Haddock, Pollock, Hake)		✓			✓			
Red hake			✓					
Dogfish			✓					
Shrimp			✓					
Salmon					✓			
Herring					✓			

Table 3-15. Gear Utilization by Target Species

Relevant Target Species	Longlines (Pelagic)	Longlines (Bottom)	Trawls	Dredges	Gillnets	Pound Nets	Purse Seines	Traps/ Pots
Mullet					✓			
Seabass					✓			
Shad					✓			
Squid							✓	
Pelagic schooling fish			✓				✓	
Whelk								✓
Scup								✓
Black Sea bass								✓
Eels								✓

Source: NOAA 2018a.

Table 3-16. Greater Atlantic Managed Fisheries – Seasons and Area

Species	Peak Harvest Season	Area Fished
Federally Managed Species		
Acadian Redfish	Year-round	Maine to New York
Atlantic Cod	Year-round	Maine to Virginia
Atlantic Herring	Year-round	Maine to North Carolina
Atlantic Pollock	November through January	Maine to Virginia
Atlantic Sea Scallop	Year-round	Maine to North Carolina
American Lobster	May to November	Maine & Massachusetts
Atlantic Mackerel	Year-round	Maine to North Carolina
Atlantic Salmon	N/A	N/A Commercial fishing prohibited
Atlantic Spiny Dogfish	Year-round	Maine to North Carolina
Atlantic Surfclam	Year-round	New England to North Carolina
Black Sea Bass	Varies by state	Massachusetts to the west coast of Florida
Bluefish	Varies by state	Massachusetts to Florida
Haddock	Year-round	Maine to New Jersey
Monkfish	late fall and spring	Maine to North Carolina
Longfin Squid	Year-round	Southern Massachusetts to North Carolina
Ocean Quahog	Year-round	Maine to Virginia
Scup	Year-round	Massachusetts to North Carolina
Atlantic Blacktip Shark	Varies due to quota	New England to Florida
Atlantic Common Thresher Shark	Year-round	New York to North Carolina
Atlantic Shortfin Mako Shark	April through October	New England to Louisiana
Silver Hake	Year-round	Maine to North Carolina
Atlantic Albacore	Fall	Massachusetts to Louisiana
Atlantic Bigeye Tuna	Year-round	Massachusetts to Florida
Atlantic Blue Fin Tuna	Year-round	Maine to Louisiana
Atlantic Skipjack Tuna	Late summer to early fall	New York to Florida
Atlantic Yellow Fin Tuna	Year-round	Massachusetts to Texas
Summer Flounder	April to November	Massachusetts to North Carolina
Tilefish	Year-round	Massachusetts to Texas
Winter Flounder	Winter to Spring	Maine to Virginia
Winter Skate	Winter to Spring	Maine to Connecticut
Yellow Tail Flounder	Winter to Spring	Maine to New Jersey
North Atlantic Swordfish	June through October	Atlantic and Gulf of Mexico

Table 3-16. Greater Atlantic Managed Fisheries – Seasons and Area

Species	Peak Harvest Season	Area Fished
Butterfish	Year-round	Maine to South Carolina
Red Hake	Year-round	Maine to North Carolina
State Managed Species		
Atlantic Northern Shrimp	N/A	Maine to Massachusetts
Atlantic Striped Bass	Year-round	Maine to North Carolina
Blue Mussel	Year-round	New England
Eastern Oyster	Year-round	Atlantic and Gulf of Mexico
King Mackerel	Year-round	New York to Texas
Spanish Mackerel	Year-round	Rhode Island to Alabama

Source: NOAA 2018b.

Recreational Fishing

Recreational fishing is a major public use of coastal natural resources along the North Atlantic coast. Marine recreational fishing takes place from shore, aboard private or rented boats, and on boats that take passengers for hire. Recreational fishing is a year-round activity, but anglers may target specific species at certain times, and recreational fishing effort is often weather-dependent. Thus, more recreational fishing effort occurs during spring through summer. The types and numbers of fish caught by recreational anglers vary by state. The top species groups harvested by recreational anglers in the Maine through Virginia area in 2017 include temperate basses (e.g., striped bass, white perch), tunas and mackerels, bluefish, and drums (NMFS 2018a).

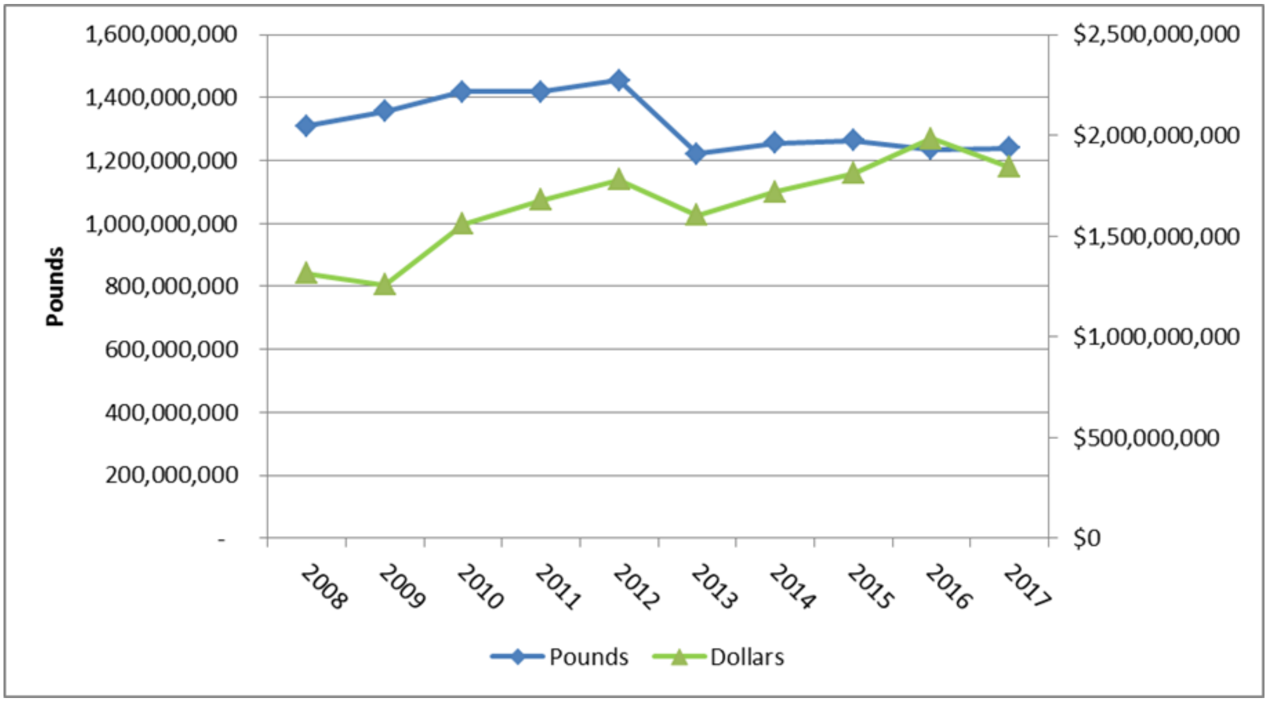
3.7.2 Past and Present Activity

Commercial Fisheries

In 2017, commercial fisheries harvested more than 1.2 billion pounds of fish and shellfish in the North and Mid-Atlantic region, for a total landed value of over $1.8 billion; over 2008 to 2017, average annual landings were 1.3 billion pounds with a value of $1.7 billion (ACCSP 2018). The top five species by landing value in 2017 for the 10-state region included American lobster, sea scallop, blue crab, eastern oyster, and northern quahog clams (ACCSP 2018). Total values and pounds landed over the past ten years are shown in Figure 3-12, based on data from the Atlantic Coastal Cooperative Statistics Program (ACCSP). Between 2008 to 2017, the value of landings has ranged from $1.3 billion to almost $2.0 billion, while landings weight has ranged from 1.22 billion pounds to 1.45 billion pounds.

The top commercial fishing ports along the Atlantic coast from Maine to Virginia, ranked by value of landings and pounds of landings are summarized in Tables 3-17 and 3-18 below. Figure 3-13 illustrates the location of the commercial fishing ports that fall within the top 132 ports ranked by NMFS in terms of dollar value and/or pounds landed.

Figure 3-12. Commercial Fishing Landings, 10 States Combined



Source: ACCSP Data Warehouse. Accessed November 3, 2018.

Table 3-17. Commercial Fishery Landings at Major Ports, by Value (Millions of Dollars)

State/Port	2017		2016		2015		2014		2013	
	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value
Connecticut										
Stonington	107	6.2	111	5.9	114	5.2	100	6.8	88	7.8
New London	123	2.7	116	5.1	108	6.5	105	5.8	101	6.1
Maine										
Stonington	21	55.8	11	68.0	14	63.8	17	60.3	22	48.9
Vinalhaven	32	36.5	24	42.3	24	39.7	34	35.7	38	30.7
Portland	38	30.5	27	38.1	29	34.6	40	31.5	37	31.5
Beals Island	55	20.5	45	23.3	51	20.7	52	22.1	64	15.1
Friendship	56	19.2	57	20.3	48	21.8	59	20.2	67	14.9
Rockland	65	15.0	54	21.1	57	17.8	61	19.1	68	14.9
Spruce Head	69	13.3	66	16.9	61	16.5	69	14.7	79	11.4
Jonesport	74	12.7	70	14.8	66	14.1	73	14.0	78	11.4
Bass Harbor	77	11.1	79	12.7	77	10.8	N/A	N/A	N/A	N/A
Owls Head	79	11.0	72	14.2	82	10.1	N/A	N/A	N/A	N/A
Milbridge	87	9.7	80	12.2	73	11.2	N/A	N/A	N/A	N/A
Swans Island	88	9.2	85	10.9	N/A	N/A	N/A	N/A	N/A	N/A
Southwest Harbor	90	8.9	83	11.4	76	11.0	N/A	N/A	N/A	N/A
Port Clyde	103	6.8	94	7.8	78	10.8	86	10.2	84	9.2
Pembroke	130	1.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 3-17. Commercial Fishery Landings at Major Ports, by Value (Millions of Dollars)

State/Port	2017		2016		2015		2014		2013	
	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value
Maryland										
Ocean City	116	4.6	115	5.7	104	7.2	103	6.3	113	4.0
Massachusetts										
New Bedford	1	389.5	1	326.5	1	321.9	1	328.8	1	379.0
Gloucester	25	52.6	18	52.4	22	44.4	26	45.8	25	42.3
Provincetown-Chatham	34	33.8	33	32.8	37	30.6	42	29.0	39	30.1
Boston	59	17.3	65	17.0	62	16.2	65	16.5	63	15.6
Fairhaven	83	10.3	51	21.8	56	17.8	64	16.9	52	22.2
New Hampshire										
Newington	45	24.8	52	21.7	59	17.1	71	14.1	77	11.6
Portsmouth	101	6.9	97	7.1	105	7.0	N/A	N/A	N/A	N/A
New Jersey										
Cape May-Wildwood	9	81.0	9	84.7	9	71.6	18	59.0	31	35.3
Point Pleasant	33	35.3	39	26.9	38	28.2	47	25.8	50	23.1
Long Beach-Barnegat	46	24.7	34	32.1	43	25.4	48	25.4	47	25.3
Atlantic City	57	18.6	60	19.7	54	19.6	53	22.1	53	21.4
Belford	122	2.7	126	3.0	123	1.9	122	2.8	124	1.8
Barnegat Light	N/A	N/A	N/A	N/A	127	0.3	128	0.2	N/A	N/A
New York										
Montauk	66	14.8	68	16.3	63	15.9	63	16.9	59	17.7
Hampton Bay-Shinnicock	109	6.1	93	8.0	117	4.9	108	5.5	98	6.9
Greenport	131	0.3	N/A	N/A	126	0.3	127	0.2	128	0.2
Rhode Island										
Point Judith	19	57.4	15	55.7	20	46.2	25	50.4	23	46.7
North Kingstown	58	17.7	74	13.7	75	11.1	83	11.2	83	9.7
Newport	95	8.5	92	8.0	99	7.5	99	6.8	69	14.3
Virginia										
Hampton Roads Area	18	58.1	13	61.0	17	56.4	23	52.1	20	52.7
Reedville	35	32.5	35	31.2	31	33.1	41	30.9	41	29.6
Accomac	73	12.8	58	20.1	69	13.0	80	12.5	71	13.9
Chincoteague	119	3.9	122	4.9	111	5.7	109	4.8	104	5.6
Cape Charles-Oyster	129	1.1	N/A	N/A	128	0.0	125	0.8	126	0.7

Source: NOAA 2018c.

Table 3-18. Commercial Fishery Landings at Major Ports, by Poundage (Millions of Pounds)

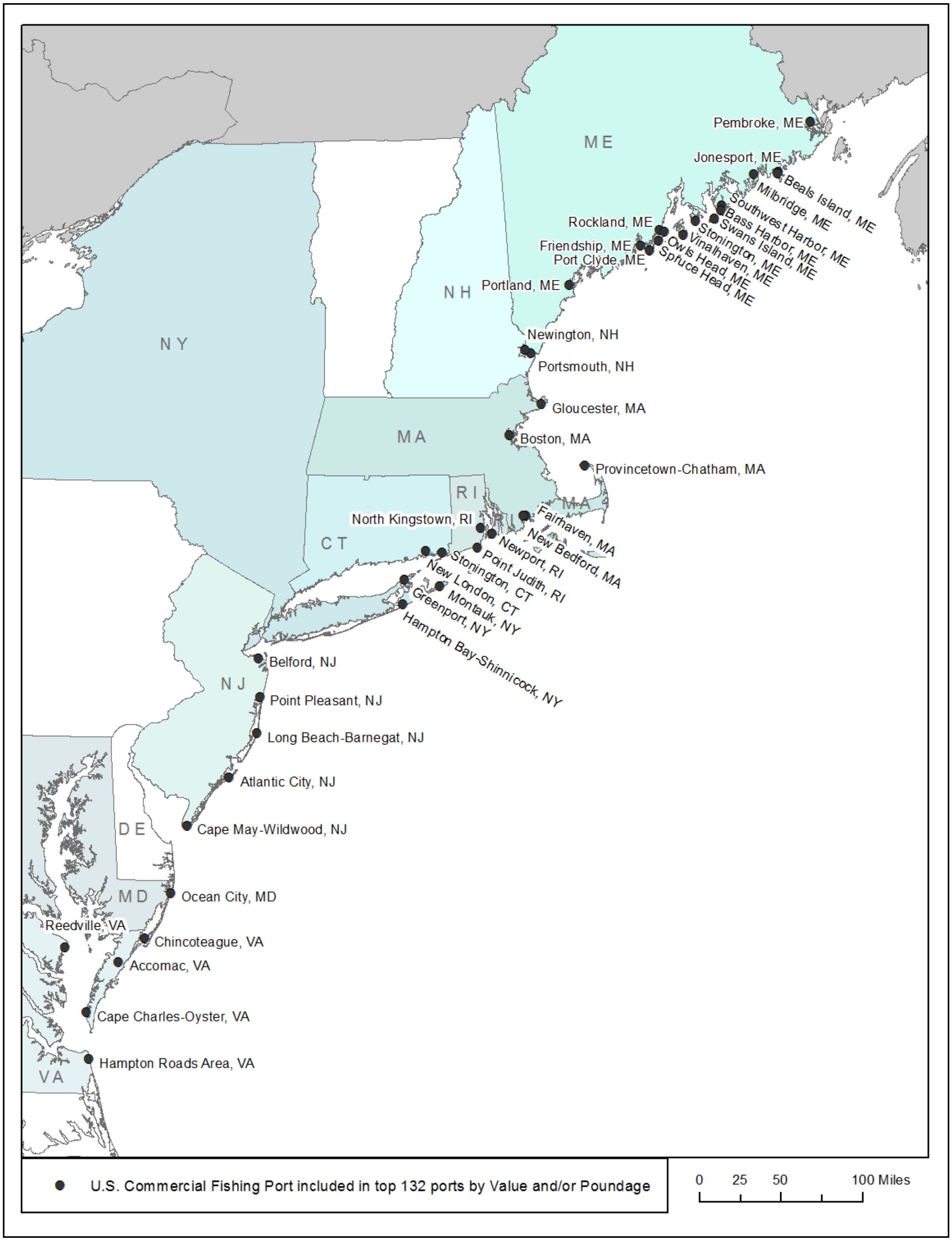
State/Port	2017		2016		2015		2014		2013	
	Rank	Pounds	Rank	Pounds	Rank	Pounds	Rank	Pounds	Rank	Pounds
Connecticut										
New London	77	5.6	61	9.0	75	6.1	94	4.3	88	4.9
Stonington	125	1.8	118	2.1	120	1.7	112	1.9	104	2.7
Maine										
Portland	22	49.2	19	49.8	22	62.4	24	56.5	23	62.1
Rockland	33	23.3	25	33.6	28	31.0	28	40.6	30	34.6
Stonington	41	17.9	32	23.2	38	19.1	36	25.4	43	19.9
Jonesport	56	10.0	56	10.4	80	5.8	72	7.1	53	14.2
Vinalhaven	64	8.8	55	10.5	58	9.7	57	10.5	56	13.3
Beals Island	68	6.9	74	7.0	76	6.0	77	6.8	83	6.2
Pembroke	85	4.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Friendship	90	4.4	87	4.7	88	5.2	62	9.1	89	4.8
Spruce Head	99	3.7	90	4.6	91	4.4	96	4.2	93	4.2
Bass Harbor	107	2.7	101	3.5	111	2.5	N/A	N/A	N/A	N/A
Owls Head	108	2.7	104	3.3	113	2.3	N/A	N/A	N/A	N/A
Milbridge	109	2.7	105	3.1	106	2.8	N/A	N/A	N/A	N/A
Port Clyde	112	2.6	121	2.0	105	2.9	86	5.7	96	3.9
Swans Island	113	2.5	112	2.7	108	2.7	N/A	N/A	N/A	N/A
Southwest Harbor	121	2.0	114	2.5	109	2.5	N/A	N/A	N/A	N/A
Maryland										
Ocean City	89	4.4	97	4.0	95	4.1	87	5.4	91	4.6
Massachusetts										
New Bedford	13	110.8	11	106.6	11	123.8	9	140.0	14	129.8
Gloucester	20	63.9	15	63.4	20	67.7	21	61.4	22	62.4
Provincetown-Chatham	35	22.3	29	26.5	35	21.2	42	20.0	55	13.6
Boston	44	15.8	52	12.2	48	14.0	46	16.4	42	20.2
Fairhaven	106	3.2	98	3.9	81	5.8	82	6.4	75	7.2
New Hampshire										
Portsmouth	87	4.6	123	2.0	79	5.9	N/A	N/A	N/A	N/A
Newington	93	4.1	99	3.9	100	3.2	97	3.9	95	4.1
New Jersey										
Cape May-Wildwood	14	101.6	20	46.6	17	77.2	27	49.9	41	20.4
Point Pleasant	26	37.5	30	26.3	34	24.4	37	24.2	50	15.4
Atlantic City	32	24.7	31	24.3	31	25.9	30	29.9	33	27.3
Long Beach-Barnegat	65	7.6	70	7.2	73	6.3	71	7.1	70	8.6
Belford	82	5.1	115	2.5	89	4.9	74	7.0	113	2.1
Barnegat Light	N/A	N/A	N/A	N/A	128	0.0	128	0.0	N/A	N/A
New York										
Montauk	55	10.1	53	11.8	53	11.6	55	11.8	58	13.1
Hampton Bay-Shinnicock	98	3.8	78	5.2	94	4.1	92	4.7	84	6.1

Table 3-18. Commercial Fishery Landings at Major Ports, by Poundage (Millions of Pounds)

State/Port	2017		2016		2015		2014		2013	
	Rank	Pounds	Rank	Pounds	Rank	Pounds	Rank	Pounds	Rank	Pounds
Greenport	132	0.2	N/A	N/A	126	0.2	126	0.2	127	0.2
Rhode Island										
Point Judith	23	44.3	18	53.4	24	46.2	23	57.3	25	54.6
North Kingstown	31	27.0	38	17.6	43	16.1	39	21.3	38	21.7
Newport	66	7.3	75	6.6	63	8.3	83	6.4	72	8.1
Virginia										
Reedville	4	319.9	5	321.3	6	350.0	5	323.9	5	317.7
Hampton Roads Area	47	15.5	51	12.3	54	11.5	48	14.7	46	16.5
Accomac	75	5.9	68	7.6	64	8.3	65	8.0	69	8.7
Chincoteague	122	1.9	116	2.4	107	2.7	98	3.6	90	4.8
Cape Charles-Oyster	131	0.3	N/A	N/A	127	0.0	127	0.1	128	0.2

Source: NOAA 2018c.

Figure 3-13. Top U.S. Commercial Fishing Ports along the Atlantic Coast from Maine to Virginia by Value and/or Poundage



Source: NOAA 2018c.

Figure 3-14 illustrates the relative amount of commercial fishing vessel activity along the Atlantic coast from Maine to Virginia. These data are available from NMFS' Commercial Fishing Vessel Monitoring System (VMS), available at the Mid-Atlantic Ocean Data Portal. VMS is a satellite surveillance system primarily used to monitor the location and movement of commercial fishing vessels in the U.S. There are several important limitations associated with the VMS data, including:

- These data are from vessels operating in certain fishery management plans; thus, there are many New England fisheries not described through any VMS-derived maps.
- Maps show the density of vessel locations following the removal of individually identifiable vessel positions. VMS records within cells that contain fewer than three VMS records were not included in the analysis.
- While legends are consistent, values represent high or low areas of vessel activity specific to each dataset.
- Data may include trips that target other fisheries but use a NE Multispecies VMS declaration for another fishery as a management and reporting mechanism.

As discussed above, fishing activity is managed by NMFS with a goal of sustainable fisheries. Fishing activity, along with other factors, can affect the status of a fishery stock. To the extent that overfishing is occurring or a stock is already overfished, fisheries resources may be at risk of cumulative impacts. Figure 3-15 provides information on the stock status for stocks by fisheries region. Of the stocks in the New England and Mid-Atlantic regions, based on NMFS latest quarterly information, there are 16 stocks that are currently on either or both the overfished list (i.e. stock having a population size that is too low and that jeopardizes the stock's ability to produce its maximum sustainable yield) or overfishing list (i.e., a stock having a harvest rate higher than the rate that produces its maximum sustainable yield). In addition, nine stocks of highly migratory Atlantic species were either on the overfished or overfishing lists.

Figure 3-14. Commercial Fishing Vessel Activity Based on VMS Reports

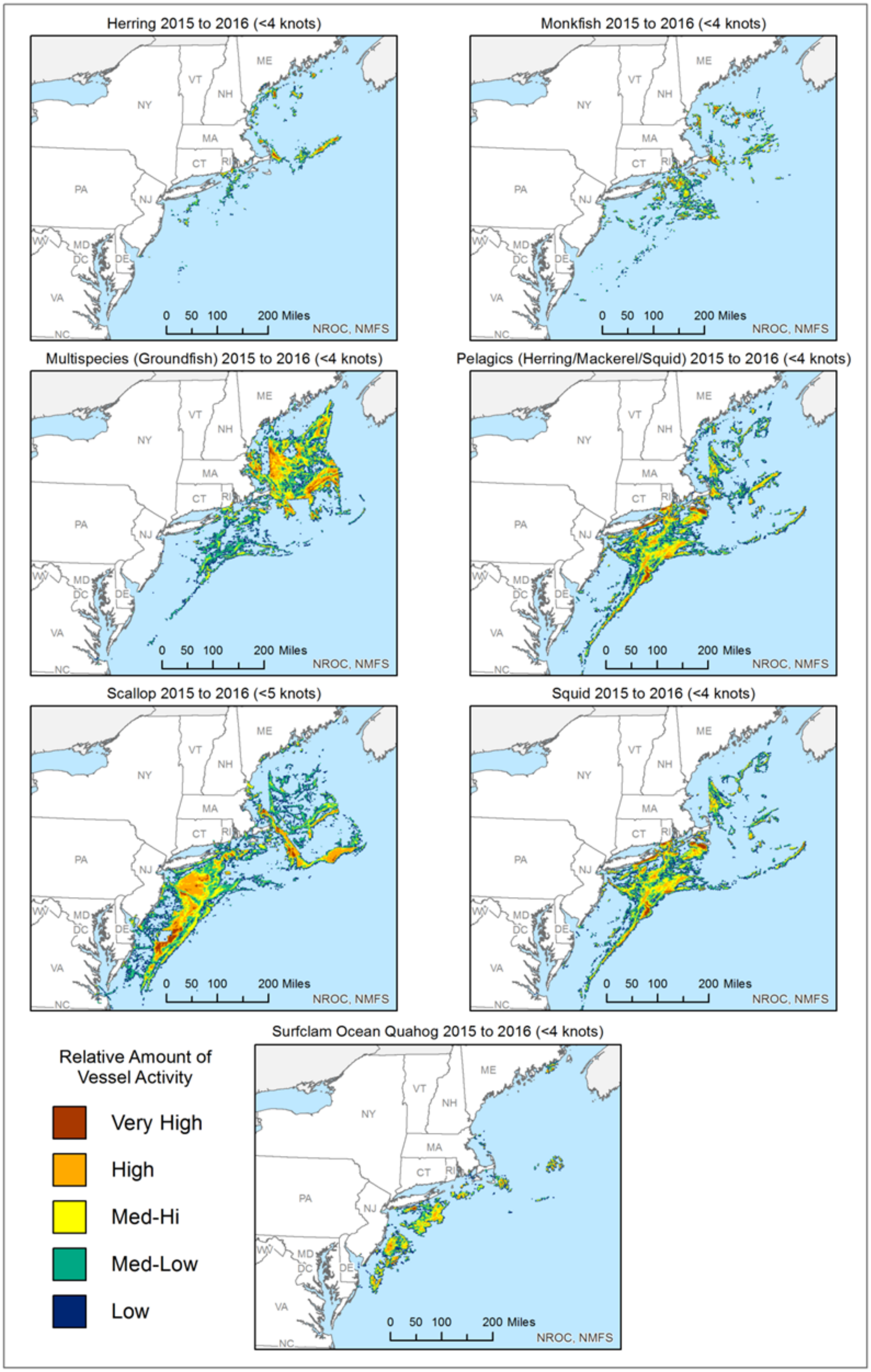
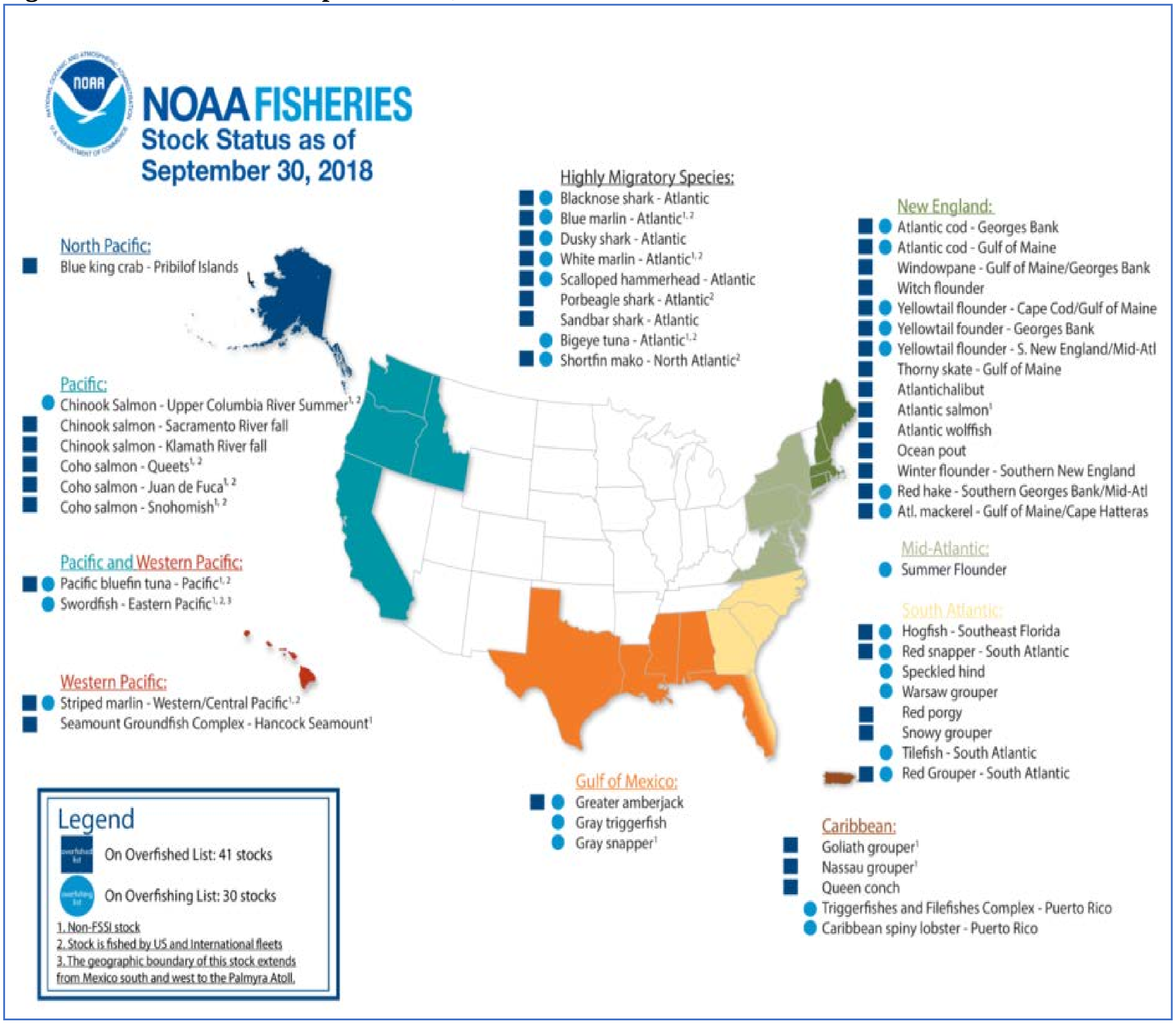


Figure 3-15. Stock Status September 30, 2018



Source: NOAA 2018d.

Recreational Fisheries

Data on recreational fishing are collected by NMFS through its Marine Recreation Information Program (MRIP). NMFS estimates that in 2016, 3.6 million resident anglers participated in recreational fishing across the New England and Mid-Atlantic regions in coastal and marine waters; the bulk of this activity was in coastal areas (3.3 million participants), while the remainder (0.3 million participants) were in non-coastal areas. Anglers took 62.8 million trips in 2017, primarily in private boats or from shore. Recreational harvest in 2017 totaled 174.5 million pounds (NMFS 2018a). Recreational fishing trips and total harvest in 2017 are broken down by state in Table 3-19; these include estimates of recreational fishing activity from shore, private boat, and for-hire boats. In 2016, there were 2,211 for-hire vessels identified in New York through Virginia (515 in New York, 836 in New Jersey, 112 in Delaware, 577 in Maryland, and 171 in Virginia) (ACCSP 2016).

Table 3-19. 2017 Recreational Fishing Statistics

State	Number of Trips	Percent of Total Trips	Harvest (Total Weight, lbs)	Percent of Total Harvest
Connecticut	3,937,263	6%	7,235,592	4%
Delaware	1,990,768	3%	3,392,589	2%
Maine	1,747,568	3%	1,567,071	1%
Maryland	8,342,836	13%	17,650,917	10%
Massachusetts	7,774,866	12%	27,725,503	16%
New Hampshire	972,380	2%	3,319,165	2%
New Jersey	12,288,340	20%	35,908,949	21%
New York	16,633,984	27%	52,988,645	30%
Rhode Island	2,317,766	4%	5,698,555	3%
Virginia	6,749,151	11%	19,042,623	11%
TOTAL	**62,754,922**	100%	**174,529,609**	100%

Source: NMFS 2018a. Note, this data includes recreational fishing trips to brackish/estuarine waters, territorial seas, and federal OCS waters; it does not include trips to inland fresh waters.

3.7.3 Reasonably Foreseeable Future Activities

Fishery management councils develop management plans for marine fisheries in waters seaward of state waters of their individual regions. Plans and specific management measures (such as fishing seasons, quotas, and closed areas) are developed based on scientific advice, and are initiated, evaluated, and adopted through a public process. The decisions made by the councils are not final until they are approved or partially approved by the Secretary of Commerce through NMFS. Fisheries management plans are updated periodically, which may result in changes to regulations affecting fishing activity. Review of fishery management plans and related rules and actions under development may provide insight into whether there may be changes in management expected in the foreseeable future. More information about the regional fishery management plans is available at the fishery council websites at: http://www.mafmc.org/fishery-management-plans and https://www.nefmc.org/management-plans. Although there are variations across years and seasons for fisheries activities, as well as geographic differences among states, there are no apparent long-term temporal trends in the level of these activities (BOEM 2014a). Trends in recreational fishing effort have been presented and discussed previously in Section 3.6, Marine Transportation, Navigation, and Traffic.

3.7.4 Impact-Producing Factors Associated with Fisheries Use and Management

The following reasonably foreseeable impacts of commercial and recreational fisheries in the North and Mid-Atlantic may interact with IPFs of offshore wind energy development:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, trash and debris
- Air emissions, vessels
- Discharges, vessels
- Light, vessels, above water
- Light, vessels, underwater
- Noise, O&M
- Noise, vessels
- Traffic, vessel strikes, sea turtles and marine mammals
- Traffic, vessels.

Additional IPFs from commercial and recreational fishing activities that may not overlap with offshore wind energy IPFs include:

- Accidental releases, invasive species
- Bycatch, bird/fish/sea turtle/marine mammals
- Gear utilization, bottom trawls, bycatch/benthic disruption
- Gear utilization, ghost fishing, entanglement
- Gear utilization, midwater trawls, bycatch/overfishing
- Regulated fishing effort
- Resource exploitation, overfishing
- Resource exploitation, prey/predator removal.

3.8 CLIMATE CHANGE

3.8.1 Description of Activities

Climate change refers to any significant change in the measures of climate lasting for an extended period of time (EPA 2013). In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer (EPA 2013). Greenhouse gases (GHGs) in the atmosphere (including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases) persist in the atmosphere for varying periods of time and are emitted naturally as well as through various human activities, such as fossil fuel combustion. GHGs increase atmospheric radiative forcing, trapping radiation inside the planet's atmosphere and increasing temperature. While not a specific action that would be part of a cumulative effects analysis, climate change could directly or indirectly impact all of the resources that are potentially affected by wind energy projects. Climate change should, therefore, be considered in terms of its combined effects with offshore wind energy development.

Warming is caused by the greenhouse effect of these GHGs trapping heat in the Earth's atmosphere (IPCC 2015). The greenhouse effect occurs naturally but the increase of atmospheric GHGs causes increased warming (IPCC 2015). Warming is the primary cause of sea level rise as glacier melts and the thermal expansion of the ocean as it warms (NOAA 2018c). Warming also results in changes to precipitation and other meteorological patterns (NOAA 2018e). Ocean acidification results from the oceans absorbing larger amounts of carbon dioxide as atmospheric levels rise. The ensuing chemical reactions create bicarbonate ions acidifying the ocean (PMEL 2018).

Climate change is a disruption to geophysical and biological resources around the world. Temperature, precipitation patterns, and storm frequency and intensity as well as other natural cycles can be altered globally by climate change (IPCC 2015). The impacts of these changes have wide ranging implications for the natural and human environment.

3.8.2 Past and Present Activities

NOAA (2018e) data identifies 2017 as the third warmest year on record following 2016 and 2015. The average temperature in 2017 was 1.51 degrees Fahrenheit above the average for the twentieth century (NOAA 2018e). The ten warmest years on the record have occurred since 1998. This warming occurs globally but non-uniformly (NOAA 2018e).

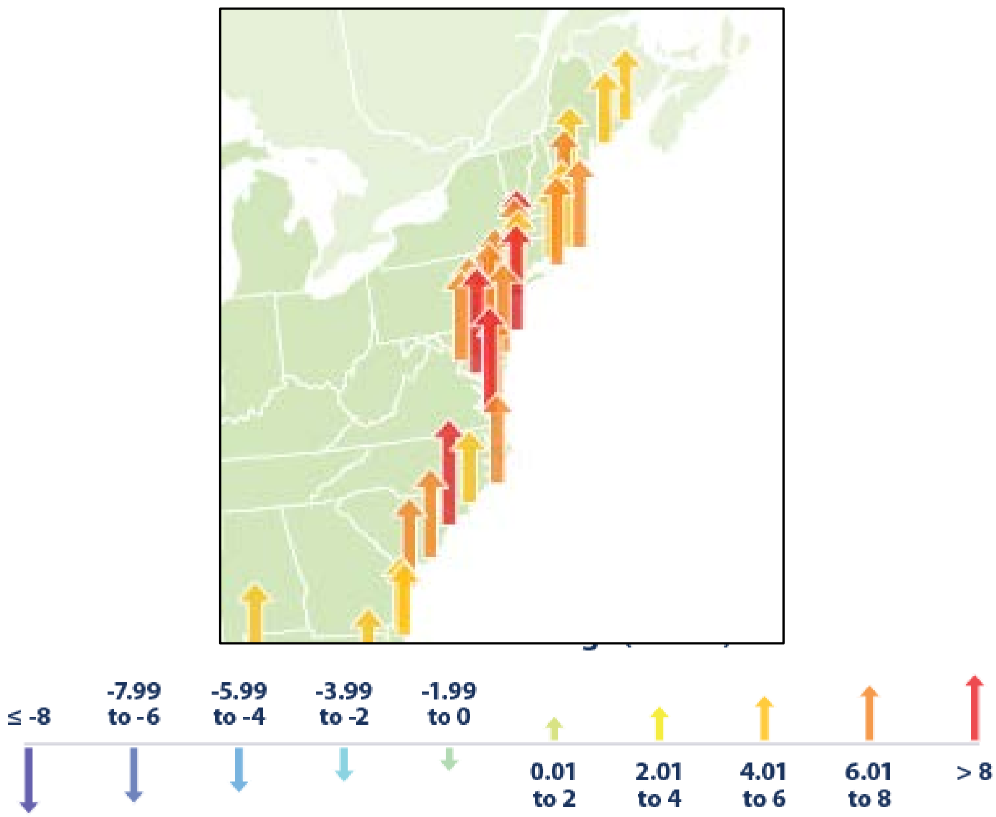
Oceans absorb the majority of temperature increases from climate change. Ninety percent of the warming on Earth over the last 50 years has occurred in the oceans, with upper oceans experiencing the majority (60%) of this warming (NOAA 2018e). Heat-gain rates in the upper ocean depths of 0 to 700 m were 0.36 to 0.4 watts/m^2 between 1993 and 2016, averaged globally (NOAA 2018e). Warmer oceans can increase evaporation, altering precipitation patterns leading to more extreme precipitation events.

Precipitation patterns also have become more extreme over land; nine of the top ten years for extreme precipitation events have occurred since 1990 (Global Change 2014). The Northeast has experienced the largest increase in extreme precipitation compared to any other region in the country. The amount of precipitation falling in very heavy events (the heaviest 1% of precipitation events) rose 70% from 1958 to 2010 (Global Change 2014).

This warming causes oceans to expand; raising sea levels consistently over the last century. In 2017, sea level was 3 inches above the 1993 average. This is the high average since 1993, when satellites began recording sea level rise. NOAA reports that as of 2018, the pace of sea level rise is accelerating (2018e). The average rate of sea level rise since 1993 was one-eighth of an inch per year.

Sea level rise does not occur uniformly. In the Atlantic Ocean, sea level rise along the coast was faster than global averages (Saba et al. 2016). EPA has mapped sea level rise along the Atlantic coast. Sea levels rose from less than 2 inches to greater than 8 inches between northern Florida and Maine; the greatest increases were along the mid-Atlantic coast and Chesapeake Bay (Figure 3-16). Sea level is predicted to rise to varying degrees across the study area and is anticipated to rise from 0.4 to 1.8 ft by 2050 (MA Office of CZM 2013). Areas that are likely to be impacted can be identified from readily available tools such as Sea Level Rise Viewer. The Park Service also has a viewer that is used to identify areas vulnerable to storm surges.

Figure 3-16. Relative Sea Level Rise on the Atlantic Coast 1960 – 2014



Source: EPA 2016

The acidity of the ocean has increased approximately 30% since the Industrial Revolution (PMEL 2018). The pH of ocean waters has decreased from 8.16 to 8.06 as ocean waters have become more acidic (PMEL 2018). (pH is a measure of acidity; the scale inverse and logarithmic, meaning pH goes down as acidity goes up, and small changes in pH are large changes in acidity.)

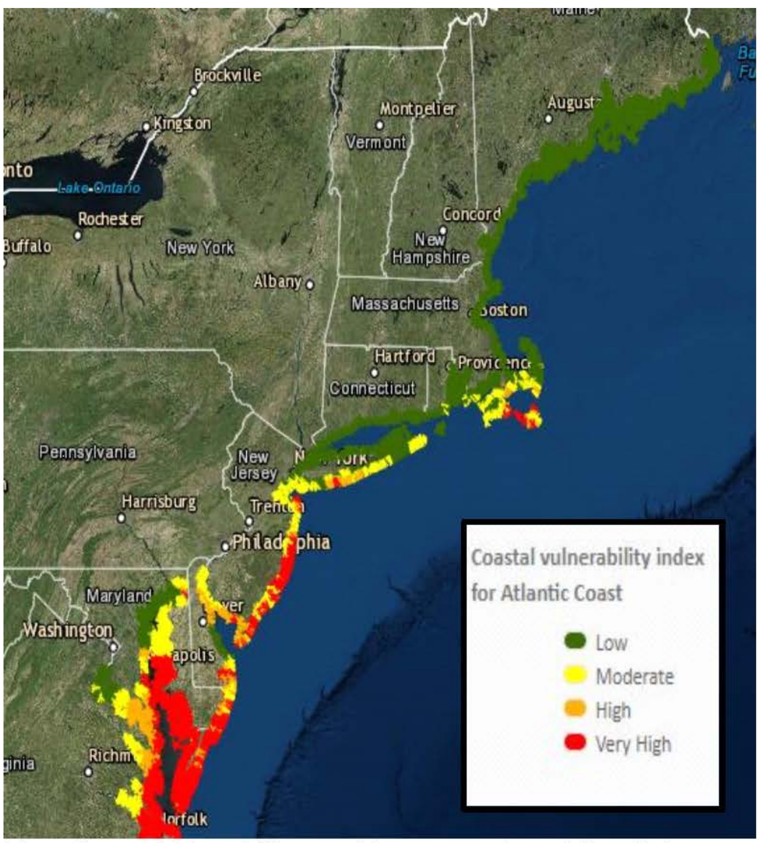
3.8.3 Reasonably Foreseeable Future Activities

Global temperature is expected to continue to increase in the next century. Since the future activities of climate change will greatly vary around the world as well as along the Atlantic coast, local vulnerability plans and vulnerability assessments can be used to identify vulnerable resources and localized projections.

By 2020, models forecast warming will be 0.9 degrees Fahrenheit above the 1986 to 2005 average (IPCC 2015). Three scenarios from the Intergovernmental Panel on Climate Change (IPCC) 2015 report forecast warming between 2 and 9.7 degrees Fahrenheit by 2100. This warming is likely to result in additional extreme events such as heavy precipitation events and extreme temperatures, both cold and warm (IPCC 2015). It will also cause the ocean to continue warming and acidifying (IPCC 2015).

Mean sea level is projected to rise as more glacier ice melts and the oceans absorb more heat and expand. Extreme precipitation and weather events are forecast to increase in the next century as climatic systems change. The highest forecast for 2100 projects mean sea level rise of 2 meters above 1992 levels; the lowest forecast projects 0.2 meters above 1992 levels (NOAA 2018e). Many regions of mid-Atlantic coast are considered to have "high" or "very high" coastal vulnerability to projected climate change and sea level rise (Figure 3-17; USGS 2018).

Figure 3-17. USGS Coastal Vulnerability Index for the Atlantic Coast



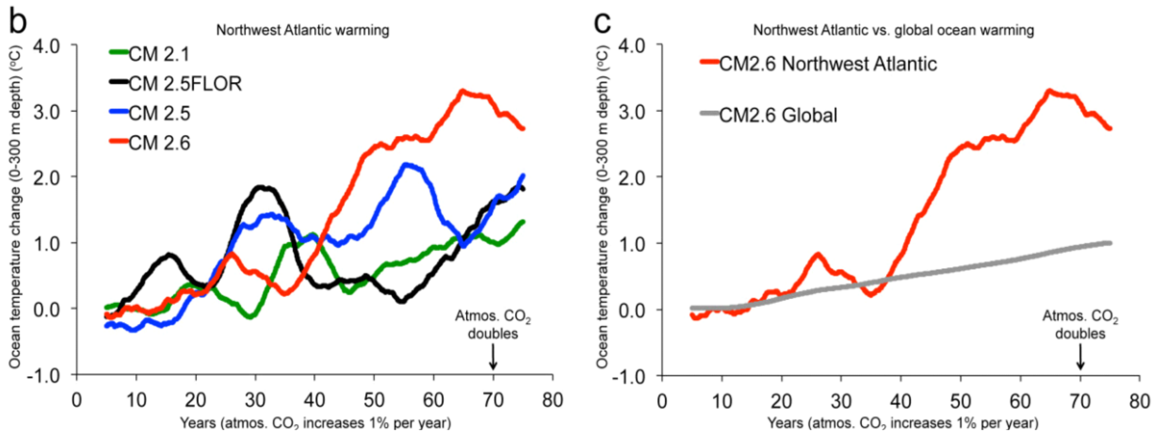
Note: Coastal Vulnerability provides an overview of the relative susceptibility of the sea-level rise
Source: USGS 2018

This vulnerability is due to warming as well as local land subsidence (sinking). The Northwest Atlantic has also been identified as an area where current projections of climate change impacts might be conservative (Saba et al. 2016). Sea level rise of two feet would more than triple the frequency of dangerous coastal flooding through the Northeast (Global Change 2014). Sea level rise has both static and dynamic impacts.

Static sea level rise will require efforts to avoid, mitigate, or forestall the long-term rise in sea level, e.g., physical barriers; relocation of structures and activities; and revised zoning, code, and construction requirements. Dynamic sea level rise impacts result from the episodic effects of sea level rise coupled with increased storm intensity, with consequent increased occurrences of flooding and damages over larger areas.

There is evidence the Gulf Stream and North Atlantic Current may be weakening as a result of global warming and increased fresh water infusion from the Greenland ice sheet (Rahmstorf et al. 2015). If the Gulf Stream weakens, increased regional sea level rise along the North and mid-Atlantic coast could be even greater than currently modelled and accompanied by colder temperatures. Warming in the Northwest Atlantic is projected to be three times faster than the global average (Figure 3-18; Saba et al. 2016). Despite uncertainty in projections, there is potential for habitat disturbance in coastal environments as well as disruption to marine life due to foreseeable climate change.

Figure 3-18. Ocean Warming Modelled in the Northwest Atlantic (left panel) and Compared to Global Averages (right)



Note: Uses four different models to project ocean warming with different parameters over an 80-year experimental run where atmospheric carbon dioxide increases 1 percent annually.
Source: Saba 2016

3.8.4 Impact-Producing Factors Associate with Climate Change

The reasonably foreseeable impacts of climate change in the North Atlantic that could affect the development of offshore wind energy include the following:

- Warming and sea level rise, property/infrastructure damage
- Warming and sea level rise, protective measures (barriers, seawalls)
- Warming and sea level rise, storm severity/frequency
- Warming and sea level rise, storm severity/frequency, sediment erosion, deposition.

Additional IPFs from climate change that may not directly overlap with offshore wind energy IPFs include:

- Ocean acidification
- Warming and sea level rise, altered migration patterns
- Warming and sea level rise, altered habitat/ecology
- Warming and sea level rise, disease frequency.

3.9 Oil and Gas Surveys and Extraction

3.9.1 Description of Action and Activities

Oil and gas activities involve several phases: G&G surveys; exploration, development, production/ extraction, and decommissioning/platform removal. G&G surveys are performed to locate map sea bottom features, e.g., to identify manmade, seafloor, or geological hazards; to locate potential archaeological or benthic resources; and obtain geologic data to assess the location and potential of recoverable hydrocarbons. G&G survey activities include: Deep-Penetration Seismic surveys; HRG seismic surveys; electromagnetic, magnetic, gravity, and remote sensing surveys; and geological testing (sampling and drilling or coring). Oil and gas exploration involves mobile drilling units (e.g., jack-ups, semi-submersibles, drill ships) and drilling a series of individual wells to locate and test the recoverability of petroleum reserves. Oil and gas development occurs when economically viable reserves are targeted for extraction and involves drilling multiple wells in close proximity to each other and the installation of a platform to collect the recovered product and transfer it to a pipeline typically for delivery onshore. Oil and gas production involves the extraction of the oil and gas and its transport for onshore processing.

3.9.2 Current Activity

Oil and gas lease sale activities are not included in the cumulative impact scenario. The Final Outer Continental Shelf Oil and Gas Leasing Program: 2017–2022 does not include lease sales in the Atlantic under this five-year plan (BOEM, 2016a).

BOEM issues G&G permits for hydrocarbon exploration, development, and production. BOEM is currently reviewing eight G&G permit applications that are listed in Table 3-20. The areas under consideration for G&G surveys are in federal waters on the Atlantic OCS and extends from Delaware to Florida.

Table 3-20. Geological and Geophysical (G&G) Permits Currently Under Review by BOEM

Permit Number	Company	Submittal Date	States Adjacent to AOI
E18-002	TDI Brooks International, Inc.	May 29, 2018	New Jersey to Florida
E18-001	ABI Holdings Limited (Austin Exploration)	February 20, 2018	Delaware to Florida
E14-001	TGS	March 31, 2014	Delaware to Florida
E14-003	GX Technology Corporation	April 3, 2014	Delaware to Florida
E14-004	WesternGeco LLC	April 9, 2014	Virginia to South Carolina
E14-005	CGG Services (US) Inc.	April 29, 2014	Delaware to Florida
E14-006	Spectrum Geo Inc.	May 8, 2014	Delaware to Florida
E14-007	Petroleum Geo Services	May 9, 2014	Virginia, North Carolina
E14-010	TDI-Brooks International, Inc.	October 16, 2014	North Carolina to Florida

These surveys overlap with the cumulative impact geographic analysis area for birds, bats, sea turtles, marine mammals, finfish, invertebrates, and essential fish habitat.

3.9.3 Reasonably Foreseeable Future Activities

The current five-year OCS oil and gas lease sale plan has no lease sales through 2020. The time span from the lease sale notice to the initiation of exploration activities is on the scale of 10 to 20 years. The Atlantic has seen minimal oil and gas development interest and activity from the 1970s through the present. With the exception of G&G activities, oil and gas development is not included in the cumulative impact scenario for proposed wind energy activities.

3.9.4 Impact-Producing Factors Associated with Oil and Gas Activities

Potential IPFs from oil and gas-related G&G permit activities that may overlap with IPFs of offshore wind energy development include those associated with G&G surveys that currently are considered a reasonably foreseeable future action (marked with asterisks ”*”) and those related to exploratory drilling, development, or production, which at present are not considered in the reasonably foreseeably cumulative impact scenario:

- Accidental releases, fuel/fluids/hazmat*
- Accidental releases, fuel/fluids/hazmat, structures
- Accidental releases, trash and debris*
- Air emissions, aircraft*
- Air emissions, onshore
- Air emissions, vessels
- Anchoring*
- Discharges, onshore point source and non-point sources, structures
- Discharges, vessels*
- Light, vessels or offshore structures, above water
- Noise, aircraft*
- Noise, demolition, structure removal
- Noise, G&G*
- Noise, O&M
- Noise, vessels*
- Port utilization, expansion
- Presence of structures, offshore space use conflicts
- Presence of structures, onshore space use conflicts
- Traffic, aircraft*
- Traffic, vessel strikes, sea turtles and marine mammals*
- Traffic, vessels.*

IPFs associated with oil and gas-related survey and extraction activities that will not materially overlap with IPFs of offshore wind energy development include:

- Accidental releases, crude oil
- Air emissions, structures
- Demolition, structure removal
- Demolition, structure removal, explosives
- Demolition, structure removal, shock waves
- Discharges, drilling, sedimentation and burial*
- Discharges, drilling, vessels*
- Discharges, drilling, water column*
- Land disturbance, onshore construction
- Light, structures, onshore
- Light, vessels or offshore structures, underwater
- Noise, drilling*
- Noise, offshore
- Noise, onshore
- Noise, trenching
- Pipeline trenching.

3.10 LNG TERMINALS

3.10.1 Description of Activities

Liquified natural gas (LNG) terminals serve to either import or export LNG, or both. Import facilities transfer LNG from tankers to storage facilities. The LNG is then either reheated, converted to vapor, and injected into a pipeline system for distribution to local markets, or transported to local utility storage tanks via trucks (NGA 2018). Export facilities export LNG from pipelines or trucks to tankers. Terminals can be situated either onshore or offshore. At onshore facilities, vessels unload LNG at shore-side docks. Offshore facilities, also called deepwater ports, typically consist of a buoy system that LNG tankers can dock to and unload their cargo into a pipeline system that brings vaporized LNG onshore.

3.10.2 Past and Present Activities

Four LNG terminals are located within the U.S. North Atlantic, with one additional terminal 97 km north of the Maine border in New Brunswick, Canada[5] (Table 3-21, Figure 3-19). These facilities provide services such as natural gas export, natural gas supply to the interstate pipeline system or local distribution companies, storage of LNG for periods of peak demand, and production of LNG for fuel and industrial use (FERC 2018).

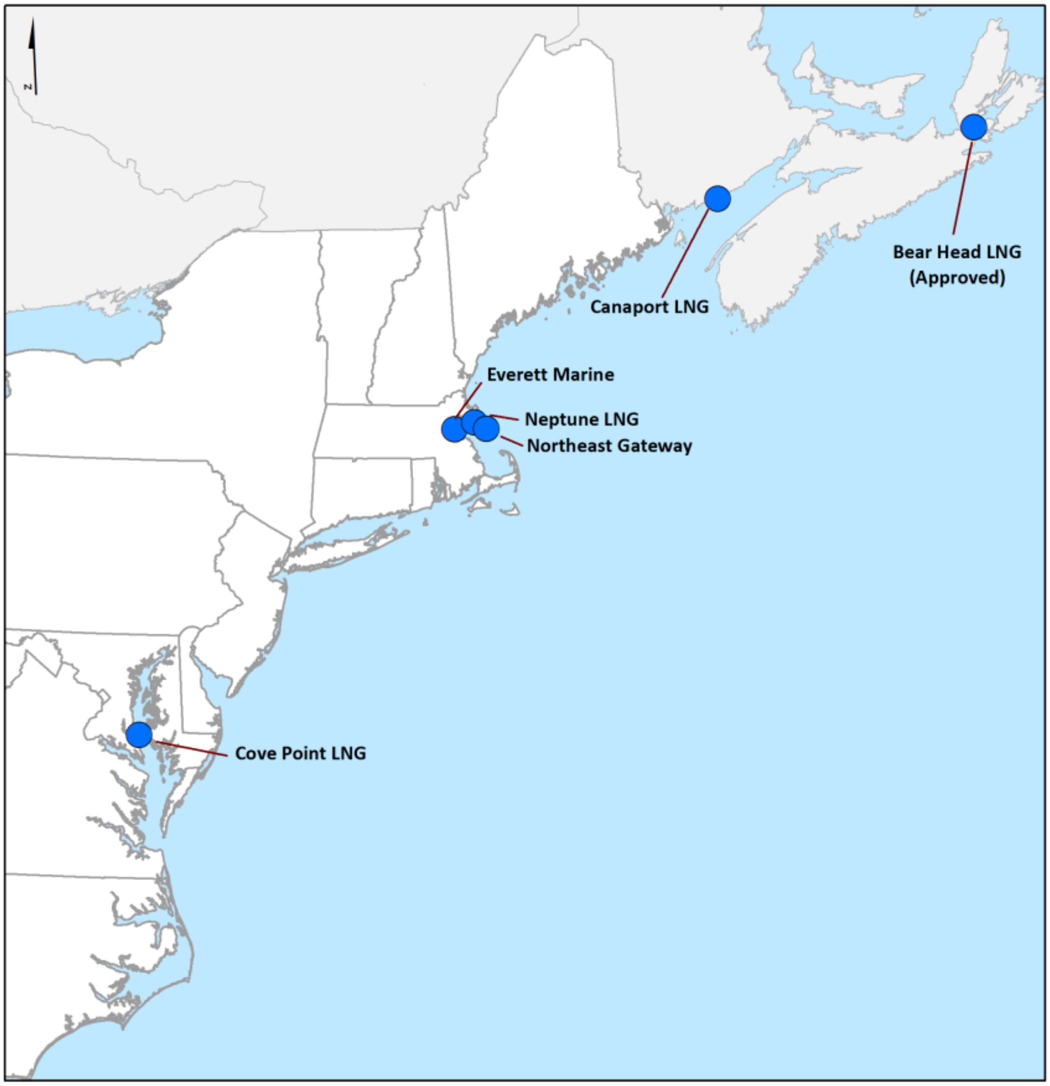
Table 3-21. Existing and Approved LNG Terminals in the North Atlantic

Status	Terminal Name	Location	Types	Owner	Jurisdiction
Existing	Canaport LNG	Saint John, New Brunswick	Import Terminal	Repsol/Fort Reliance	National Energy Board, Canada
Existing	Everett Marine	Everett, MA	Import Terminal	GDF SUEZ – DOMAC	FERC
Existing	Neptune LNG	Offshore Boston, MA	Import Terminal	GDF SUEZ	U.S. Department of Transportation MARAD /USCG
Existing	Northeast Gateway	Offshore Boston, MA	Import Terminal, authorized to re-export delivered LNG	Excelerate Energy	MARAD/USCG
Existing	Cove Point LNG	Cove Point, MD (Chesapeake Bay)	Import/Export Terminal	Dominion	FERC
Approved	Bear Head LNG	Port Hawkesbury, Nova Scotia	Export Terminal	Bear Head LNG	National Energy Board, Canada

Source: FERC 2018

[5] Information is provided on Canadian facilities that are likely to include vessel transit through the U.S. waters of the North Atlantic.

Figure 3-19. LNG Terminals in the North Atlantic



Source: FERC 2018

The following are brief descriptions of existing LNG terminals.

Canaport LNG Terminal

The Canaport LNG terminal is an onshore receiving and regasification terminal located on the north shore of the Bay of Fundy. It is capable of sending 34 million cubic meters of natural gas per day. LNG arrives by ship and is offloaded via pipes into LNG storage tanks. Following regasification, the natural gas is distributed via the Brunswick Pipeline to markets in Canada and the U.S. (Canaport LNG 2018).

Neptune LNG Terminal

The Neptune LNG terminal is a deepwater port located 16 km off the coast of Gloucester, Massachusetts, in Massachusetts Bay. The facility consists of two mooring and unloading buoys, two pipeline end manifolds (PLEMs), a pipeline, and a transition manifold that receives natural gas from "shuttle and regasification vessels" (SRVs). The natural gas is transferred from the SRVs through the unloading buoy to a series of lines ultimately leading to the Algonquin Hubline natural gas pipeline. The terminal is located in U.S. federal waters in water depths ranging from 38 to 76 meters (USACE 2017). In 2017, Neptune LNG applied for a permit to decommission its facility (USACE 2017).

Northeast Gateway LNG Terminal

The Northeast Gateway LNG terminal is a deepwater port located 20 km offshore of Boston, Massachusetts, in Massachusetts Bay. It is capable of sending natural gas at a rate of 17 million cubic meters per day. The facility consists of a dual submerged turret-loading buoy system, including PLEMs, flexible risers, and subsea flow lines. Vessels dock at the buoys to transfer natural gas through a series of pipelines to the Algonquin Hubline natural gas pipeline. The terminal is situated in U.S. federal waters in water depths of approximately 82 to 88 meters (Excelerate Energy 2018).

Everett Marine Terminal

The Everett Marine terminal is located in Everett, Massachusetts, along the Mystic River. It is the largest LNG terminal in the U.S., providing 20% of the regional market demand for natural gas. Since 1971, this import and regasification facility has received more than 1,000 shipments of LNG imported from various international sources, with approximately 80% of natural gas arriving from Trinidad. Natural gas offloaded from ships is stored at the terminal before distribution by pipeline or tanker truck to the regional market (ENGIE 2018).

3.10.3 Reasonably Foreseeable Future Activities

As indicated in Table 3-21, there is one LNG terminal in the North Atlantic that has been approved for construction but has not yet been built. The onshore Bear Head LNG terminal is proposed to be located on the Straight of Canso, Nova Scotia, Canada, 451 km from the Maine border. The facility will consist of two 180,000 cubic meter LNG storage tanks and will accommodate LNG vessels with a capacity of 125,000 and 267,000 cubic meters. There are no other proposed terminals in the North Atlantic.

As noted above, Neptune LNG applied for a permit to decommission its facility in 2017 (USACE 2017). Natural gas imports have declined in recent years as U.S. domestic natural gas production has increased (NGA 2018). Cove Point LNG is the only facility on the U.S. East Coast that is capable of exporting LNG, though there has been recent interest in developing export facilities, with other U.S. companies filing for export licenses (NGA 2018). However, in the absence of additional information, it appears reasonable at this time to assume that the Neptune LNG terminal will be decommissioned, and the other existing LNG terminals will continue to operate into the reasonably foreseeable future. Until a reasonably foreseeable action, e.g., permitting or approval of a proposed construction plan is issued, LNG terminals need not be included in the cumulative impact analysis for wind energy development in the North and Mid-Atlantic. Therefore, in Chapter 4 of this document, LNG terminals are not discussed.

3.10.4 Impact-Producing Factors Associated with LNG Terminals

Construction and development of LNG terminals may result in short-term impacts to fisheries in localized areas, including impacts from increased vessel traffic to conduct surveys of sites. For operating LNG terminals, accidental releases of fuel/fluids from tankers or service vessels involved in LNG facility activities could harm fisheries through fish kills or contamination of large numbers of fish. Vessel traffic impacts from operating LNG terminals would be localized and recreational vessels may be able to avoid interaction with vessels as they transit to/from the LNG terminals. In addition, accidental releases from vessels transiting to/from the LNG terminals could occur which have the potential to affect recreation and tourism activities if they preclude recreational activities from occurring or result in oiling or trash along the shoreline at recreation/tourism locations. Construction/installation of LNG facilities has the potential to impact recreation and tourism by creating noise and vessel activity; however, permitting processes would likely ensure that these impacts are limited. The presence of LNG terminals as well as light from these facilities along the coastline could result in visual impacts for recreational boaters. Accidental releases, light and construction/installation, decommissioning impacts would be localized around the LNG facility sites.

IPFs associated with LNG terminals that may overlap potential offshore wind energy development IPFs include:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, fuel/fluids/hazmat, structures
- Accidental releases, trash and debris
- Air emissions, structures
- Air emissions, vessels
- Discharges, structures
- Discharges, vessels
- Noise, construction/installation
- Noise, O&M
- Presence of structures
- Traffic, vessels.

LNG terminals have no IPFs that do not also overlap with offshore wind energy development IPFs.

3.11 GEOSEQUESTRATION

3.11.1 Description of Action and Activities

Geosequestration is the process of removing carbon from the atmosphere and depositing it in a deep reservoir beneath the earth's surface. Geosequestration involves drilling wells, placing anchors, and laying pipelines on the seafloor. G&G surveys would be required for geosequestration projects for evaluating subsea formations and placement of structures, drilling of CO_2 injection wells, and construction/installation of a seabed pipeline to shore.

The OCSLA, as amended by the Energy Policy Act of 2005, gave BOEM the authority to issue leases, easements, and rights-of-way for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas." Sub-seabed CO_2 sequestration falls under BOEM's authority if the CO_2 is produced as by-product of the production of electricity from a coal-fired power plant. BOEM is developing regulations to implement its authority and developing Best Management Practices for CO_2 transport and sequestration projects on the OCS (USDOI, BOEM, 2011d). An advantage to offshore geosequestration is that many of the risks, liabilities, and legal issues that occur onshore are removed or substantially reduced, e.g., property rights issues, title or ownership of the CO_2, and statutory issues (e.g., Safe Drinking Water Act, clean streams laws, solid/hazardous waste management, regulatory issues affecting CO_2 pipelines, post-injection risks from radon, etc.).

An example of one such potential offshore geosequestration project is PurGen One. The proposed location is outside the AOI and the SCS Energy LLC's website states PurGen One is no longer under development, but the project is an example of the type of geosequestration project that could occur within the AOI. The $5.2 billion, privately developed PurGen One project proposed to build a 750 MW Integrated Gasification Combined Cycle with Carbon Capture and Storage (IGCC) power plant plus a manufacturing facility to produce hydrogen commodities, such as urea, at the site of a former chemical plant in Linden, New Jersey.

The project claimed access to geologic storage capacity of one trillion tons of CO_2 and planned to capture and transport up to10 million tons of CO_2 annually through a submarine pipeline to injection wells 113 km (70 mi) off the Atlantic Coast for sequestration in formations approximately 2,438 m (8,000 ft) beneath the seabed (PurGen 2012). The project faced intense local opposition and expected extensive regulatory scrutiny by federal, state, and local agencies.

3.11.2 Current Activity

Currently, there are no geosequestration projects planned near or within the AOI. One proposed project offshore northern New Jersey is no longer under development.

3.11.3 Reasonably Foreseeable Future Activities

Offshore geosequestration potentially could occur and would include either the short- or long-term presence of pipelines and structures. Until a reasonably foreseeable action, e.g., permitting or approval of a proposed construction plan is issued, geosequestration need not be included in cumulative impact analyses for wind energy development in the North and Mid-Atlantic. Therefore, in Chapter 4 of this document, geosequestration is not discussed.

3.11.4 Impact-Producing Factors Associated with Geosequestration

G&G surveys for geosequestration projects will be similar to those for oil and gas extraction; i.e., will include the use of airguns for deep penetration seismic surveys. Reasonably foreseeable IPFs would be similar to those for oil and gas exploration and development and include:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, fuel/fluids/hazmat, structures
- Accidental releases, trash and debris
- Air emissions, aircraft
- Air emissions, structures
- Air emissions, vessels
- Light, structures, above water
- Light, vessels, above water
- Noise, construction/installation
- Noise, O&M
- Presence of structures.

Impact producing factors that may not overlap wind energy development include:

- Discharges, drilling, sediment deposition/burial
- Light, structures, underwater
- Pipeline trenching.

3.12 SUBMARINE TRANSMISSION LINES, PIPELINES, CABLES AND INFRASTRUCTURE

3.12.1 Description of Activities

A variety of activities require underwater lines, cables, and infrastructure, including:

- Offshore renewable energy development requires subsea transmission line connections to coastal transmission infrastructure. These cables allow electric power produced offshore to be transported and consumed onshore. Subsea transmission cables also link power grids onshore to island power grids. Transmission cables are often high voltage direct current lines, which is then converted back to alternating current when connecting to onshore transmission infrastructure. Power cables are often smaller than 300 mm (11.8 in).

- Pipelines connect offshore LNG import terminals and oil and gas infrastructure to onshore pipelines and infrastructure that then deliver the product to refineries or storage facilities and then to consumers. Offshore pipelines may be constructed for specific infrastructure, such as an offshore oil rig or an offshore LNG import terminal, or used to carry oil and gas long distances underwater from one coast to another. Submarine pipelines for oil and gas infrastructure are typically the largest seabed cables ranging up to 1500 mm (59.1 in) in diameter.

- Submarine telecommunications cables are communication links that can span an entire ocean. These are vital links for commercial telecommunications companies, modern infrastructure, and national security. These cables are typically the smallest and involve fiber optics. A set of international rules are in place to avoid clustering and conflicts between submarine telecommunications cables that run across oceans[6]. Telecommunications cables are often smaller than 50 mm (1.9 in).

Installing or laying this infrastructure involves coordination of various activities, entities, and permitting, including review by the Federal Communications Commission (FCC), USACE, and NOAA. Depending on the particular project and site characteristics, construction and maintenance of submarine line and cable infrastructure may include the following activities:

- Geologic survey of a proposed cable route
- Use of specialized vessels and submarine equipment, as well as divers, to lay the cable
- Use of a machine or plough to bury the cable in the sea floor
- Surveys following installation
- Construction of (or connection to) a coastal landing station to connect the cable to onshore systems
- Maintenance repairs and/or removal of a cable, potentially including grappling, splicing and replacing cable lines; a submarine cable typically has a 25-year lifespan but can often extend longer.

3.12.2 Past and Present Activities

Current installed underwater lines, cables, and infrastructure are shown in Figure 3-20 and described below.

As of December 2012, NOAA charted 77 submarine cables in the North Atlantic. These cables are primarily submarine telecommunications cables with a small subset of power cables. Not all of these cables are currently utilized as certain cables can become obsolete or uneconomical due to technological improvements. The NOAA listing includes active cables as well as those that are currently out of service. The North American Submarine Cable Association (NASCA) also maintains a listing of submarine cables. NASCA, which is focused on telecommunications cables only for their organization members, identifies 35 cables in the North Atlantic; of those 12 (34%) are identified as out of service.

Other transmission, telecommunications, and pipeline activity in the AOI include the following:

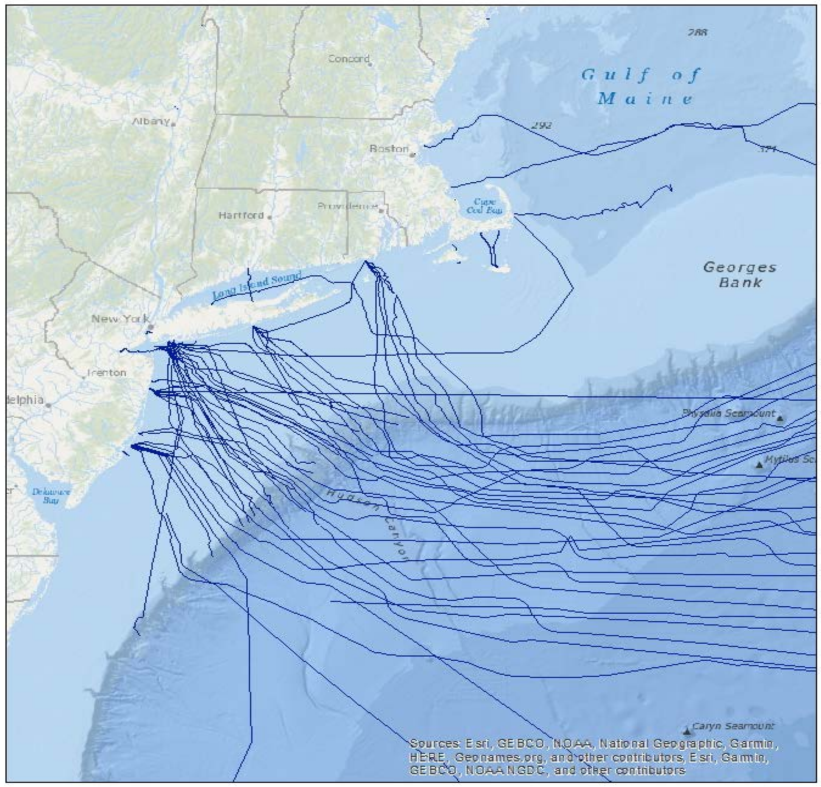
- BOEM holds the authority over right-of-way grants for the development and installation of transmission lines connecting offshore wind energy projects to onshore electricity grids. BOEM has issued 12 commercial renewable energy permits for offshore wind development from south of Cape Cod to Virginia. Block Island is the only right-of-way grant issued as of June 2018. The Block Island Wind Farm currently transmits generated electricity to Block Island and then to shore in Narragansett, Rhode Island via a single submarine transmission line. This transmission line first delivered electricity in 2016.

- Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/ Massachusetts mainland. Undersea electricity transmission lines connect the two islands of Martha’s Vineyard and Nantucket to onshore electricity infrastructure. Six cables (four to Martha’s Vineyard and two to Nantucket) connect the islands to the south shore of Cape Cod. A power cable also connects from the north shore of Long Island sound to Long Island.

[6] The primary source of international industry standards is the International Cable Protection Committee (IPPC) and the North American Submarine Cable Association, which issues recommendations (intended to be authoritative) for coordinating marine activities and submarine cables. An example recommendation from ICPC is a default separation distance of 500 meters between offshore wind facilities and active cables in shallow water (ICPC 2011a; b).

- Seabed cables for the telecommunications industry are prominent across the North Atlantic. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island infrastructure. Another cluster of submarine cables make landfall in southern Rhode Island as can be seen in Figure 3-20. These cables are primarily operated by private telecommunications entities.

Figure 3-20. NOAA Charted Submarine Cables



Note: This map includes cables that might currently be out of service or inactive. It was last updated in December 2012 and therefore is not comprehensive of all current submarine cables.

- The FCC has six pending submarine cable applications; one of the six would make landfall in the North Atlantic if approved by the FCC (FCC 2018). Submarine telecommunications cables are consistently being upgraded and enhanced for modern communications.
- In the Massachusetts Bay there are two LNG pipelines that connect to terminals offshore. These pipelines connect to Neptune LNG and Northeast Gateway. These terminals are 10 miles and 13 miles offshore, respectively. A pipeline also exists that runs along the seabed from New Jersey to Long Island, New York as part of a transcontinental pipeline operated by Williams Transco. No other major submarine pipelines are located in the North or Mid-Atlantic.
- There are currently no offshore oil and gas extraction activities in the North or Mid-Atlantic and hence no pipelines from oil or gas extraction sites. All 51 wells that industry has drilled in the Atlantic were abandoned as non-commercial.

3.12.3 Reasonably Foreseeable Future Activities

Submarine telecommunications cables are consistently being upgraded and enhanced for modern communications. As circuit capacity is used, more cables are needed resulting in new cable infrastructure to support telecoms operations. Replacement and repair of existing cables should also be expected in the foreseeable future as current cables reach the end of their effective lifespan or obsolete.

- Additional offshore energy projects would lead to an increase in submarine electricity transmission cables. Vineyard Wind, a proposed wind energy project, has a proposed subsea transmission link that would run from the project lease area south of Martha's Vineyard through Nantucket Sound to

Yarmouth on the south shore of Cape Cod. Vineyard Wind has proposed an alternative route that would connect onshore at Covell’s beach. Vineyard Wind has proposed onshore cabling routes and substation connections for both options.

- BOEM approved the qualifications of a commercial application for a right-of-way grant for New York and New Jersey in June 2018. This proposal is a part of the New York/New Jersey Ocean Grid Project that would create an offshore transmission system for future offshore wind. The proposal is designed to support 5,000 MW of offshore wind power from installation of offshore collector platforms. These platforms would connect multiple submarine cables from wind turbines before increasing the current and transmitting power to the shore. The proposal has a 12-month timeline following BOEM approval with a current anticipated grant date of the second quarter of 2019. The Atlantic Link project proposed a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts; the project is not proceeding for the foreseeable future since it lost the Massachusetts PPA and
- Multiple proposals for pipelines, LNG terminals, and transmission lines offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles and are not likely to proceed in the foreseeable future. An LNG terminal and pipelines were vetoed by the governor of New York in 2015 on the basis of security, energy, and navigational and fisheries concerns. An additional two LNG terminals were withdrawn before a record of decision. In 2018, the New York Department of Environmental Conservation rejected a proposed pipeline, proposed by Williams Transco, through the New York harbor due to incomplete information on environmental impacts. This pipeline would not connect to new infrastructure but would be expansions of current lines originating from the Gulf of Mexico.
- Additional oil and gas development as well new LNG terminals along the Atlantic coastline would require pipelines to connect to consumers and onshore infrastructure. At this time, no LNG terminals have been approved for production and no oil development leases under the current leasing program. No lease sales are scheduled for the lease sale period of 2017 to 2022 in the Atlantic.
- As of April 2018, the FCC has 6 pending applications for submarine cable operations and landings in the U.S.; from 2016 through April 2018 the FCC has granted ten licenses for submarine cable operations and landings in the U.S.

  Of the six pending applications, one is within the AOI:

  - America Europe Connect applied for a license in May 2018 to land and operate a non-common carrier fiber-optic submarine cable system connecting Wall, New Jersey; Blaabjerg, Denmark; Old Head Beach, Leckanvy, Ireland; and Kristiansand, Norway.

  Since 2016, the FCC has granted three licenses for landings within the AOI (FCC 2018):

  - Telefonica International Wholesale Services USA, Inc. in August 2017 - a license to land and operate a non-common carrier fiber-optic submarine cable network connecting Virginia Beach, Virginia; San Juan, Puerto Rico; and Fortaleza and Rio de Janeiro, Brazil. The cable became operational in August 2018.
  - Edge Cable Holdings USA, LLC in May 2017 - a license to land and operate a non-common carrier fiber-optic submarine cable network connecting Virginia Beach, Virginia with Bilbao, Spain. The cable became operational in February 2018.
  - Seabras 1 USA, LLC in November 2016 - a license to land and operate a non-common carrier fiber-optic submarine cable network connecting an existing cable landing station at Avon-by-the-Sea, New Jersey, with a new cable landing station in Brazil. The cable became operational in September 2017.

3.12.4 Impact-Producing Factors Associated with Submarine Transmission Lines, Pipelines, Cables and Infrastructure

The reasonably foreseeable impacts of submarine transmission lines, pipelines, cables and infrastructure that overlap with the IPFs of offshore wind energy development include the following:

- Accidental releases, fuel/fluids/hazmat
- Accidental releases, trash and debris
- Air emissions, vessels
- Discharges, vessels
- Electromagnetic fields
- New cable emplacement/maintenance
- Noise, vessels
- Presence of structures, entanglement, gear loss/damage
- Presence of structures, onshore
- Presence of structures, transmission cable infrastructure
- Traffic, vessel strikes, sea turtles and marine mammals
- Traffic, vessels

There are no IPFs related to submarine lines, cables, and pipelines that do not also overlap with the IPFs of offshore wind energy development.

3.13 LAND USE AND COASTAL INFRASTRUCTURE

3.13.1 Description of Activities

Land use on the North and Mid-Atlantic coast is diverse, encompassing many distinct environments including wetlands, developed areas, forests, and agricultural land. Atlantic coastal environments support a wide range of ecosystems as well as human activities. Developed coastal areas are common on the North and Mid-Atlantic coast due to the presence of large coastal population centers, including recreational, tourism, residential, commercial, and industrial infrastructures (NOAA 2010). Other infrastructure, such as onshore lighthouses and harbors, facilitate marine navigation and offshore activities and development.

American coastal zones are regulated and managed through a cooperative partnership between states and the federal government as part of the Coastal Zone Management Act (CZMA). The program is voluntary and is administered by NOAA. The regulation of coastal infrastructure is often collaborative between CZM programs, federal agencies, port authorities and municipalities, depending on the location and jurisdiction. Other coastal areas and structures such as parks and lighthouses are managed by the USCG and the National Park Service for historic preservation and recreation.

Ports are vital economic hubs that import and export significant quantities of goods every day. Container ports, as well as terminals for petroleum products or other goods that cannot be transported in container ships, can be public terminals operated by port authorities or private terminals. Ports include a variety of infrastructure, including storage facilities and railroad or roadway connections. Most major ports also have crane installations as well as conveyor systems for loading.

Offshore infrastructure connects and relies on onshore activities and infrastructure. For oil and gas projects or renewable energy development, these activities include providing for construction or fabrication and staging of projects and platforms before using port infrastructure to deliver materials to the installation site offshore. Ports serve a role in provisioning workers and general operation and maintenance activities for offshore infrastructure after installation. Other onshore infrastructure, including landing stations, connects submarine cables to onshore cabling and electricity grids.

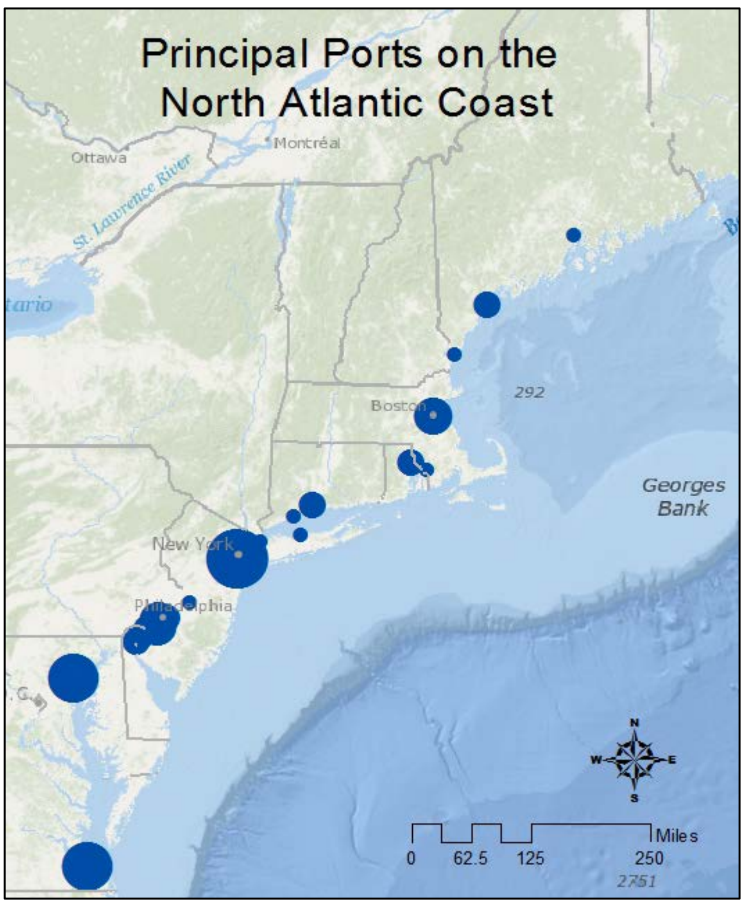
3.13.2 Past and Present Activities

Every state along the North Atlantic coast has a NOAA approved Coastal Zone Management program. The scale (i.e. how much area inland) that is covered varies by state. These programs were approved by NOAA in the late 1970s and 1980s and are administered by state agencies (NOAA 2018a). Many coastal zone management programs require planning and implementation for coastal and port infrastructure in collaboration with other entities (NOAA 2018e).

NOAA estimates that 9% of the Northeast Coastal Region is developed, however this is highly concentrated around high intensity development urban areas. From 1996 to 2010, developed land has increased (NOAA 2010). The developed areas of the Northeast are primarily along the coast including major metropolitan areas like Boston and New York. As of 2017, four of the ten largest metropolitan areas are in the region (US Census 2017). Three of the top twenty commercial fishing ports are in the North Atlantic (NOAA 2016). NOAA Atlantic Fisheries office identifies 16 major fishing ports in the Northeast with four each in Maine, Massachusetts and New Jersey (NOAA 2018c).

Port activity is concentrated in the New York area as well as Philadelphia, Baltimore, and Boston (USACE 2018). The USACE identifies 15 principal ports along the North Atlantic coast, shown in Figure 3-21 (USACE 2018a).

Figure 3-21. Principal Ports on the North Atlantic



Note: Size indicates total commodity tonnage in tons
Source: USACE 2018

As of 2014, there are no oil and gas platform fabrication yards in the Mid-Atlantic (BOEM 2014a). For offshore wind energy development, New Bedford, Massachusetts has a purpose-built terminal for offshore wind that was completed in 2015 (MA CEC 2017). The Department of Energy conducted an assessment of current port infrastructure for offshore wind energy development. Many regional ports would require infrastructure installations including increased bearing capacity (DOE 2014). Bearing capacity was the most common area for improvement in current ports as of 2014 with larger and heavier turbines coming into production (DOE 2014).

The USCG maintains a listing of all coastal light sources (USCG 2018)[7], which includes the location of onshore and offshore structures (e.g. buoys, markers and lighthouses). Public listings of lighthouse resources are also available that include directories and maps from both government and private citizen efforts. The majority of Atlantic lighthouses are along the New York and Massachusetts coast with 84 and 61, respectively (U.S. Lighthouse Society 2018).[8] Many Atlantic lighthouses are designated as historical locations as part of the National Historic Lighthouse Preservation Act (NPS 2018). The National Park Service also identifies 35 maritime-related national parks in the Northeast Atlantic region (NPS 2018). These include the Cape Cod national seashore and other recreation areas but they are not all coastal areas.

3.13.3 Reasonably Foreseeable Future Activities

Infrastructure developments and port improvements are funded and approved by a variety of agencies at both the federal and state level as well as by port authorities directly. Additional port and coastal infrastructure would likely require investment, permitting and review by these state and federal authorities. The DOT Port Performance Report is published every year and contains statistics and proposed updates as well as the relevant investments (DOT 2018). Table 3-22 presents the most recent report (updated in February 2018) identifying foreseeable port developments at the largest Atlantic ports by cargo volume.

Table 3-22. Foreseeable Future Port Development at Large Atlantic Coast Ports

Port	Updates
Baltimore	The Maryland Port Administration announced in 2017 that they had purchased 70 acres near one existing terminal to develop for container and roll on-roll off storage.
Boston	MassPort received $42 million in federal grants in 2016 for projected repairs and improvements at a variety of terminals.
New York and New Jersey	The Port Authority of New York and New Jersey has received federal grants as well as self-funded future projects including: • Cross Harbor Freight Program – improve rail connections. Currently undergoing a second round of environmental analysis • Bayonne Bridge – $1.6 billion project to raise the bridge above Kill Van Kull to allow for the largest current cargo ships to pass. Completion scheduled for 2019
Philadelphia	The state has invested $300 million in capital improvements for the port and the Packer Avenue Marine Terminal. Work with the U.S. Army Corps of Engineers to deepen the channel to 45 feet (which would allow for larger cargo ships) is ongoing.
Virginia	The Virginia Port Authority is in the process of developing a new container terminal. This would also involve dredging of the channel.
Wilmington (DE)	The Port has purchased land north of the current port area for potential expansion. Dredging of the Delaware River channel is ongoing.

Source: DOT 2018

Increases in marine navigation, fishing and offshore energy development would increase the use of onshore infrastructure and port facilities. Wind energy turbine construction would necessitate additional usage of port areas and infrastructure. The Port of New Bedford appears to be the key facility in offshore wind

[7] The USCG lighting list can be found here: https://www.navcen.uscg.gov/?pageName=lightLists
[8] For directories and listings of lighthouses: https://uslhs.org/resources/lighthouse-directories-organizations/directories

development in the North Atlantic. Vineyard Wind, one of only three COPs being processed by BOEM as of March 2019, intends to use the New Bedford terminal for installation procedures (MA CEC 2017). The materials would be constructed elsewhere and transported to the terminal for transportation and installation offshore. The State of Massachusetts has signed a Letter of Intent with DONG Energy, Deepwater Wind and Offshore MW to lease the New Bedford Marine Commerce Terminal as a staging and deployment location for future wind projects. The Port of New Bedford also has received a $15.4 million grant from the U.S. Department of Transportation that, in part, will help the Port of New Bedford extend its bulkhead, making room for 60 additional commercial vessels and providing an additional site for offshore wind staging. A DOE assessment report in 2014 (DOE 2014) estimated that the North Atlantic region would require a minimum of four staging ports to address projected growth in offshore wind development in the next 10-20 years (i.e. by 2030).

3.13.4 Impact-Producing Factors Associated with Land Use and Coastal Infrastructure

The reasonably foreseeable impacts of land use and onshore infrastructure activity IPFs that could overlap with offshore wind energy development IPFs include the following:

- Accidental releases, fuel/fluids/hazmat
- Air emissions, onshore
- Discharges, onshore point source and non-point sources
- Light, structures, onshore
- Presence of structures, viewshed
- Traffic, vessels.

IPFs associated with land use and onshore infrastructure that have no material overlap with IPFs of offshore wind energy development include:

- Land disturbance, erosion and sedimentation
- Land disturbance, onshore, land use changes
- Noise, pier and infrastructure, development
- Traffic, onshore.

4. CUMULATIVE IMPACTS ON AFFECTED RESOURCES

4.1 Cumulative Impacts Scenario IPFs That Interact with Offshore Wind Energy

Table 4-1 provides an overview of the IPFs from the actions included in the cumulative impacts scenario. These include IPFs that result from offshore wind energy development as well as IPFs from other activities that affect the same resources as offshore wind energy development. Compiling IPF information from past NEPA reviews for wind energy development projects was not straightforward. Often, past NEPA reviews for wind energy development used different terms to describe IPFs, e.g., “decommissioning” versus “platform removal.” We also found that past EIS’s defined IPFs differently, with some documents identifying IPFs that could more strictly be considered as impacts and not as factors that produce impacts, e.g., “benthic disruption or destruction” was identified as an IPF and not “benthic trawling.”

Our review of past NEPA documents for wind energy projects identified a total of 551 IPFs, many of which overlapped with each other. Eliminating duplicate IPFs resulted in 98 unique IPFs. These IPFs were then grouped by type into a list of 27 primary IPFs. Of these, 12 IPFs result from wind energy development, and 14 additional IPFs affect the same resources that are affected by wind energy development, as shown in Table 4-1. One objective of this project is to increase the consistency in BOEM’s future NEPA review documents.

Table 4-1. Cumulative Impacts Scenario IPFs

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Air emissions	●	●	●	●	●	●	●	●	●	
Anchoring						●	●	●		
Discharges	●	●	●	●	●	●	●	●	●	
Electromagnetic fields								●	●	
Energy generation, energy security								●		
Light			●				●	●		
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Bycatch		●								
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Gear utilization		●		●		●				●
Guidance/fiber optic/wires, entanglement						●				
Ingestion						●				

Table 4-1. Cumulative Impacts Scenario IPFs

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Land disturbance			●				●			●
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Regulated fishing effort		●								●
Resource exploitation		●								●
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea-level rise										●

Due to the lack of any ongoing or reasonable foreseeable activity, geosequestration, LNG terminals, and tidal energy projects were excluded from the cumulative impact scenario for North and Mid-Atlantic OCS wind energy development activities. They are not further discussed in this chapter.

4.2 Additional Potential Sources That May Interact with Wind Energy-Related IPFs

In addition to the actions listed above, there are minor, infrequent, or intermittent sources of IPFs that occur. These IPFs have the future potential to interact with the cumulative impacts scenario for wind development projects or may occur at a level significant enough to be considered in the cumulative impacts scenario. A few examples are briefly discussed below.

Natural releases

Methane, a potent greenhouse gas, seeps occur in deep waters along the Atlantic shelf more than 100 km from shore. There are hundreds of seeps along the shelf from Georges Bank to Cape Hatteras. The methane from these seeps is oxidized into carbon dioxide in the water column and plays a role in oceanic cycling of carbon (USGS 2016).

Discharges

Offshore fish processing currently is not practiced off the Atlantic coast. If such fish processing vessels begin operating off the Atlantic coast their impacts could materially contribute to cumulative discharges for consideration.

Electromagnetic fields and new cable emplacement and maintenance

Construction of monitoring or tracking installations for the purpose of homeland security have not been included in the cumulative impacts scenario. These activities could contribute to electromagnetic fields or cabling to the AOI.

Research Surveys

Research surveys conducted by federal agencies, universities, and research organizations can contribute to the impacts produced by G&G surveys covered in this cumulative impacts scenario.

Noise

Ambient sound in the ocean is derived from waves, wind, and animal communication. NOAA has deployed sound monitoring stations to determine background noise levels, including one station in Stellwagen Bank National Marine Sanctuary located off the coast of Massachusetts. https://www.st.nmfs.noaa.gov/feature-news/acoustics

4.3 CUMULATIVE IMPACTS OF IPFS ON POTENTIALLY AFFECTED RESOURCES

In this section, IPFs from all the actions and activities covered under the cumulative impact scenario are described for the potentially affected resources within scope, which include the following 19 resources:

Physical Resources

- Acoustic Environment
- Air Quality
- Mineral Resources/ Geology
- Water Quality

Biological Resources

- Terrestrial Fauna
- Birds and Bats
- Coastal Habitat
- Benthic Communities
- Fish Resources/Essential Fish Habitat/ Threatened and Endangered Fish
- Marine Mammals
- Sea Turtles

Socioeconomic & Cultural Resources

- Demographics, Employment, Economics, and Environmental Justice
- Cultural and Historic Resources
- Visual Resources
- Tourism and Recreation
- Commercial and Recreational Fisheries
- Land Use and Infrastructure
- Military Range Complexes and Civilian Space Programs
- Marine Transportation, Navigation, and Traffic
- Energy Production and Distribution

For each resource, the impacts of each of the 10 actions/activities (dredge material ocean disposal; fisheries use and management, land use and coastal infrastructure, marine minerals extraction, marine transportation and navigation, military range complex/civilian space program use, OCS oil and gas surveys and extraction, OCS wind energy development, seabed lines/cables/pipelines, and global warming) are discussed below. The interaction between OCS wind energy development and each of the other actions and activities is noted.

4.3.1 Physical Resources

4.3.1.1 Acoustic Environment

Table 4-2. Cumulative Impacts Scenario IPFs – Acoustic Environment

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Energy generation, security								●		
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Gear utilization		●		●		●				●
Land disturbance			●				●			●
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Resource exploitation		●								●
Sediment profile alterations				●						●
Warming and sea level rise										●

The acoustic environment can affect multiple biological and socioeconomic resources. Considered as a resource itself, offshore wind energy development IPFs that can affect the quality of the acoustic environment include: noise generated during site characterization (G&G) surveys, construction of data collection and wind turbine structures, emplacing submarine transmission lines, O&M of data collection and wind turbine structures, decommissioning/ structure removal, port utilization activities, and vessel traffic related to G&G surveys, construction/ installation, O&M, and decommissioning. HRG surveys that don't use air guns greatly reduces impacts from G&G survey activities. Among these, the most intense impact on the acoustic environment occurs as impulsive noise during pile driving to support meteorological towers and wind turbine structures. However, several mitigation measures reduce the potential impact of noise from pile driving activity (e.g., "soft" starts and seasonal restrictions) and pile driving only occurs during the construction/installation phase for wind energy structures. In contrast, noise impacts on the acoustic environment associated with wind energy-related vessel traffic are continuous and far less intense but still contribute to the overall occurrence of noise in the marine environment.

The resources most affected by noise include marine mammals, sea turtles, fisheries, and to a lesser extent, birds and bats. Acoustic impacts are manifest at several levels. Hearing threshold shifts involve temporary or permanent reductions in hearing ability. Temporary threshold shifts (TTS) is temporary and recoverable damage to hearing structures; it can vary in intensity and duration. Normal hearing abilities return over time from TTS; animals may not detect prey or predators during the recovery period: Permanent threshold shifts (PTS) results in variable but permanent hearing loss.

Masking occurs at sound levels below those that cause TTS or PTS impacts. Natural or anthropogenic acoustic input may be sufficient to interfere with hearing relevant sounds or induce evasive behavior. Masking sound can interfere with finding prey or mates, avoiding predators, and identifying appropriate nesting sites in the case of sea turtles. Animals can respond to acoustic inputs with behavioral responses, such as fleeing, diving, or changing swimming direction or speed. If sufficiently powerful, acoustic signals can cause physical injury, such as occurs with PTS and mortality.

Two studies have examined ambient noise in the North, Mid-, and South Atlantic and have analyzed species occurrence and migration patterns to establish some baseline conditions. BOEM (2014c) provides a statistical description of ambient sound levels for one year offshore Delaware Bay and Nantucket Sound. The authors considered the acoustic recordings provided an accurate acoustic baseline that may be used for comparisons to ambient levels during wind turbine construction and operation and for comparison with other sites. The statistical description of ambient sound levels was presented as percentile (5th, 25th, 50th, 75th, and 95th percentile) spectral-level histograms of spectral density values. The authors compared the percentile levels to the envelope values of the Wenz curves, which are generally reasonable at predicting ambient noise. The authors found frequency bands and seasons when sound levels occurred that were greater than those predicted by the Wenz curves.

Anthropogenic sources and natural sources were found at each site throughout the year. Sound levels exceed maximal predictions of the Wenz curves for heavy shipping and large storms at lower frequencies (<100 Hz) and biological fish choruses at higher frequencies (200–4000 Hz). Biological sound activity included marine mammals and fish. Delphinids and fin whales were the most commonly detected marine mammals at the Delaware Bay site. North Atlantic right whale calls were detected on a few occasions at both sites. Humpback whale call detections occurred only at the offshore Delaware Bay site. Although North Atlantic right whale calls were detected at the Nantucket site for a few hours in April 2011, marine mammals were essentially absent from this site. Fish choruses were heard in late summer and fall offshore Delaware Bay and in winter and summer at Nantucket Sound. These events occasionally exceeded the Wenz curves.

The authors suggested future development offshore Delaware Bay should consider the presence of endangered North Atlantic right, fin, and humpback whales mainly from January to March (although see BOEM [2015] below). The authors also noted that work is needed to identify the fish species whose calls were detected at the Nantucket site in winter to determine if these temporal presence/occurrence data are useful for commercially important species.

BOEM (2015a) conducted a baseline study of marine mammals and fish at two wind energy planning areas that are part of the Beaufort North Carolina (within Onslow Bay) and Brunswick Georgia (within the Georgia Bight) lease areas, from June 2012 to April 2013. Rice et al. also considered the ambient noise data acquired provide a baseline so that any contributions to future baseline noise from increases in ship traffic, construction, and wind farm operations can be measured and potential impacts assessed.

Long duration (multiple weeks or months) spectrograms and power spectra were used to evaluate ambient noise conditions. Summer and fall months (June/November) had higher levels of noise than winter and spring months (December/April). The Georgia location had higher noise levels than in North Carolina. Sources at both locations included: weather and biological, anthropogenic, and unknown sources. Fish chorusing was the dominant biological sound source; several unknown sound sources, potentially biological, made significant contributions to ambient noise. Marine mammal vocalizations were recorded throughout the study, but occurred too infrequently to be detected on long term spectrograms.

The authors detected North Atlantic right whales throughout the study, with peak presence November/April. Presence between January and March decreased in Georgia while increasing in North Carolina, corresponding to right whale migration. An unexpected secondary peak of right whale presence occurred in

June and July in the Georgia site. The authors also noted that right whale daily presence outside of November 1-to-April 30 Mid-Atlantic seasonal management period was 14% in North Carolina and 29% in Georgia. These data suggested North Atlantic right whales may occur in this region more often than previously documented. Multiple years of acoustic surveys are needed to decide if these results are an aberration or an annual pattern of occurrence. A significant presence of fin whales or humpback whales was not detected in Georgia or North Carolina. Humpback whale vocalizations were found on 8 days and 12 days in Georgia and North Carolina, respectively, but primarily in December 2012.

Black drum and oyster toadfish were acoustically detected over differing time periods at the North Carolina and Georgia sites. Black drum are predominantly present in fall/spring (November/April). Oyster toadfish are predominantly present in the early spring/summer (March/April and June/August). Based on the lower acoustic occurrence of black drum and toadfish in North Carolina, these two species would not be effective indicator species at this site. At the Georgia site, black drum and oyster toadfish may be good indicators of environmental change.

Dredged material ocean disposal

The contribution of ocean disposal to the acoustic environment primarily is noise from vessel operations, which may interact with noise from wind energy-related vessel traffic and construction. There are 15 disposal sites located in the North Atlantic, with half of those being around New York harbor (EPA 2018 in Chapter 3). The national trend appears to be a gradual increase in dredge spoil generation, and ocean dumping in the North and Mid-Atlantic would commensurately increase. Vessel traffic will concentrate around shoreward routes to and from disposal sites. Wind energy projects located near these sites may need to consider potential noise interactions. However, vessel traffic associated with ocean disposal and wind energy development is a minor contributor to marine noise compared to that from marine transportation, commercial/recreational fishing, and military marine activity.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual decline in activity, and vessels stay relatively closer to shore. The potential effects of noise on fishes can be categorized in increasing order of severity as: behavioral responses; masking of biologically important sounds; temporal threshold shifts (hearing loss); physiological/ anatomical effects; and mortality.

The IPFs of commercial and recreational fishing are primarily related to larger vessels used in commercial fishing. The IPFs that may interact with offshore wind energy development and contribute to the acoustic environment include vessel traffic noise and noise related gear deployment, operations, and retrieval (e.g., bottom dredges). Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast but is expected to remain stable for the foreseeable future; the long-term trend for recreational fishing shows a gradual, persistent decline in angler trips since 2004.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relates to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. These structures are related to site assessment studies through turbine and distribution platform installation. The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. Ports are already responding to accommodate the larger ships and cargo that can now traverse the Panama Canal (PONYNJ 2016).

IPFs related to land use and coastal infrastructure that may interact with wind energy-related IPFs and the acoustic environment is noise from vessel traffic. This impact will be spatially limited to the area near the port. The incremental increase in noise from offshore wind development vessel activity is expected to be a minor contributor to overall port activity compared to commercial, industrial, and recreational inputs. However, baseline levels of vessel traffic and commerce at the most likely ports to be used for a specific wind energy development project need to be assessed when assessing the significance of the incremental contribution of wind energy development to the acoustic environment.

Marine minerals extraction

Data on projected sand mining activity, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island/Barnegat Inlet/Little Egg Harbor Inlet project offshore New Jersey and the Sandbridge Beach project offshore Virginia.

Sand mining IPFs that have the potential to interact with wind energy IPFs and the acoustic environment include noise from vessel traffic, dredging, construction, and G&G activities. Noise from vessel traffic, dredging, and construction activities occur under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts−one or two years. However, dredging for a series of beach restoration projects is possible and result in longer-term impacts, thus needs to be assessed if the wind energy lease is near active borrow sites. Marine minerals mining may also require G&G activities similar to wind energy G&G surveys and related impacts e.g., vessel activity and HRG surveys. The interaction of minerals mining and wind energy G&G surveys will be temporally limited and could be scheduled to be avoided. These surveys can be spatially extensive, but they are of relatively short duration and could be scheduled to avoid overlapping impacts to the acoustic environment.

Marine transportation

Certain types of vessel traffic have increased recently and may continue to increase in the foreseeable future, although the lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 suggests that, with a few exceptions, vessel traffic is expected to remain relatively stable in the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016). IPFs that overlap wind energy-related IPFs and the acoustic environment include noise from vessel traffic from G&G surveys and construction/maintenance operations, and channel dredging.

The Panama Canal is a key link in the international maritime industry. Since the canal opened in 1914, the largest ships that were able to travel through the Canal were Panamax vessels and was determined by the dimensions of the canal lock chambers (length of 965 feet and width of 106 feet). This roughly translates to a container ship capacity of about 4,500 TEUs (cargo containers, twenty-foot equivalent units). The Panama Canal Authority built a second set of chambers, completed in 2016, to accommodate larger vessels (length of 1,401 feet and width of 180 feet), and the "New-" or "Neo-Panamax" vessels have a capacity of 12,000 TEU. The cargo shipping industry is trending towards these bigger ships because of economies of scale for vessel construction and operations (Le 2013). Port facilities aren't the only maritime operations that have to change. As ships get bigger, tugs and their gear, e.g., winches and braking capacity, have to increase as well (Workboat 2016). Also, as the large container ships transiting world trade routes grow even larger, they hold down the cost of ocean shipping, but also raise concerns among vessel operators, insurers, and regulators about the potential for catastrophic accidents (WSJ 2015).

The data from 2006 through 2015 (Figure 3-9) have a high variability, but suggest vessels calls are stable or slightly decreasing. However, although fewer calls suggest a potential lessening of the maritime shipping industry reduce noise generation from marine transportation, these larger ships may also create a greater acoustic profile that negates any decrease from less traffic. Vessel activity from wind energy leases near vessel traffic routes may interact, although wind energy vessel activity is small portion of overall marine vessel traffic. Interactions with G&G surveys are possible; however, the limited duration of these surveys minimizes their potential acoustic impacts. Noise related to wind energy construction could interact with marine vessel traffic only to a limited temporal and spatial degree, also minimizing potential acoustic impacts. Wind energy development could potentially impact shipping fairways, traffic lanes, and anchorage areas and increase noise near these areas that already are subject to heavy marine traffic. This concern, however, should be addressed in the scoping and public comment phases of the offshore wind energy leasing process.

Military use, military range complexes, civilian space programs

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018. The Navy determined training and testing activities have the potential to expose marine biota to multiple acoustic stressors that could produce temporary or permanent hearing threshold shift, auditory masking, physiological stress, or behavioral responses. However, because individual animals typically would experience a small number of behavioral responses or temporary hearing threshold shifts per year that acoustic stressors are unlikely to incur substantive costs on individuals and population level effects are unlikely.

In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to the acoustic environment and could overlap with those of wind energy development include: construction/installation impacts from anchoring buoys and structures, installing pilings, and dredging; demolition/structure removal; aircraft and vessel aircraft noise; noise from operations, e.g., sonar, weapons explosions, etc.; morality of fauna in range of target structures; and aircraft and vessel traffic.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs of note related to G&G surveys that overlap with those of offshore wind energy primarily involve noise and vessels: noise from seismic surveys, including airgun blasts, vessel noise, vessel traffic, and vessel strikes. IPFs that impact the acoustic environment include noise from vessels and seismic surveys. BOEM concluded that impacts from airguns used in oil and gas G&G surveys on fisheries resources and EFH would be minor to moderate (BOEM, 2014a). The interaction of oil and gas extraction and wind energy development IPFs can be minimized by timing and location considerations. Seismic surveys can extend over a time scale of months, whereas HRG surveys typically on a scale of weeks. However, identifying the locations and schedules of wind energy G&G and construction/installation activities and of oil and gas G&G activities could avoid overlapping impacts by scheduling activities to avoid cumulative impacts to the acoustic environment.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. Currently, three leases have been granted; one has an SAP submitted; three have SAPs approved; two have approved SAPs with COPs under development; two have approved SAPs and have submitted COPs; one leases has an approved Research Activities Plan.

BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies (i.e., G&G surveys, without airguns), site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to impacts on the acoustic environment are:

- *Site characterization surveys***.** G&G surveys IPFs include: noise from vessels and HRG (no airguns) surveys; and vessel traffic.
- *Site assessment studies: installation of meteorological towers and/or buoys***.** Site assessment studies have the same IPFs as G&G surveys with the exception of noise from HRG surveys. In addition, site assessment-related IPFs include: onshore fabrication of structures; construction/installation impacts and anchoring, driving pilings, and setting foundations for buoys; noise from driving pilings and setting of buoys; port utilization and traffic.
- *Installation of turbine structures***.** Installation of turbines will have all of the IPFs described for site assessment studies but also include new cable emplacement; noise from O&M and decommissioning/structure removal.

Submarine cables, transmission/telecommunication lines, pipelines

Installation and maintenance of submarine cable, transmission lines, telecommunications lines, and pipelines are ongoing processes, as evidenced by BOEMs grants of right of ways for power transmission lines and the pending and recently approved FCC applications for several fiber optic transmission lines (Section 3.12.3).

Submarine cables, lines, and pipeline IPFs that may overlap with those of wind energy development include: accidental releases, of fuel, fluids, trash, and debris; air emissions from vessels; installation of new subsea cables; vessel discharges; electromagnetic fields; vessel and construction noise; presence of structure impacts such as offshore and onshore new cable infrastructure; onshore space use conflicts; and vessel traffic and vessel strikes.

Future seabed cable, line, and pipeline activity appears to be dynamic and has the potential to interact with wind energy IPFs. Although most of this activity appears to be located close to shore, an investigation of future application approvals will be needed and the routes of these transmission connections reviewed. The IPFs of seabed cables, lines, and pipelines of note are primarily related to the benthic impacts of installation, maintenance, and repair. The level of vessel activity is relatively low; impacts from presence of structures are spatially localized.

The IPFs most important to the acoustic environment are related to the construction and emplacement of submarine transmission lines. These acoustic disturbances will include both above water (e.g., vessels and associated equipment) and underwater perturbations (e.g., from trenching or dredging). These impacts will be temporary and localized and have little likelihood on interacting with the IPFs of other activities.

Climate Change

Climate change will not directly affect the acoustic environment. Indirect impacts are conceivable, e.g., changes in noise levels occurring in different areas or at different times from fish stocks changing their distribution in response to climate change. However, such indirect impacts are not quantifiable at present.

4.3.1.2 Air Quality

Table 4-3. Cumulative Impacts Scenario IPFs – Air Quality

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Air emissions	●	●	●		●	●	●	●	●	
Discharges	●	●	●	●	●	●	●	●	●	
Energy generation/security								●		
Port utilization		●			●	●	●	●		●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Demolition, structure removal						●	●			
Port utilization	●	●			●	●	●	●		●

The Clean Air Act covers emissions of air pollutants that occur up to 25 nautical miles from shore. Air pollutants in this zone must comply with the closest onshore standards. As such, analysts may prefer to focus the cumulative impacts analysis of impacts to air quality in the zone covered by Clean Air Act.

In particular, areas near shore that are proximate to large population centers may have existing air quality problems in designated non-attainment areas. Although offshore vessel traffic may have limited effects on air quality of communities onshore, vessel traffic near large ports and in or near nonattainment areas is an important consideration of impacts to air quality with regard to wind energy development in the North and Mid-Atlantic OCS. Every activity that uses oceangoing vessels produces some level of air emissions, including marine transportation, fisheries, and recreational vessels. Although vessel impacts are short-term, chronic use of vessels in particular areas may contribute to adverse impacts to air quality. Because of the high volume of vessels used, commercial vessel traffic may be the most important category of vessel traffic to examine (BOEM, 2014a). Meteorological conditions and localized air quality conditions will impact the cumulative assessment of these activities (Navy 2018).

Dredged material ocean disposal

Vessels required for dredging, as with other vessels types, create air pollutant emissions from operations. There are 36 dredged material disposal sites designated in the Atlantic region and the majority of dumping activity occurs at these designated sites (MMS 2007). Fifteen sites are located in the North Atlantic; half of these sites are located near New York harbor (EPA 2018). Vessel traffic associated with dredged materials management is expected to be concentrated in and on shoreward routes to these areas.

Fisheries use and management

Commercial fishing vessels emit air pollutants when travelling to and from fishing areas. While some commercial fishing activities occur throughout the year, other activities are seasonal. Particularly in the northern part of the Atlantic, summer months see more commercial fishing activities. Some areas are closed to fishing due to conservation of species such as the right whale which reduces fishing traffic in particular areas (BOEM 2012a). Most recreational fishing vessels stay relatively near to shore, while commercial fisheries may travel further into open waters (BOEM 2012a). Commercial fishing vessels also concentrate and cluster in areas known as good fishing grounds (Kirkpatrick et al., 2017).

Land use and coastal infrastructure

Industrial point sources are substantial sources of onshore air pollutant emissions. To the extent that wind energy projects are anticipated to result in substantial air emissions, such sources should be considered. Other onshore activities contributing to air pollutant emissions include onshore construction activities, which affect air quality in the short-term through vehicle use (MMS 2007).

Marine minerals extraction

Surveying for, as well as implementation of, marine minerals extraction occurs in the Atlantic. Vessel traffic associated with these activities produces air emissions in the short term (BOEM, 2014a). Vessels operate on a variety of schedules that impact operations and associated air emissions, some for multiple days, returning to shore each day or staying out at sea (BOEM, 2014a). Vessel surveys for prospecting of marine minerals are often over smaller areas relative to oil and gas surveys of 300 to 1000 hectares, last one to five days, and are conducted by smaller vessels of 65 to 98 ft (BOEM, 2014a). Geotechnical testing surveys similarly use smaller vessels and last three days or less (BOEM, 2014a).

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that occurs across the coast and in the long term this traffic is expected to increase (BOEM, 2012a). Marine transportation activities are sources of chronic (long-term) air pollutant emissions throughout many offshore areas (BOEM, 2014a). Closer to shore, traffic is concentrated in key shipping channels and port areas (BOEM, 2014a). Vessels travelling in the North Atlantic within 200 nautical miles are required to comply with the ECA requirements for low sulfur oxide and nitrous oxide emissions. In response, operators can elect to change fuel types as they approach the 200 nautical mile boundary, which could be a potential operational or navigational concerns if near offshore structures.

Military use, military range complexes, civilian space programs

Military aircraft and vehicles emit a variety of air pollutants and greenhouse gases during operations. In addition, air emissions are emitted from munitions training and testing. These emissions are generally localized and temporary (Navy 2018). Repetitive and routine training could result in higher air emissions (Navy 2018). Cumulative impacts would be expected in and adjacent to areas where military training or testing activity occurs (Navy 2018).

Oil and gas surveys and extraction

Air pollutant emissions are produced during the construction of new oil and gas production platforms and pipelines, as well as during well drilling (BOEM 2016a). Drilling rigs emit air pollutants and risk accidental releases of fluids or fuel (BOEM, 2014a). Currently, there is no oil and gas drilling in the Atlantic. The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. Therefore, the cumulative impact scenario considers only the impacts of G&G activities. Support vessels and survey vessels for oil and gas extraction create air pollutant and greenhouse gas emissions (MMS 2007). Survey vessels often operate for multiple days and may spend multiple days at sea. Accidental releases of fuel or oil spills could also impact air quality as fugitive air emissions and air toxins are released from chemicals (BOEM 2016a). Ships conducting seismic exploration surveys can take days, weeks or months depending on the size of the survey area. HRG surveys use ships around 150 ft long and take about 36 hours to cover one OCS block (usually 2.6 nautical miles on a side).

Renewable energy development, wind

Renewable energy development has the potential to reduce air pollutant and greenhouse gas emissions if the new energy generation offsets or displaces fossil fuel generation (MMS 2007). Since renewable energy does not produce pollutants during operations, the primary IPFs that affect air quality would be related to vessel trips and construction/installation procedures (MMS 2007). The duration of these activities as well as the distance to shore from offshore activities is important to consider when reviewing impacts on ambient air quality (BOEM, 2012a). Fugitive dust emissions could occur from heavy equipment operation and vehicular traffic and impact ambient air quality (MMS 2007). These emissions would likely be concentrated in the earliest phases of onshore construction (MMS 2007). Construction of wind turbines could range from six months to two years depending on the number of turbines being installed (MMS 2007). Offshore assembly of individual devices might require less than a day for some turbines although there are many other offshore activities that require vessels (MMS 2007). Larger construction vessels may use bunker fuel and have much high emissions than vessels using diesel (MMS 2007).

The proximity and the timing of other offshore construction projects should also be considered (MMS 2007). Daytime sea breezes may also transport air emissions onshore but are typically minor due to mixing with onshore emissions and wind (MMS 2007). Onshore, transportation and freight traffic for materials would be the largest source of carbon monoxide and nitrous oxide emissions. Nearshore pre-construction surveys typically take 3 to 5 days and use vessels between 75 and 98 ft (BOEM, 2014a). In one example, the Massachusetts EA (BOEM 2014b) found that additional air emissions from 2,806 to 6,500 vessel trips associated with the WEA was anticipated to be small compared to the projected future vessel traffic in the heavily used waterways. Decommissioning activities have shorter time frames and lower activity levels creating fewer air quality impacts relative to construction and would likely be minor (MMS 2007).

Submarine cables, transmission/telecommunication lines, pipelines

The impacts of cable installation primarily result from the vessels required to install submarine lines. The air emissions associated with these vessels is typically isolated to the area specific to the cable line and shore (BOEM, 2014a). Short term air emissions impacts could occur onshore from the construction of onshore electricity distribution facilities that connect to submarine cables (MMS 2007). Onshore construction to connect to power facilities also may occur. This is most common if the power is serving an area with a small population or if the facilities are producing larger amounts of power (MMS 2007). The construction of landing stations and substations for cables would likely be concentrated in the early phases of wind development (MMS 2007).

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change may indirectly alter the impacts of wind energy development IPFs that affect air quality, e.g., air emissions related to vehicles and equipment used to protect against or repair damage from more frequent and intense storms. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.1.3 Minerals Resources

Table 4-4. Cumulative Impacts Scenario IPFs – Minerals Resources

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Anchoring						●	●	●		
Discharges	●	●	●	●	●	●	●	●	●	
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●									●
Cables, fiber optic/wires, guidance						●				
Gear utilization		●		●		●				●
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Resource exploitation		●								●
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea level rise										●

OCS sand, gravel, and shell resources are used for shore protection and for beach and coastal restoration. Although using offshore sand for beach replenishment along the Atlantic coast has occurred for decades, recent storm events have highlighted the national importance of coastal remediation and resilience in the sustainability of coastal ecosystems, tourism, coastal development, marine transportation, fisheries, energy development, and both defense and strategic infrastructure.

Compared to other resources considered in this document, minerals mining has three important distinctions. One is the value of minerals resources is in their extraction; the major impact producing factor affecting minerals resources is their exploitation. Another distinction is that minerals resources are not damaged by many IPFs that adversely affect other resources. For example, air emissions, bycatch, discharges, ingestion, or noise. The third distinction is that space-use conflicts seem to be the primary way these resources could be affected by other OCS actions or activities. Many other IPFs, such as anchoring, new cable/transmission line emplacement, pipeline trenching, or presence of structures are bottom-directed. However, because borrow sites go through a designation and approval process and are at fixed locations, potential impacts can be avoided or otherwise managed through the planning process for minerals mining and other OCS actions or activities with these types of associated IPFs. Vessel traffic of other OCS actions and activities remains as an unmanaged potential IPF

Dredged material ocean disposal

There are 15 disposal sites located in the North and Mid-Atlantic, half of those around New York harbor (EPA 2018). Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable. Vessel traffic is concentrated around shoreward routes to these 15 sites. The contribution of ocean dumping to overall marine traffic is small compared to other sources of vessel traffic, e.g., that from marine transportation, commercial/recreational fishing, military marine activity.

The IPFs related to dredge material ocean disposal that are relevant to marine minerals resources and may interact with offshore wind energy IPFs are primarily sediment deposition/burial and vessel traffic. There is little likelihood that ocean disposal will impact marine minerals resources because both disposal sites and borrow sites are designated respectively by EPA and BOEM. EPA also regulates the quality of dredge spoils and must concur with USACE disposal permits.

Because ocean disposal activity off the Atlantic coast appears to be static or decreasing, revisiting expected ocean disposal activity in the cumulative impact scenario would be prudent in case the current observed trend is becomes skewed by some transient or unforeseen factor.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual decline in activity, and vessels stay relatively near shore. Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coasts; minerals mining is a relatively small contributor to overall vessel traffic.

The IPFs of commercial and recreational fishing that are relevant to marine minerals resources and may interact with offshore wind energy is vessel traffic. The impact of commercial/recreational fishing on offshore minerals mining is limited primarily by the relatively low amount of mining-related vessel traffic as well as the designation use of specified borrow sites.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. The incremental increase from offshore wind development will be a minor contributor to port activity or port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports is considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE, 2014).

IPFs related to land use and coastal infrastructure that are relevant to marine minerals resources and may interact with offshore wind energy include land disturbance/development. Coastal development can increase the need for beach and coastal habitat restoration and thus the demand for sand and gravel. Offshore wind energy development is expected to have a small incremental impact on coastal infrastructure or development and the demand for offshore minerals.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (see Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes also are expected to be relatively stable (NROC 2016).

IPFs of marine transportation that are relevant to marine minerals resources and may overlap with wind energy IPFs include: port utilization and channel maintenance dredging and vessel traffic. These IPFs will have little or no impact on marine minerals resources. The impact of marine transportation on designated borrow sites can be minimized in site designation by BOEM.

Military use, military range complexes, civilian space programs

The Navy represents a significant military use of the offshore environment. The Navy's Atlantic fleet training and testing activities have the greatest potential to interact with minerals mining. The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to marine minerals mining and may overlap with those of wind energy development is vessel traffic.

Although there is great overlap of the AOI and military use areas (see Figure 3-3), the likelihood of an impact on marine minerals mining is low because of BOEM authority to designate borrow sites with input from DOD and BOEM's coordination and evacuation lease stipulations with the military and NASA that remove civilian activities from testing and training areas in active use.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs of oil and gas extraction that are relevant to marine minerals mining and may overlap with those of offshore wind energy primarily involves vessel traffic from seismic surveys. The interaction of oil and gas G&G surveys, wind energy development, and minerals mining is determined by BOEM, which authorizes all three activities. BOEM can avoid overlapping impacts by locating and scheduling activities to avoid cumulative impacts to minerals resources.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. Currently, three leases have been granted; one has an SAP submitted; three have SAPs approved; two have approved SAPs with COPs under development; two have approved SAPs and have submitted COPs; one lease has an approved Research Activities Plan.

BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to marine minerals resources that may overlap with offshore wind energy development are:

- *Site characterization surveys***.** HRG surveys IPFs include: accidental releases; discharges from vessels; and vessel traffic.
- *Site assessment studies: installation of meteorological towers and/or buoys***.** Site assessment studies have the same potential IPFs as site characterization studies except for HRG surveys. In addition, site assessment-related IPFs include: construction/installation impacts and seabed alterations from anchoring, driving pilings, and setting foundations for buoys; port utilization and traffic; impacts from presence of structures, including creating vessel traffic exclusion zones; and navigational hazards.
- *Installation of turbine structures***.** Installation of turbines will have all of the potential IPFs described for site assessment studies but also includes accidental releases from structures; impacts from scour protection; new cable emplacement; and the presence of structures.

The interaction between wind energy development and minerals mining IPFs is determined by BOEM, which authorizes both activities and can minimize impacts by locating and scheduling activities to avoid cumulative impacts to marine minerals resources.

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has issued 12 commercial energy permits for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, New York to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island. infrastructure

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/ New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

The IPFs of submarine cables, lines, and pipelines that are relevant to marine minerals mining and could overlap with those of offshore wind energy include: installation and maintenance of new subsea cables, presence of structure impacts, and vessel traffic. Future seabed cable, line, and pipeline activity appears to be dynamic. Although most of this activity appears to be located close to shore, an investigation of future application approvals will be needed, and the routes of these transmission connections reviewed. The greatest impacts of seabed cables, lines, and pipelines would be related to the benthic impacts of installation, maintenance, and repair. The level of vessel activity related to new cable emplacement is relatively low.

Because minerals mining occurs at well-designated borrow sites by BOEM, future seabed cable, line, and pipeline activity will avoid these sites and any impacts on marine minerals mining.

Climate change

Climate change disrupts geophysical and biological resources globally (see Section 3.8). Climate change may directly or indirectly alter the impacts of IPFs that affect marine minerals mining by increasing the need for beach and coastal restoration projects due to increase storm intensity and frequency. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.1.4 Water Quality

Table 4-5. Cumulative Impacts Scenario IPFs – Water Quality

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Anchoring						●	●	●		
Discharges	●	●	●	●	●	●	●	●	●	
New cable emplacement/maintenance								●	●	●
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Demolition, structure removal						●	●			
Gear utilization		●		●		●				●
Land disturbance			●				●			●
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea level rise										●

The Clean Water Act (CWA) is the principle legislation that regulates water quality in U.S. waters. EPA administers the CWA and regulates the discharge of pollutants form point and nonpoint sources through a number of regulations, of which permits issued through the NPDES are fundamental. NPDES permits use technology-based, water quality-based, whole effluent toxicity, and receiving water- based pollution controls. The NPDES permit system covers discharges from oil and gas extraction units and production facilities, ships >79 feet and ballast water discharges from all vessels, including commercial fishing vessels. EPA sets the criteria for designating ocean disposal sites, the quality of the material authorized for ocean disposal, and approves all ocean disposal permits issued by USACE. EPA regulates industrial and municipal point source discharges, municipal ocean outfalls, and non-point source pollution to water bodies of the US.

Dredged material ocean disposal

Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable. The contribution of ocean dumping to overall marine traffic is small compared to other sources of vessel traffic, e.g., that from marine transportation, commercial/recreational fishing, military marine activity, and will concentrate around shoreward routes for these 15 sites.

The IPFs of ocean disposal that are relevant to water quality and could overlap with those of offshore wind energy include: accidental releases, both operational and dredge spoil discharges, and vessel traffic. The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972, commonly called the "London Convention" is an international agreement to control pollution of the sea from ocean disposal. Impacts of ocean disposal to water quality are minimized because EPA has established criteria that dredge spoils are required to meet for spoils to be authorized for ocean disposal and EPA must concur on ocean disposal permits issued by the USACE. Operational discharges from ships are regulated under multiple statutes: MARPOL 73/78 and Annexes I - VI, which is implemented in the U.S. under the Act to Prevent Pollution from Ships (APPS); the EPA National Pollutant Discharge Elimination System (NPDES) general permits for large (>24 m) and small vessels; and the USCG approves marine sanitation devices for the treatment of sewage waste. Water quality impacts from ship discharges are minimized through these requirements. Accidental releases are low probability events, as are releases of contaminants from ship collisions and are expected to have little impact on dredge spoil disposal operations or disposal site conditions.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity. Recreational fishing trip data indicate a gradual decline in activity; the long-term trend shows a gradual, persistent decline in angler trips since 2004.

The IPFs of commercial and recreational fishing relevant to water quality that may interact with offshore wind energy development are vessel-related: accidental releases; waste discharges; and vessel traffic. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast but is expected to remain stable for the foreseeable future. Impacts of commercial fishing vessel discharges are regulated under MARPOL/APPS but not under the large or small vessel NPDES general permits; accidental releases are low probability events, as are releases of contaminants from ship collisions and are expected to have little impact on dredge spoil disposal operations or disposal site conditions.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. This includes: site assessment and characterization studies through turbine and distribution platform installation; seabed transmission line emplacement; and onshore substation connections. 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 modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand. The incremental increase from offshore wind development will be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE, 2014).

IPFs related to land use and coastal infrastructure relevant to water quality that may interact with wind energy-related IPFs include: accidental releases; point and nonpoint discharges; and land disturbance and development. Point source discharges are controlled through NPDES permit requirements; nonpoint sources discharges are controlled by EPA through Best Management Practices. Any impacts to water quality will generally be spatially limited to the nearshore area. Coastal development may result in a greater demand for beach and coastal restoration projects, with its associated increase in ship traffic due to offshore sand and gravel mining. The incremental increase in ship traffic will be small and water quality impacts from these operations are regulated under multiple authorities.

Marine minerals extraction

Data on projected sand mining, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island and Barnegat Inlet to Little Egg Harbor Inlet project, offshore New Jersey and the Sandbridge Beach project, offshore Virginia.

The IPFs of marine mining relevant to water quality that may overlap with those of offshore wind energy include: accidental releases, discharges, and vessel traffic. Sand mining IPFs related to discharges from vessels have the potential to interact with wind energy IPFs under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts−one or two years, with a maximum duration of three years for USACE permits−and impacts arising from seafloor disturbances from either activity are relatively localized in their spatial extent. However, the likelihood of dredging for a series of beach restoration projects is possible, resulting in longer-term impacts; the expected low levels of dredging need to be reviewed in case natural or anthropogenic actions alter current projections. The ship traffic associated with marine mining will be small and any water quality impacts from these operations commensurately small.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (see Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016).

The IPFs of marine transportation relevant to water quality that may overlap with those of offshore wind energy include: accidental releases; discharges; port utilization and channel maintenance dredging; and vessel traffic. The greatest water quality impacts will likely be local impacts at ports and terminals. Incremental impacts on water quality from offshore wind development would generally be a local concern near port facilities from vessel traffic if occurring in water bodies designated by EPA as impaired. Operational discharges from ships are regulated under multiple statutes: MARPOL 73/78 and Annexes I - VI, which is implemented in the U.S. under APPS; the EPA NPDES general permits for large (>24 m) and small vessels; and the USCG approval of marine sanitation devices for the treatment of sewage waste. Water quality impacts from ship discharges are minimized through these requirements. Accidental releases are low probability events, as are releases of contaminants from ship collisions; water quality impacts from marine transportation are expected to be minimal.

Military use, military range complexes, civilian space programs

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to water quality and could overlap with those of wind energy development include: accidental releases; construction/installation impacts from vessels and anchoring buoys and structures, installing pilings, and dredging; discharges from vessels; mortality of fauna in range of target structures; and vessel traffic. Although there is great overlap of the AOI and military use areas (see Figure 3-3), the likelihood of interaction with wind energy development is low because BOEM has coordination and evacuation lease stipulations with the military and NASA that remove civilian activities from testing and training areas in active use.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018 and concluded the physical and chemical changes resulting from its testing and training activities, as measured by the concentrations of contaminants or other anthropogenic compounds, may be detectable but would be below applicable regulatory standards for determining effects on biological resources.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs oil and gas extraction are limited to impacts from G&G surveys; the IPFs relevant to water quality and may overlap with those of offshore wind energy primarily involve vessels: accidental releases; vessel discharges, and vessel traffic. The interaction of oil and gas extraction and wind energy development IPFs can be minimized by timing and location considerations. Seismic surveys can extend over a time scale of months, whereas HRG surveys typically on a scale of weeks. However, identifying the locations and schedules of wind energy HRG surveys and construction/installation activities and those of oil and gas G&G activities could minimize or avoid overlapping impacts by scheduling of wind energy and oil and gas activities, which are both under BOEM oversight and control. That water quality impacts from oil and gas G&G surveys are expected to be negligible can be inferred from the absence of any analysis of potential water quality impacts in the Final Programmatic EIS for G&G Activities in the Mid- and South Atlantic.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to water quality that may overlap with offshore wind energy development are:

- *Site characterization surveys***.** G&G surveys IPFs include: accidental releases; discharges from vessels; and vessel traffic.
- *Site assessment studies: installation of meteorological towers and/or buoys***.** Site assessment studies have the same IPFs as G&G surveys with the exception of HRG surveys. In addition, site assessment-related IPFs include: discharges from onshore fabrication of structures; construction/ installation impacts and seabed alterations from anchoring, driving pilings, and setting foundations for buoys; discharges from vessels and structures; port utilization and traffic; and vessel traffic and navigational hazards.

- *Installation of turbine structures***.** Installation of turbines will have all of the IPFs described for site assessment studies but also include impacts from scour protection and new cable emplacement.

Incremental impacts on water quality from offshore wind development would generally be a local concern near port facilities from vessel traffic if occurring in water bodies designated by EPA as impaired. Operational discharges from ships are regulated under multiple statutes: MARPOL 73/78 and Annexes I - VI, which is implemented in the U.S. under APPS; the EPA NPDES general permits for large (>24 m) and small vessels; and the USCG approval of marine sanitation devices for the treatment of sewage waste. Water quality impacts from ship discharges are minimized through these requirements. Accidental releases are low probability events, as are releases of contaminants from ship collisions; water quality impacts from offshore wind energy development are expected to be negligible.

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has 15 active commercial energy leases for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, New York to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island. Infrastructure.

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. Multiple proposals for pipelines offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles, e.g., security, energy, navigational and fisheries concerns, and incomplete information on environmental impacts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

Submarine cables, lines, and pipeline IPFs relevant to water quality that may overlap with those of wind energy development include: accidental releases; installation of new subsea cables; vessel discharges; construction of new cable infrastructure; and vessel traffic. Future seabed cable, line, and pipeline activity appears to be dynamic and has the potential to interact with wind energy IPFs. The level of vessel activity associated with submarine cables, lines, and pipelines is relatively low; impacts from construction of structures are spatially localized and temporally limited. Impacts from accidental releases are minimized due to their low probability of occurrence and relatively limited spatial impact. Impacts from discharges are minimized through MARPOL/APPS and NPDES permit requirements. New cable emplacement will disturb benthic communities and cause temporary increases in suspended sediment; these disturbances will be local, limited to the emplacement corridor.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change may indirectly alter the impacts of IPFs that affect water quality by increased vessel traffic associated with beach and coastal restoration projects to protect against or repair damage from storms of increased intensity and frequency and associated with potential impacts from storm-related damage to infrastructure, e.g., sewage treatment facilities, oil or gas pipelines, industrial retention ponds. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.2 Biological Resources

4.3.2.1 Birds and Bats

Table 4-6. Cumulative Impacts Scenario IPFs – Birds and Bats

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Air emissions	●	●	●	●	●	●	●	●	●	
Energy generation/security								●		
Light			●				●	●		
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Bycatch		●								
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Ingestion						●				
Land disturbance			●				●			●
Port utilization, maintenance, dredging	●									●
Resource exploitation		●								●
Warming and sea level rise										●

The potential for avian mortality from collisions with wind energy structures is a key concern in the assessment of the potential impacts of offshore wind energy development. BOEM has sponsored several studies to address this concern,

BOEM (2016d) developed a quantitative model for fatality rates of *rufa* Red Knots from collisions with the physical structures of a model offshore wind energy facility in federal waters of Nantucket Sound, Massachusetts. The authors used a team of experts to conduct a comprehensive review of literature related to bird collision risk modeling at offshore wind energy facilities and to synthesize this information for the development of a quantitative, collision risk model. The authors included the Band model in their modeling approach to represent a subset of collision dynamics and added model elements representing the most important biological and meteorological dynamics.

The model predicted that the overall average collision fatality rate for *rufa* Red Knots, under baseline conditions, was 0.16 Red Knots per year at the facility, or equivalent to one fatality every 6.25 years. This fatality rate. consisted of 0.10 predicted fatalities per fall migration season and 0.06 predicted fatalities per spring migration season, Predicted fatalities scaled linearly with population size. Collision fatality rates were largely driven by collisions with stationary structures, particularly turbine towers, which accounted for roughly 90% of all collision fatalities in most model simulations.

The effects of varying wind speed and direction, precipitation, and visibility were incorporated into the model as behavioral switches between high and low elevation migratory flight altitudes, fall migratory flight departure delay decisions, and avoidance rate parameters. Simulation results indicated that only effective headwind speed exerted a strong influence on the fatality rates.

BOEM (2017a) followed several tagged northern long-eared bats and did not detect offshore movements. The tracking system was found capable of detecting wide-ranging and offshore movements by other bat species that were tagged as part of their efforts. During the summer months, female northern long-eared bats on the island were active throughout the night and could easily have accessed offshore environments for foraging under calm conditions. However, the authorsthey recorded no movements that exceeded 2 km, suggesting female northern long-eared bats the bats are unlikely to travel into federal waters (5.6 km offshore) during this time period. The authors were not able to capture adult males northern long-eared bats on the Vineyard in 2015 or 2016. The authors also did not detect off-island movements by two northern long-eared bats tagged in September 2015 or the single northern tagged in October 2016, suggesting that some northern long-eared bats are hibernating locally on Martha's Vineyard. Given the few northern long-eared bats tracked in the fall and the timing of those efforts, it is possible that some northern long-eared bats migrate off-island still exists.

BOEM (2016e) conducted 38 aerial surveys of seabirds south of the islands of Nantucket and Martha's Vineyard, Massachusetts from November 2011 to January 2015 to develop a distribution of seabirds offshore Massachusetts. The study area extends some 85 km offshore to the 60 m depth contour that was designated as a by BOEM. BOEM (2016e) sampled approximately 23,000 linear km of transect for the study and mapped the distribution of all birds from the data acquired along standardized strip transects. Species with high abundance south of Nantucket and Martha's Vineyard included white-winged scoters, long-tailed ducks, northern gannets, and razorbills. The authors searched for and identified locations where larger than average aggregations of seabirds occurred on a regular or repeated basis and found two. One location was near the western edge of the Nantucket Shoals; it consisted mainly of long-tailed ducks and white-winged scoters during winter and common and roseate terns during spring. A second location was in the Muskeget Channel area, consisting of scoters and eiders, loons, and terns. Overall densities of seabirds in the area were similar between years.

Brief descriptions of the interactions between birds and bats and the cumulative impact scenario actions are provided below.

Dredged material ocean disposal

The IPFs related to dredged material ocean disposal that may interact with wind energy-related IPFs and affect birds and bats are primarily vessel-derived stressors and include accidental releases of fuel, trash and debris, air emissions, noise, and vessel traffic. Among these IPFs, fuel spills are generally the most serious for bird populations. Discharges and traffic IPFs are not likely to have any impact of significance on bird and bat resources. Ocean disposal activity in the North and Mid-Atlantic is expected to gradually decrease or remain stable. The vessel activity contributed by ocean disposal activities to overall vessel activity in the AOI is very small in relation to other marine transportation vessel traffic; for example, recreational fishing effort alone approximates some 8 million trips annually. Seafloor and benthic disruption resulting from offshore wind energy vessel anchoring and installation of towers and buoys have a potential to interact with disposal activities, but these impacts are located at designated disposal sites and would have a low probability of interacting with offshore wind energy development benthic impacts.

Fisheries use and management

The IPFs of commercial and recreational fishing that may interact with offshore wind energy development are all vessel-related: accidental discharges, air emissions, waste discharges, noise, and traffic. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast. Although recreational fishing has generally ranged from for 7 to 8 million trips annually in territorial sea and federal OCS waters, the long-term trend for recreational fishing shows a gradual, persistent decline in angler trips starting in 2004. Of the IPFs that are relevant to bird and bat populations, fuel spills are generally considered the most serious.

Land use and coastal infrastructure

IPFs related to land use and coastal infrastructure that may interact with wind energy-related IPFs include accidental releases, air emissions, effluent discharges, noise, the presence of structures, and traffic. The impact of wind energy development on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures, from site assessment and characterization to turbine, and distribution platform installation, seabed transmission line emplacement, and onshore substation connections. The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in habitat loss for coastal bird and bat populations. However, the incremental increase from wind development will be a minor contribution in the port expansion required to meet increased commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE, 2014).

Marine transportation

IPFs that overlap wind energy-related IPFs include: accidental releases of fuel, fluids, trash and debris; air emissions; discharges; noise; port utilization; and vessel traffic. The trend data indicate that although cargo tonnage and twenty-foot equivalent units (TEUs) are gradually increasing, vessel traffic (ship calls) are gradually decreasing. The result is a fairly stable level of shipping activity. Interactions of any consequence with individual bird and bats with marine transportation are more likely to occur along the coastal margins and in or near ports far from offshore wind energy projects. The patchy and relatively sparse distribution of birds offshore will result in negligible impacts to bird and bat populations.

Military use, military range complexes, civilian space programs

Among the IPFs the Navy considered to have a potential for bird and bat impacts, accidental releases, air emissions, discharges, noise, the presence of structures, and traffic would interact with wind energy IPFs. The Navy considered the impact of naval training and testing activities as low to discountable because although individuals may be affected, population level impacts were not expected; a high proportion of nonlethal, short-term, and localized interactions having short recovery periods is expected; and widely dispersed naval activities occur offshore where bats occur infrequently and bird distributions are patchy, resulting in a low number of exposed individuals and low potential for interactions. Military activities are expected to present a negligible impact on birds and bats and not increase their vulnerability to the impacts of offshore wind energy development.

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to avian species and could overlap with those of wind energy development include: accidental releases; noise from construction/installation of structures or setting pilings; discharges from vessels; and mortality of fauna in range of target structures. Although there is great overlap of the AOI and military use areas (see Figure 3-3), the likelihood of interaction with wind energy development is low because BOEM has coordination and evacuation lease stipulations with the military and NASA that require cessation of activities prior to commencement of military exercises.

IPFs of military and civilian space uses that are relevant to birds and bats and may overlap with those of wind energy development include: accidental releases; emissions for aircraft and vessels; noise from construction/installation of structures, anchoring buoys, driving pilings, or demolition/structure removal; discharges from vessels; aircraft and vessel traffic and noise; noise from operations, e.g., sonar, weapons explosions, etc.; entanglement from operations using fiber optic cables or guidance wires; mortality of fauna in range of target structures.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018 and concluded and identified six IPFs that could affect birds and bats (Navy 2018).

Physical Disturbance and Strikes. Individual birds can be injured or killed by physical strikes during training and testing. However, there would not be long-term species or population level impacts because of the low numbers likely to be exposed over the large areas of operation. Impacts to bats would be similar but less than those described for birds because bats are relatively sparse in the Study Area.

Entanglement. Entanglement stressors can impact birds. However, the likelihood is low because the relatively small quantities of materials that could cause entanglement are dispersed over very wide areas and often in locations or depth zones outside the range or foraging abilities of most birds. A few individuals may be impacted, but no population-level effects are expected. The possibility of an ESA-listed bird becoming entangled is remote due to their rarity and limited occurrence in study areas. Bats rarely occur at the water surface in the Study Area, few or no entanglement impacts are anticipated.

Ingestion. It is possible that persistent expended materials could be accidentally ingested by birds while they were foraging for natural prey items. This is a low probability event is low because foraging depths of diving birds is generally restricted to the surface or shallow depths; these materials are unlikely to be mistaken for prey; and most material remains near the sea surface for only a short duration. No population-level effect to any bird species is anticipated. Bats do not occur in the water and rarely feed at the surface in the AOI. Few or no impacts to bats are expected.

The interaction of IPFs of military activities with wind energy development IPFs is not anticipated to be common because wind energy development activities near the area of naval training or testing are required to cease prior to commencement of naval exercises. Also, offshore wind energy is not generally expected to overlap with military use IPFs as they will occur in different geographic areas. For highly mobile or migratory species there is the possibility they could be affected from naval activities and then again affected by wind energy development activities if they transit both areas. Such interactions are expected to be low frequency events.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs of note related to G&G surveys that overlap with those of offshore wind energy primarily involve noise and vessels: noise from seismic surveys, including airgun blasts, vessel noise, vessel traffic, and vessel strikes. IPFs that impact birds and bats include noise from vessels and seismic surveys. BOEM assessed impacts to birds from G&G surveys (BOEM, 2014a) and concluded:

- The primary potential for impact to marine and coastal birds from airguns and other active acoustic electromechanical sources is to seabirds and waterfowl that dive below the water surface and are exposed to underwater noise. Among the listed and candidate species, piping plover and red knot are shorebirds unlikely occur near G&G activities. These birds migrate over the OCS but at heights far above G&G activities. Roseate terns are a pelagic species and come on land only to nest and roost.

They forage in shallow waters by plunge-diving, contact-dipping, or surface-dipping over sandbars, reefs, or schools of fish. The Bermuda petrel occurs in the AOI and feeds offshore by snatching prey from the sea surface. They typically remain aerial and rarely land on the sea surface. They also are known to feed on squid at night when they come to the surface. Active acoustic sound sources are highly directive with very narrow beam widths, reducing exposure of bird species other than plunge diving species. Because of these factors, other species of seabirds, waterfowl, and shorebirds would not be affected by active acoustic sound sources.

- Some seabirds and waterfowl either rest on the water surface or shallow-dive for only short durations. The short exposure time for shallow-dive birds and lower sound energy level that these diving birds could be exposed to would result in a negligible impact. Diving seabirds and waterfowl could be susceptible to active acoustic sounds generated from seismic airgun surveys. However, seismic pulses are directed downward, highly attenuated near the surface, and have a limited potential for direct impact from airgun surveys. Mortality or life-threatening injury is not expected, and little disruption of behavioral patterns or other non-injurious effects would occur, resulting in a negligible impact.
- There is the potential for minor, temporary displacement of coastal and marine bird species or their prey from a portion of feeding areas during non-migration seasons that would resulting in negligible impacts. However, if airgun surveys cause displacement from preferred feeding areas during migration, then the impact would be considered minor.

The interaction of oil and gas extraction G&G IPFs and wind energy development IPFs can be minimized by timing and location considerations. Seismic surveys can extend over a time scale of months, as does construction and installation of wind energy structures. However, identifying the locations and schedules of wind energy G&G and construction/installation activities and of oil and gas G&G activities could avoid overlapping impacts by scheduling activities to avoid cumulative impacts to birds.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. Currently, three leases have been granted; one has an SAP submitted; three have SAPs approved; two have approved SAPs with COPs under development; two have approved SAPs and have submitted COPs; one leases has an approved Research Activities Plan.

BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies (i.e., G&G surveys, without airguns), site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to impacts on birds and bats are:

- *Site characterization surveys.* G&G survey IPFs include: accidental release of fuel, fluids, trash, and debris; air emissions and discharges from vessels; noise from vessels and HRG (no airguns) surveys; and vessel traffic and vessel strikes.
- *Site assessment studies: installation of meteorological towers and/or buoys.* Site assessment studies have the same IPFs as G&G surveys with the exception of noise from HRG surveys. In addition, site assessment-related IPFs include: air emissions from offshore installation of pilings and towers or buoys and from onshore fabrication of structures; discharges from onshore fabrication of structures; construction/installation impacts and seabed alterations from anchoring, driving pilings, and setting foundations for buoys; noise from driving pilings and setting of buoys; port utilization and traffic; impacts from presence of structures, including creating fishing exclusion zones and gear entanglement, damage, or loss; navigational hazards; and viewshed impacts.
- *Installation of turbine structures*. Installation of turbines will have all of the IPFs described for site assessment studies but also include accidental release of fuel or fluids from structures; air emissions from generators; impacts from scour protection; electromagnetic fields; energy generation; new cable emplacement; noise from O&M and decommissioning/structure removal; presence of structure impacts from habitat creation/fish aggregation, altered migration, radar disturbances; air space conflicts; and turbine bird and bat strikes.

While birds may be affected by vessel traffic and discharges, the presence of meteorological towers and buoys, noise, vessel discharges, and accidental fuel releases offshore, wind energy development activities pose no threat of significant impacts**.** The risk of collisions with meteorological towers is minor due to the small number and size of the towers and their distance from shore and between each other. The impact of meteorological buoys is much smaller and closer to the sea surface than meteorological towers and their impacts less than those of towers. BOEM determined for its Mid-Atlantic wind energy lease sale that impacts to ESA-listed and non-ESA listed migratory birds is expected to be negligible from towers and buoys. USFWS concurred with BOEM’s determination for Roseate tern and piping plover but requested BOEM to provide additional consideration regarding the Bermuda petrel in light of new data on potential seasonal occurrence near the Virginia WEA. Bats may occasionally be driven offshore by prevailing winds and weather but rarely are expected to forage or migrate through WEAs. Bats may present either avoidance or attraction behaviors near towers. Any impacts to individuals would not be sufficient to affect the sustainability of the populations.

Submarine cables, transmission/telecommunication lines, pipelines

European studies have not considered impacts on birds and bats as substantial enough to evaluate (OSPAR, 2009; Meissner et al., 2006). The IPFs related to wind energy development include accidental releases, air emissions, discharges from vessels, construction and installation benthic impacts, noise, introduction of artificial hard substrate, electromagnetic fields, and thermal radiation. These impacts on birds and bats are primarily related to the potential impacts from vessels during the installation and maintenance of seabed transmission infrastructure.

Climate change

Climate change disrupts geophysical and biological resources globally (see Section 3.8). Climate change may indirectly alter the impacts of IPFs that affect birds and bats. Wind energy development would have a beneficial impact on the global warming impacts to the extent its energy generation will reduce the fossil fuel otherwise used to meet power demands. but may adversely affect bird and bat populations To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.2.2 Coastal Habitats

Table 4-7. Cumulative Impacts Scenario IPFs – Coastal Habitat

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Air emissions	●	●	●	●	●	●	●	●	●	
Discharges	●	●	●	●	●	●	●	●	●	
Light			●				●	●		
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●		●							●
Bycatch		●								
Gear utilization		●		●		●				●
Land disturbance			●				●			●
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Regulated fishing effort		●								●
Resource exploitation		●								●
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea level rise										●

The Atlantic coastline consists of a complex range of diverse coastal habitats, including barrier islands, sand spits, beaches, dunes, tidal and non-tidal wetlands, mudflats, and estuaries. Much of the Atlantic shoreline has been substantially altered from development, agriculture, vessel and ground traffic, industry, agriculture, beach replenishment, or shore protection activities.

Delaware has 24 miles of oceanfront coastline and over 380 miles bordering various estuaries, including Delaware Bay. New Jersey has 127 miles of coastline and 83 miles of shoreline along the Raritan and Delaware Bays, and over 300,000 acres of tidal wetlands. Maryland has 32 miles of coastline and several coastal habitat types along the Atlantic Ocean and Chesapeake Bay, including Assateague Island National Seashore, and numerous shallow coastal bays. Virginia has 5,000 miles of shoreline, with 120 miles on the Atlantic Ocean, and over one million acres of non-tidal and non-wetlands. The Chesapeake is a major resting ground along the Atlantic Flyway for about one million waterfowl. The Bay is an important commercial and recreational waterway and produces more than 500 million pounds of seafood annually.

New York has 193 km of coastline bordering the Atlantic Ocean. North-facing shores of the barrier islands consist of tidal flats and tidal/brackish wetlands; the interior of the islands comprise pockets of freshwater marshes, swamps, and scrub shrub wetlands. Deeper into the New York-New Jersey harbor, the shoreline is composed of rocky, exposed cliffs, man-made structures, and coarse-grained sand and gravel beaches, with fewer scattered tidal flats, eroding scarps, and saltwater marshes.

Massachusetts has approximately 148 km of oceanfront coastline and over 2,445 km of shoreline. The coastal resources of Massachusetts include seagrass beds, kelp beds, shellfish beds, sandy sediments (sand dunes), rocky shore, mudflats, saltmarshes, estuarine wetlands, and open water.

In 2017 BOEM released an extensive review of Atlantic coastal habitats, "*Effects Matrix for Evaluating Potential Impacts of Offshore Wind Energy Development on U.S. Atlantic Coastal Habitats*" (BOEM 2017). This document reviewed then existing information; provided a description of Atlantic coastal habitats; characterized the environments of BOEM's North, Mid-, and South Atlantic and Straits of Florida Planning Areas; reviewed reasonably foreseeable COP activities and their potential direct and indirect effects; and created a matrix of COP activities and their effects determinations.

Dredged material ocean disposal

There are 15 disposal sites located in the North Atlantic (MMS 2007), half of those being around New York harbor (EPA 2018). Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable. Vessel traffic is will concentrate around shoreward routes to these 15 sites. The contribution of ocean dumping to overall marine traffic is small compared to other sources of vessel traffic, e.g., that from marine transportation, commercial/recreational fishing, military marine activity.

The IPFs related to ocean disposal relevant to coastal habitat impacts that may interact with wind energy-related IPFs are primarily vessel-derived stressors and include accidental releases; air emissions; discharges; noise; and vessel traffic. Less important IPFs are fuel spills due to their low probability of occurrence and relatively limited spatial impact.

A potential indirect impact on coastal habitat could arise from an increased need for channel maintenance dredging from offshore wind energy vessel traffic. However, in comparison to the number and size of vessels that use the port facilities along the East Coast, the size and traffic anticipated from offshore wind energy development represents a negligible increase in dredging activity due to vessel traffic.

The incremental impacts of offshore wind energy on the benthic impacts of ocean disposal of dredge spoils associated with a need to maintain navigation channels used by offshore wind energy vessel traffic is expected to be negligible because the contribution of wind energy-related vessel activity to overall marine traffic is expected to be negligible.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual decline in activity, and vessels stay relatively near shore. Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity. Some areas are closed to fishing or have seasonal restrictions due to fisheries conservation or species protection measures and may reduce fishing traffic in designated areas (BOEM, 2012a).

The IPFs of commercial and recreational fishing relevant to coastal habitat impacts that may interact with offshore wind energy development are all vessel-related: accidental release; air emissions; waste discharges; noise; and traffic. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast but is expected to remain stable for the foreseeable future; the long-term trend, for recreational fishing shows a gradual, persistent decline in angler trips since 2004.

Vessel traffic associated with offshore wind energy development is a negligible contribution to overall marine traffic that includes commercial and recreational fishing vessel traffic. Offshore wind energy development will not affect commercial or recreational fishing to any material degree. Existing fishing impacts on coastal habitat do not appear to be a substantial contributor to coastal habitat degradation. The impact of commercial and recreational fishing and any potential interaction with wind energy development are expected to have a negligible impact on coastal habitat.

Marine minerals extraction

Data on projected sand mining, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island and Barnegat Inlet to Little Egg Harbor Inlet project, offshore New Jersey and the Sandbridge Beach project, offshore Virginia. Sand mining IPFs have the potential to interact with wind energy IPFs under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts−one or two years− and impacts arising from seafloor disturbances from either activity are relatively localized in their spatial extent. However, the likelihood of dredging for a series of beach restoration projects is possible and could result in longer-term impacts.

IPFs of marine minerals mining relevant to coastal habitat impacts that may overlap with wind energy IPFs are primarily seafloor stressors and include accidental releases; vessel discharges of settleable solids; sediment deposition/burial. Marine minerals mining activities projects may also require geophysical and geotechnical survey activities similar to oil and gas development and related impacts e.g., vessel activity, noise, air emissions, and spills. Vessel anchoring and installation of pilings for wind energy structures could potentially interact with dredging activities but only if located near borrow sites and thus overall have a low probability of interacting with minerals mining activities.

The impact of minerals marine mining on coastal habitat is primarily beneficial as beach and coastal restoration projects provide continued shoreline protection that will be increasingly needed due to increased storm intensity and frequency resulting from climate change. The impact of wind energy development on dredging activity will be negligible and have no impact on the beneficial impact of minerals mining on beach and coastal restoration projects. Any potential conflicts with wind energy development can be managed through planning and siting.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (see Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016).

IPFs relevant to coastal habitat impacts that overlap wind energy-related IPFs include: accidental releases; air emissions; discharges; noise; port utilization and dredging; and vessel traffic. Of these, local impacts at ports and terminals (e.g., air emissions and vessel traffic) are the most substantial relative to wind energy development. Marine transportation needs may create port expansion or upgrades due to increased vessel size, which may require land development and habitat loss. Offshore wind energy requirements are currently met along the Atlantic coast and thus play no role in any increased port capabilities. Wind energy impacts on marine transportation and its interaction with coastal habitat impacts are negligible.

Military use, military range complexes, civilian space programs

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses relevant to coastal habitat impacts that could overlap with those of wind energy development include: accidental releases; air emissions from aircraft and vessels; construction/installation impacts from anchoring buoys and structures, installing pilings, and dredging; demolition/structure removal; discharges from vessels; aircraft and vessel aircraft noise; noise from operations, e.g., sonar, weapons explosions, etc.; entanglement from operations using fiber optic cables or guidance wires; mortality of fauna in range of target structures; and aircraft and vessel traffic.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018 and concluded impacts from its testing and training activities on coastal resources would be negligible because of the distance from shore at which its testing and training occur. One exception was that of nearshore training exercises. For this activity, the impact of most concern was air emissions. Because of the brief duration of exercises, relative infrequency of training, and existing air quality, there would be no violations of air quality standards. Direct impacts to coastal habitat were not directly addressed but are not likely because the vast majority of testing and training activity occurs far offshore.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs from G&G surveys relevant to coastal habitat impacts that may overlap with those of offshore wind energy primarily involve noise and vessels: noise from seismic surveys, including airgun blasts, vessel noise, and vessel traffic. G&G survey activities occur far enough offshore to have no direct impact on coastal resources. G&G survey activity is currently supported by existing port capabilities and should not contribute to any port expansion or improvement requirements. A potential increased need for channel maintenance dredging is likely the most significant impact from oil and gas G&G surveys. This impact will have little or no impact on coastal habitat.

The interaction of oil and gas extraction and wind energy development IPFs will primarily occur offshore and can be minimized by timing and location considerations. Identifying the locations and schedules of wind energy G&G and construction/installation activities and of oil and gas G&G activities could avoid overlapping impacts by scheduling activities to avoid cumulative impacts offshore. There is little likelihood that oil and gas G&G surveys or offshore wind energy development will have any material impact on coastal habitat.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. Currently, three leases have been granted; one has an SAP submitted; three have SAPs approved; two have approved SAPs with COPs under development; two have approved SAPs and have submitted COPs; one leases has an approved Research Activities Plan.

BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project.

BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies (i.e., G&G surveys, without airguns), site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to impacts on coastal habitat are:

- *Site characterization surveys.* G&G surveys IPFs include: accidental releases; air emissions and discharges from vessels; noise from vessels and HRG (non-airgun) surveys; and vessel traffic.
- *Site assessment studies: installation of meteorological towers and/or buoys*. Site assessment studies have the same IPFs as G&G surveys with the exception of noise from HRG surveys. In addition, site assessment-related IPFs include: air emissions from offshore installation of pilings and towers or buoys and from onshore fabrication of structures; discharges from onshore fabrication of structures; construction/installation impacts and seabed alterations from anchoring, driving pilings, and setting foundations for buoys; noise from driving pilings and setting of buoys; port utilization and traffic; impacts from presence of structures, including creating fishing exclusion zones and gear entanglement, damage, or loss; navigational hazards; and viewshed impacts.
- *Installation of turbine structures.* Installation of turbines will have all of the IPFs described for site assessment studies but also include accidental release of fuel or fluids from structures; air emissions from generators; impacts from scour protection; electromagnetic fields; energy generation; new cable emplacement; noise from O&M and decommissioning/structure removal; presence of structure impacts from habitat creation/fish aggregation, altered migration, radar disturbances; air space conflicts; and turbine bird and bat strikes.

The BOEM assessed impacts on coastal habitats from OCS wind energy lease issuance and site assessment activities for wind energy development offshore the Mid-Atlantic (BOEM 2012a) and Massachusetts (BOEM 2014b). Site characterization surveys, and the construction, operation and decommissioning activities of meteorological towers/buoys occurring would have no direct impact on coastal habitats. No expansion of existing onshore areas or existing channels is anticipated, and no additional dredging would be required. Impacts may occur from wake erosion from vessel traffic associated with offshore wind energy but would be limited to approach channels and the coastal areas near ports and bays. This dredging could have indirect impacts on coastal habitat from noise, air emissions, and sediment resuspension and turbidity. Given the amount and nature of vessel traffic into and out of these ports, the small size and number of vessels associated with offshore wind energy would cause a negligible increase, if any, to wake-induced erosion of associated channels. An accidental spill could occur from wind energy development activities and would most likely result in release of diesel fuel, but the expected size of such a spill is projected to produce negligible, localized, and temporary impacts to coastal habitats.

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has issued 12 commercial energy permits for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, New

York to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island. infrastructure

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. Multiple proposals for pipelines and LNG terminals offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles, e.g., security, energy, navigational and fisheries concerns, and incomplete information on environmental impacts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

Submarine cables, lines, and pipeline IPFs relevant to coastal habitat impacts that may overlap with those of wind energy development include: accidental releases; air emissions from vessels; installation of new subsea cables; vessel discharges; electromagnetic fields; vessel and construction noise; presence of structure impacts such as offshore and onshore new cable infrastructure; and vessel traffic.

Future seabed cable, line, and pipeline activity appears to be dynamic and appears likely to interact with wind energy IPFs. Most of this activity will be located close to shore and an investigation of future application approvals and the routes of these transmission connections will require reviewed. The IPFs of seabed cables, lines, and pipelines of note are primarily related to the benthic impacts of installation, maintenance, and repair. However, with respect to coastal habitat impacts, siting and space requirements for onshore connections to telecommunications networks or from offshore wind energy structures to the power distribution grid represent the most significant potential impact on coastal habitat that requires consideration in offshore wind energy development.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change may directly or indirectly alter the impacts of IPFs that affect coastal habitat in numerous ways, from habitat alterations from warming to the requirement for protective measures and restoring damage from storms. Long-term biophysical and climate trends indicate that Mid-Atlantic states will likely be subject to continued shoreline erosion, higher sea levels, and loss of natural coastal buffers. USGS has assessed the vulnerability to sea level rise along the Atlantic coast and the highest vulnerability index was a nearly continuous stretch from the Virginia/North Carolina border to central New Jersey, including the Chesapeake Bay nearly to Washington, D.C. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.2.3 Benthic Communities

Table 4-8. Cumulative Impacts Scenario IPFs – Benthic Communities

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Air emissions	●	●	●	●	●	●	●	●	●	
Anchoring						●	●	●		
Discharges	●	●	●	●	●	●	●	●	●	
Electromagnetic fields								●	●	
Energy generation/security								●		
New cable emplacement/maintenance								●	●	●
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Gear utilization		●		●		●				●
Ingestion						●				
Pipeline trenching							●			
Resource exploitation		●								●
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea level rise										●

Benthic community impacts occur from multiple activities, including commercial finfish and shellfish bottom fisheries, navigational and port channel maintenance dredging and dredge spoil disposal, beach renourishment dredging, residential and commercial coastal development. They can also be influenced by the quality of the water and sediment from rivers. OCS wind energy development can affect benthic communities through anchoring, setting of piles for jackets, monopoles, or gravity-based systems for tower stabilization, emplacement of seabed transmission cables and armoring of transmission cables that aren't buried below minimum sub-seabed depths, armoring of structures for scour protection.

Dredged material ocean disposal

There are 15 disposal sites located in the North Atlantic (MMS 2007), half of those being around New York harbor (EPA 2018). Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable.

The IPFs of ocean disposal relevant to benthic impacts that may interact with wind energy-related IPFs are primarily seafloor stressors and include accidental releases; vessel discharges of settleable solids; and sediment deposition/burial. Vessel anchoring and installation of pilings for wind energy structures could potentially interact with disposal activities but only if located near disposal sites and thus overall have a low probability of interacting with ocean disposal benthic impacts.

The benthic impacts of ocean disposal are the intentional sediment deposition and burial from the release of dredge spoils. Benthic impacts are managed through restricting ocean disposal to sites designated by EPA and managed by the USACE through its issuance of ocean disposal permits. EPA and USACE also minimize benthic impacts by EPA setting the standards for assessing the acceptability of dredge spoils that USACE then implements through its permitting process. EPA concurrence is required for USACE ocean disposal permits.

The incremental impacts of offshore wind energy on benthic impacts of ocean disposal of dredge spoils would be associated with a need to maintain navigation channels used by offshore wind energy vessel traffic. The contribution of wind energy-related vessel activity to overall marine traffic is expected to be negligible, and the impact on the benthic impacts of dredge spoil disposal similarly negligible.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual decline in activity since 2004 and vessels stay relatively near shore. Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity. Some areas are closed to fishing or have seasonal restrictions due to fisheries conservation or species protection measures, and may reduce fishing traffic in designated areas (BOEM, 2012a).

The IPFs of commercial and recreational fishing relevant to benthic community impacts that may interact with offshore wind energy development are seafloor stressors: use of bottom trawl gear; vessel discharges of settleable solids; sediment deposition/burial; and vessel anchoring and installation of pilings for wind energy structures.

Bottom trawling is internationally recognized as likely to be the most damaging anthropogenic cause of marine benthic community disruption. The New England and Mid-Atlantic Fisheries management councils have enacted multiple restrictions on bottom trawl fisheries to reduce benthic impacts:

- Mid-Atlantic Fishery Management Council
    - Rollers restricted to 6” diameter in the “southern management area” of the monkfish fishery to protect deep sea corals
    - Rollers restricted to 18” in scup and black sea bass fisheries
    - No restrictions on rollers or rockhoppers in other fisheries.
- New England Fishery Management Council
    - Rollers restricted to 6” diameter in the “southern management area” of the monkfish fishery to protect deep sea corals
    - Rollers restricted to 12” in the Gulf of Maine/Georges Bank Inshore Restricted Roller Gear Area
    - Rollers restricted to 18” for the scup and black sea bass
    - No restrictions on rollers or rockhoppers in other areas or fisheries
    - Bottom trawling for monkfish prohibited in Lydonia and Oceanographer Canyons to protect deep sea corals
    - Bottom trawling prohibited in other identified areas to protect habitat or fish populations, or to reduce gear conflicts.

Future benthic impacts from commercial fishing are expected to remain at current levels as there is no discernable trend for commercial fishing landings. The bottom impacts from offshore wind energy development are mainly restricted to bottom impacts from anchoring during construction/installation of pilings for towers of bottom anchoring of meteorological buoys. Potential impacts from wind energy-related activities are small in comparison to that from commercial fishing activity and wind energy-related impacts are expected to be negligible.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. This includes: site assessment and characterization studies through turbine and distribution platform installation; seabed transmission line emplacement; and onshore substation connections. 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 modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand. The incremental increase from offshore wind development will be a minor contributor to any port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE, 2014).

IPFs related to land use and coastal infrastructure relevant to benthic impacts that may interact with wind energy-related IPFs include land disturbance/development with habitat loss. These impacts will be spatially limited to the area near the port. The incremental contribution of offshore wind energy development is expected to be small compared to the needs for port expansion or handling improvements derived from marine transportation. Residential and commercial coastal development may result in a greater demand for beach and coastal restoration projects, with its associated increase in dredging activity and ship traffic due to offshore sand and gravel mining. Benthic impacts from marine minerals mining are limited to designated borrow areas.

Marine minerals extraction

Data on projected sand mining, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island and Barnegat Inlet to Little Egg Harbor Inlet project, offshore New Jersey and the Sandbridge Beach project, offshore Virginia. Sand mining IPFs have the potential to interact with wind energy IPFs under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts−one or two years−and impacts arising from seafloor disturbances from either activity are relatively localized in their spatial extent. However, the likelihood of dredging for a series of beach restoration projects is possible and would result in longer-term impacts; the expected low levels of dredging need to be reviewed in the event natural or anthropogenic actions alter current projections.

IPFs of marine minerals mining relevant to benthic impacts that may overlap with wind energy IPFs are primarily seafloor stressors and include accidental releases; vessel discharges of settleable solids; and sediment deposition/burial. Vessel anchoring and installation of pilings for wind energy structures could potentially interact with disposal activities but only if located near borrow sites and thus overall have a low probability of interacting with ocean disposal benthic impacts. The impacts of offshore wind energy on the benthic impacts of marine minerals mining are expected to be negligible.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (see Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes also are expected to be relatively stable (NROC 2016).

IPFs of marine transportation relevant to benthic community impacts that may overlap wind energy-related IPFs include: accidental releases; port utilization and channel maintenance dredging; and vessel discharges of settleable solids. The most important IPF of marine transportation is the need for maintenance dredging of navigation channels and the associated requirement for ocean disposal of the dredge spoils. The impacts of marine minerals mining and dredge spoils disposal have been discussed above. Offshore wind energy development in not likely to interact with the benthic impacts of marine transportation, such as ship channel wake erosion, because they are unlikely to be sited close enough to shipping lanes or channels for their impacts to interact. Because marine transportation appears to have a stable trajectory and current activity appears compatible with maintaining the benthic community impact status quo, future impacts are likely to be negligible.

Military use, military range complexes, civilian space programs

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to benthic community impacts and could overlap with those of wind energy development include: accidental releases; construction/installation impacts from vessels and anchoring buoys and structures, installing pilings, and dredging; and demolition/structure removal. Although there is great overlap of the AOI and military use areas (see Figure 3-3), the likelihood of interaction with wind energy development is low because BOEM has coordination and evacuation lease stipulations with the military and NASA that remove civilian activities from testing and training areas in active use.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018 and concluded benthic impacts to sediment quality and invertebrates could result from chemical contamination of sediments, acoustics, explosions, energy stressors, and physical disturbance. Chemical changes resulting from explosions, chemicals other than explosives, metals, and other expended materials are not likely to be detectible and similar in concentration of chemical and material residue from nearby reference sites or may be detectable but would be below applicable regulatory standards for determining effects on biological resources. Impacts from acoustic, energy stressors, explosions, and physical disturbance would be localized near the site of the activity; impacts on individuals are expected but not at the population level due to the limited spatial extent of disturbances, their relatively infrequent occurrence, and dynamic nature of benthic communities.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs of oil and gas G&G surveys that overlap with those of offshore wind energy primarily involve noise: airgun blasts could potentially affect benthic invertebrates. That benthic community impacts from oil and gas G&G surveys are expected to be negligible, can be inferred from the absence of any analysis of potential water quality impacts in the Final Programmatic EIS for G&G Activities in the Mid- and South Atlantic.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce benthic community impacts from site assessment data collection activities that involve anchoring construction vessels and equipment and installation of meteorological towers or bottom anchoring of buoys and that involve installation and operation of turbine structures. The IPFs of offshore wind energy development relevant to benthic community impacts are:

- *Site assessment studies: installation of meteorological towers and/or buoys***.** Site assessment-related IPFs include: seabed alterations from anchoring, driving pilings, and setting foundations for buoys; noise from driving pilings and setting of buoys; impacts from presence of structures.
- *Installation of turbine structures***.** Installation of turbines will have all of the IPFs described for site assessment studies but also may include impacts from scour protection; electromagnetic fields; new cable emplacement; and decommissioning/structure removal.

Incremental impacts on benthic communities from offshore wind development would be localized to the area surrounding the tower or buoy and most pronounced during construction/installation phase for towers, buoys, and new submarine cables and lines. Recovery would be expected after cessation of construction/installation/emplacement and benthic community impacts from wind energy development are expected to be negligible.

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has issued 12 commercial energy permits for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, NY to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island infrastructure

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/ New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. Multiple proposals for pipelines and LNG terminals offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles, e.g., security, energy, navigational and fisheries concerns, and incomplete information on environmental impacts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

Submarine cables, lines, and pipeline IPFs relevant to benthic community impacts that may overlap with those of offshore wind energy development include: installation of new subsea cables; electromagnetic fields; presence of structure impacts from new cable infrastructure; seabed alterations from anchoring, driving pilings, and setting foundations for buoys; and noise from driving pilings and setting of buoys.

Future seabed cable, line, and pipeline activity appears to be dynamic and will interact with offshore wind energy development in the emplacement of transmission lines to onshore power distribution systems. The siting of these transmission lines will require coordination with local, state, and federal agencies as well as private interests. Benthic community impacts will be local, not extending far from the transmission line corridor. Impacts are also expected to be transient; recovery is expected to occur, although further benthic disruptions may occur during maintenance, repair, or replacement activities. The benthic impacts of offshore wind energy submarine cables, lines, and pipeline emplacement and maintenance are expected to be minor to negligible.

Climate change

Climate change disrupts geophysical and biological resources globally (see Section 3.8). Climate change may alter the impacts of IPFs that affect benthic communities primarily indirectly, resulting from both community alterations from warming and community disruptions from increased storm intensity and frequency. Increased sand mining and dredge spoil disposal directly affect benthic communities but are limited in their areal extent. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.2.4 Fish, Essential Fish Habitat, and Threatened and Endangered Fish

Table 4-9. Cumulative Impacts Scenario IPFs – Fish, EFH, and T&E Fish

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Discharges	●	●	●	●	●	●	●	●	●	
Electromagnetic fields								●	●	
Energy generation/security								●		
Light			●				●	●		
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Cumulative Impact Scenario, Other IPFs										
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Gear utilization		●		●		●				●
Ingestion						●				
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Regulated fishing effort		●								●
Resource exploitation		●								●
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea level rise										●

Discussions of commercially and recreationally valuable fisheries are presented in Chapter 3.7. Several fish species on the continental shelf of the northwest Atlantic Ocean are federally listed as endangered, threatened, candidates for listing, or species of concern (Table 4-10). Atlantic salmon (Gulf of Maine population), Atlantic sturgeon (four populations, New York Bight, Chesapeake Bay, Carolina, South Atlantic), and shortnose sturgeon are the only fish species currently listed as endangered under the ESA that are found in the northwest Atlantic Ocean. The Gulf of Maine population of Atlantic sturgeon is considered threatened. Shortnose sturgeon and Atlantic sturgeon are demersal species.

Dredged material ocean disposal

There are 15 disposal sites located in the North Atlantic, half of those around New York harbor (EPA 2018). Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable. Vessel traffic is will concentrate around shoreward routes to these 15 sites. The contribution of ocean dumping to overall marine traffic is small compared to other sources of vessel traffic, e.g., that from commercial/recreational fishing, military activity, and marine transportation,

Table 4-10. Threatened, Endangered, Candidate, and Species of Concern, Northwest Atlantic

Atlantic salmon (*Salmo salar*) – Gulf of Maine DPS	E
shortnose sturgeon (*Acipenser brevirostrum*)	E
Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)	
New York Bight DPS	E
Chesapeake Bay DPS	E
Carolina DPS	E
South Atlantic DPS	E
Gulf of Maine DPS	T
basking shark *(Cetorhinus maximus)*	C
great hammerhead shark (*Sphyrna mokarran)*	C
scalloped hammerhead shark *(Sphyrna lewini)*	C
American eel (*Anguilla rostrata)*	C*
alewife *(Alosa pseudoharengus)*	C/S
blueback herring *(Alosa aestivalis)*	C/S
cusk *(Brosme brosme)*	C/S
Atlantic bluefin tuna (*Thunnus thynnus*)	S
Atlantic halibut *(Hippoglossus hippoglossus)*	S
Atlantic wolffish *(Anarhichas lupus)*	S
dusky shark *(Carcharhinus obscurus)*	S
porbeagle shark *(Lamna nasus)*	S
rainbow smelt *(Osmerus mordax)*	S
sand tiger shark *(Carcharias taurus)*	S
thorny skate *(Amblyraja radiata)*	S

*The USFWS is the lead federal agency responsible for conservation of American eel
E: endangered T: threatened C: candidate S: species of concern

The IPFs related to ocean disposal relevant to endangered fish that may interact with wind energy-related IPFs include accidental releases; discharges from vessels; construction/installation activity and noise; sediment deposition/burial; and vessel traffic. Because both listed sturgeon species are demersal, ocean disposal could affect their foraging. However, disposal activity is infrequent and the impact on these fish populations is expected to be negligible. Similarly, vessel traffic, noise, and seafloor disruptions from anchoring construction vessels and bottom anchored meteorological buoys, driving pilings for meteorological or turbine towers will cause temporary benthic impacts that may affect these species but the impact is anticipated to be negligible because it is temporary and has an insignificant footprint compared to available forage area. Vessel and construction/installation of structures may cause temporary impacts on Atlantic salmon that is of limited duration and very limited spatial significance. Impacts from fuel spills are expected to be negligible because they are low probability events. Accidental releases of trash and debris likewise are also expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.

Offshore wind development seafloor and benthic impacts from vessel anchoring and installation of pilings for wind energy structures could potentially interact with ocean disposal activities but only if offshore wind energy activity was located close to a designated disposal site.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual decline in activity, and vessels stay relatively near shore. Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity. Some areas are closed to fishing or have seasonal restrictions due to fisheries conservation or species protection measures and may reduce fishing traffic in designated areas (BOEM, 2012a).

The IPFs of commercial and recreational fishing that may interact with offshore wind energy development are all vessel-related: accidental discharges; wastewater discharges from vessels; vessel noise and traffic. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast but is expected to remain stable for the foreseeable future; the long-term trend for recreational fishing shows a gradual, persistent decline in angler trips since 2004. The listing of these threatened and endangered species listed they occur infrequently to rarely, and thus are not likely to be entrapped as bycatch. IPFs that do not overlap with those of wind energy development include air emissions and port utilization.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. This includes: site assessment and characterization studies through turbine and distribution platform installation; seabed transmission line emplacement; and onshore substation connections. 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 modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand. The incremental increase from offshore wind development will be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE, 2014).

IPFs related to land use and coastal infrastructure relevant to endangered fish species that may interact with wind energy-related IPFs include accidental releases, effluent discharges, vessel noise and traffic. These impacts will be spatially limited to the area near the port. As marine transportation and commercial fishing activity appears to be stable for the foreseeable future, there should be little port development pressure. Thus, impacts from port development will be minimized; the same is true for offshore wind energy development as existing port capabilities are sufficient. Residential and commercial coastal development is likely to have little direct impact on endangered species.

Marine minerals extraction

Data on projected sand mining, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island and Barnegat Inlet to Little Egg Harbor Inlet project, offshore New Jersey and the Sandbridge Beach project, offshore Virginia. Currently, there are six active lease agreements for sand mining in the South Atlantic; the closest sand mining activity is offshore Morehead City, North Carolina, more than 250 km from the Virginia/North Carolina border. Sand mining IPFs have the potential to interact with wind energy IPFs under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts‒one or two years‒ and impacts arising from seafloor disturbances from either activity are relatively localized in their spatial extent, on the order of a several kilometers at most. However, the likelihood of dredging for a series of beach restoration projects is possible and result in longer-term impacts.

IPFs potentially relevant to endangered fish species that may overlap with wind energy IPFs include: accidental releases; discharges from vessels; vessel noise and traffic. Marine minerals mining activities projects may also require geophysical and geotechnical survey activities similar to oil and gas development and related impacts e.g., vessel activity, HRG survey noise, and spills.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016).

IPFs relevant to marine transportation that may overlap wind energy-related IPFs include: accidental releases of fuel, fluids, trash and debris; air emissions; discharges; noise; port utilization and dredging; and vessel traffic. Of these, local impacts at ports and terminals (e.g., air emissions and vessel traffic) are the most substantial relative to wind energy development.

Marine transportation involving large vessels make about 12,000 port calls annually in the AOI. Although impressive, this vessel traffic is nearly negligible compared to the millions of commercial and recreational fishing trips made annually in the same region. The contribution of marine transportation to the impacts of vessel traffic on threatened and endangered fish is expected to be similarly negligible. Offshore wind energy development has little overlap with marine transportation, principally limited to vessel traffic-related impacts. Offshore wind energy-related vessel traffic is at about the same level as marine transportation and thus represents a similarly negligible contribution to regional vessel traffic.

Military use, military range complexes, civilian space programs

Among the IPFs the Navy considered to have a potential for bird and bat impacts accidental releases, air emissions, discharges, noise, the presence of structures, and traffic would interact with wind energy IPFs. The Navy considered the impact of naval training and testing activities as low to discountable because although individuals may be affected, population level impacts were not expected; a high proportion of nonlethal, short-term, and localized interactions having short recovery periods is expected; and widely dispersed naval activities occur offshore where bats occur infrequently and bird distributions are patchy, resulting in a low number of exposed individuals and low potential for interactions. Military activities are expected to present a negligible impact on birds and bats and not increase their vulnerability to the impacts of offshore wind energy development.

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to water quality and could overlap with those of wind energy development include: accidental releases; construction/installation impacts from vessels and anchoring buoys and structures, installing pilings, and dredging; discharges from vessels; mortality of fauna in range of target structures; and vessel traffic. Although there is great overlap of the AOI and military use areas (see Figure 3-5), the likelihood of interaction with wind energy development is low because BOEM has coordination and evacuation lease stipulations with the military and NASA that require cessation of activities in testing and training areas prior to commencement of naval exercises.

IPFs of military and civilian space uses that are relevant to endangered fish and could overlap with those of wind energy development include: accidental releases; construction/installation impacts from anchoring buoys and structures, installing pilings, and dredging; demolition/structure removal; discharges from vessels; noise from operations, e.g., sonar, weapons explosions, etc.; entanglement from operations using fiber optic cables or guidance wires; morality of fauna in range of target structures; and vessel traffic.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018 and concluded that training and testing activities may affect designated critical habitat for the Atlantic sturgeon and gulf sturgeon but have no effect on designated critical habitat for the Atlantic salmon.

The combined impacts under the preferred alternative from all stressors would not be expected to impact fish populations because activities involving more than one stressor are generally short in duration and such activities are dispersed widely throughout the Study Area. Existing conditions would not change considerably, therefore, no impacts on fish populations would occur with the implementation of the preferred alternative.

The interaction of IPFs of military activities with wind energy development IPFs is not anticipated to be common because wind energy development activities near the area of naval training or testing are required to cease prior to commencement of naval exercises. Also, offshore wind energy is not generally expected to overlap with military use IPFs as they will occur in different geographic areas. For highly mobile or migratory species there is the possibility they could be affected from naval activities and then again affected by wind energy development activities if they transit both areas. Such interactions are expected to be low frequency events. Offshore wind energy is expected to have little to no impact on military use IPFs and impacts on endangered fish.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs of note related to G&G surveys that overlap with those of offshore wind energy primarily involve noise and vessels: noise from seismic surveys, including; airgun blasts; and vessel noise and traffic. IPFs that impact threatened and endangered fish also include accidental releases; seafloor disturbances and discharges from drilling. In a programmatic FEIS covering G&G activity in the Mid-Atlantic, BOEM concluded that as shortnose sturgeon and Atlantic sturgeon are demersal species, they are unlikely to be affected by vessel and equipment noise and therefore have a negligible impact.

Impacts of vessel traffic itself on all endangered species are expected to be negligible. Some G&G survey activities could disturb the seafloor and result in localized impacts on demersal fishes, i.e., shortnose sturgeon, and Atlantic sturgeon. Impacts of trash and debris releases on the water column and benthic environment are expected to be negligible through vessel operators' required compliance with USCG and EPA regulations.

Discharges from drilling deep stratigraphic and shallow test wells could smother nearby benthic communities. However, the total area of seafloor disturbance would be a negligible percentage of the benthic habitat in the AOI. Because BOEM's approval process requires mitigation of G&G activities involving seafloor-disturbing activities, impacts on listed fishes and their habitat are expected to be avoided and thus negligible.

In the event of an accidental fuel spill, it is likely to be diesel fuel, which evaporates quickly, and small. Because of their life histories, none of the threatened or endangered fish species would have sensitive eggs or larvae in the water column of the AOI where they would be exposed to spilled diesel fuel. Impacts are expected to be negligible for all three of these species.

The potential interaction of oil and gas extraction and wind energy development IPFs can be minimized by timing and location considerations. Seismic surveys can extend over a time scale of months, as does construction and installation of wind energy structures. However, identifying the locations and schedules of wind energy G&G and construction/installation activities and of oil and gas G&G activities could avoid overlapping impacts by scheduling activities to avoid cumulative impacts to threatened and endangered fish.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. Currently, three leases have been granted; one has an SAP submitted; three have SAPs approved; two have approved SAPs with COPs under development; two have approved SAPs and have submitted COPs; one leases has an approved Research Activities Plan.

BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies (i.e., G&G surveys, without airguns), site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to impacts on endangered fish are:

- *Site characterization surveys*. G&G surveys IPFs include: accidental release s; discharges from vessels; noise from HRG (non- airgun) surveys; and vessel noise and traffic.
- *Site assessment studies: installation of meteorological towers and/or buoys*. Site assessment studies have the same IPFs as G&G surveys with the exception of noise from HRG surveys. In addition, site assessment-related IPFs include: discharges from onshore fabrication of structures; construction/ installation impacts and seabed alterations from anchoring, driving pilings, and setting foundations for buoys; noise from driving pilings and setting of buoys; vessel traffic; impacts from presence of structures
- *Installation of turbine structures*. Installation of turbines will have all of the IPFs described for site assessment studies but also include accidental releases from structures; impacts from scour protection; new cable emplacement; noise from O&M; decommissioning/structure removal; presence of structure impacts from habitat creation/fish aggregation.

Most of the potential impacts are associated with construction/installation, e.g., construction and vessel noise, seabed disturbances, vessel traffic. Impacts from HRG surveys represent most of the remaining impacts These impacts are all temporally and spatially limited, and the potential for any material impact on endangered species similarly limited. In a revised EA for wind energy lease sale offshore New York, BOEM concluded the following for ESA-listed Atlantic sturgeon

- Impacts from acoustic sound sources from HRG surveys and geotechnical exploration are expected to be minor. A boomer sub-bottom profiler is the only source expected to be produce sound within the hearing range of Atlantic sturgeon. Atlantic sturgeon are expected to avoid HRG sources, any avoidance or disruptions to behavior are expected to be temporary.
- Impacts from vessel and equipment noise are expected to be negligible.
- Impacts from vessel traffic are expected to be negligible. Impacts from seafloor disturbances associated with bottom sampling and bottom-anchored monitoring buoys are expected to be negligible.

BOEM also concluded in its revised EA for lease issuance and site assessment offshore Massachusetts that, in most cases, few fish are expected in wind energy G&G site assessment survey areas because of the limited immediate area of sonification and short duration of individual HRG surveys (BOEM 2014b). Thus, potential population-level impacts on fish from HRG surveys are expected to be negligible. During pile-driving activity for tower construction BOEM anticipates the soft start requirement would lead to the majority of fish fleeing the area during construction and return to normal activity in the area post-construction. Those fish that do not flee the immediate action area during the pile-driving procedure could be exposed to lethal SPLs. However, significant effects to fish populations are not anticipated

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has issued 12 commercial energy permits for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, New York to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island. infrastructure

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. Multiple proposals for pipelines and LNG terminals offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles, e.g., security, energy, navigational and fisheries concerns, and incomplete information on environmental impacts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

Submarine cables, lines, and pipeline IPFs that may overlap with those of wind energy development include: accidental releases, of fuel, fluids, trash, and debris; air emissions from vessels; installation of new subsea cables; vessel discharges; electromagnetic fields; vessel and construction noise; presence of structure impacts such as offshore and onshore new cable infrastructure; onshore space use conflicts; vessel traffic and vessel strikes.

Future seabed cable, line, and pipeline activity appears to be dynamic and has the potential to interact with wind energy IPFs. Most of this activity appears to be located close to shore. The IPFs of seabed cables, lines, and pipelines of note related to endangered fish are primarily installation, maintenance, and repair. The level of vessel activity is relatively low; impacts from construction of structures are spatially localized and temporary; maintenance, while ongoing, is intermittent and brief in any one area. Benthic disturbances will be a major impact factor and affect the demersal sturgeon species more than the Atlantic salmon. Nonetheless, these disturbances represent a very small fraction of forage area and are relatively brief. Although individuals may be disturbed population-level impacts are expected to be negligible.

Wind energy development IPFs clearly overlap with these general public and private subsea cable, line, and pipeline activities from the need to bring offshore power to the onshore distribution grid. Coordination among local, state, federal, and public and private sector stakeholders may be needed to avoid potential site or resource conflicts.

Climate change

Climate change disrupts geophysical and biological resources around the world (see Section 3.8). Climate change may directly or indirectly alter the impacts of IPFs that affect threatened and endangered fish. Warming and ocean acidification may directly alter habitat and the geographic distribution of species; species’ ranges may be altered due to changes in food source availability in response to changing ocean temperatures and current patterns. Wind energy development could have a beneficial impact on climate change to the extent its energy generation reduces that from fossil fuels that would otherwise be used to meet power demands.

4.3.2.5 Marine Mammals

Table 4-11. Cumulative Impacts Scenario IPFs – Marine Mammals

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Discharges	●	●	●	●	●	●	●	●	●	
Electromagnetic fields								●	●	
Energy generation/security								●		
Light			●				●	●		
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Cumulative Impact Scenario, Other IPFs										
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Gear utilization		●		●		●				●
Ingestion						●				
Pipeline trenching							●			
Resource exploitation		●								●
Warming and sea level rise										●

Approximately 39 species of marine mammals occur in Atlantic OCS waters from Florida to Maine. The Atlantic Coast’s marine mammals include baleen whales (the North Atlantic right whale, blue whale, fin whale, sei whale, and humpback whale, all of which are endangered species), toothed whales (dolphins, porpoises, and the endangered sperm whale), the endangered West Indian manatee, and four species of seals.

The western stock of the North Atlantic right whale (*Eubalaena glacialis*) is the most endangered whale occurring along the Atlantic Coast. This species ranges from wintering and calving grounds in the South Atlantic region to summer feeding, nursery, and mating grounds in New England waters and northward. Three areas have been designated under the ESA as critical habitat: coastal Florida and Georgia; Great South Channel (east of Cape Cod), and portions of Cape Cod Bay.

Blue whales may be found in all oceans of the world, but sightings in the Atlantic OCS waters have been sporadic. The fin whale is an oceanic species that occurs worldwide and is the most abundant of the ESA-listed large whale species in Mid- and North Atlantic waters. Fin whales may calve in the mid-Atlantic region from October to January. The sei whale is an oceanic species that occurs from tropic to polar regions; in Atlantic waters of the U.S., more often seen at more northern latitudes. The humpback whale occurs in all oceans, migrating from a winter range over shallow tropical banks to higher latitudes in the rest of the year.

The sperm whale is found worldwide in deep waters between approximately 60˚N and 60˚S latitudes. Sperm whales occur year-round offshore the Atlantic Coast. Although migratory, its patterns are not as predictable or well understood. The North Atlantic stock ranges from northeast of Cape Hatteras in winter to Georges Bank and into the Northeast Channel region in summer.

The West Indian manatee primarily uses shallow nearshore areas and estuaries, but are found far up in freshwater tributaries. The majority of the West Indian manatee population along the Atlantic Coast is located in eastern Florida and southern Georgia; it’s typical northern limit is coastal North Carolina although individuals have been observed as far north as New England.

The Atlantic OCS also supports diverse nonendangered and nonthreatened cetacean. Approximately 28 species are found in Atlantic OCS waters. The four species of seals are found in Mid- and North Atlantic waters are harbor, gray, harp, and hooded seals.

Dredged material ocean disposal

There are 15 disposal sites located in the North Atlantic, half of those being around New York harbor (EPA 2018). Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable. Vessel traffic is concentrated around shoreward routes to these 15 sites. The contribution of ocean dumping to overall marine traffic is small compared to other sources of vessel traffic, e.g., that from marine transportation, commercial/recreational fishing, and military marine activity.

The ocean disposal IPFs relevant to marine mammals that may interact with wind energy-related IPFs are primarily vessel-derived stressors and include accidental releases; discharges; noise; and vessel traffic and associated vessel strikes. More important IPFs include vessel strikes and noise. Given the relatively small contribution of ocean disposal vessel traffic to overall vessel traffic in the Mid- and North Atlantic OCS regions, their impacts to marine mammals are expected to be negligible. Offshore wind energy IPF interactions with ocean disposal activity is expected to be unlikely and not contribute in any material way to oceans disposal impacts on marine mammals.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual decline in activity, and vessels stay relatively near shore. Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity. Some areas are closed to fishing or have seasonal restrictions due to fisheries conservation or species protection measures and may reduce fishing traffic in designated areas (BOEM, 2012a).

The IPFs of commercial and recreational fishing relevant to marine mammals that may interact with offshore wind energy development are vessel- and gear-related: accidental releases; waste discharges; noise; fishing gear/bycatch; and traffic and associated vessel strikes. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast. Bycatch is a significant population stressor for smaller cetaceans and pinnepeds. NOAA examined the bycatch of 10 species of cetaceans and pinnepeds from the Mid-Atlantic bottom trawl fishery. Mean annual serious injury and mortality estimates for 8 of the 10 species were below their potential biological removal (PBR) levels. The exceptions were gray and harp seals, for which PBRs are unknown.

Wind energy IPFs are not expected to interact materially with commercial or recreational fishing impacts and are expected to have a negligible impact on marine mammals. Other potentially overlapping IPFs include accidental releases, air emissions, discharges, noise, port utilization, and vessel traffic. IPFs associated with commercial and recreational fishing that do not overlap with those of offshore wind energy include bycatch and gear utilization.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. This includes: site assessment and characterization studies through turbine and distribution platform installation; seabed transmission line emplacement; and onshore substation connections. 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 modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand. The incremental increase from offshore wind development will be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE, 2014).

IPFs related to land use and coastal infrastructure potentially relevant to marine mammals that may interact with wind energy-related IPFs include accidental releases, effluent discharges, noise, and vessel traffic. These impacts will be spatially limited to areas near ports. Direct impacts on marine mammals from land use and coastal infrastructure are not likely to be significant. Indirect impacts from port development that leads to increased vessel traffic and the associated potential for vessel strike impacts is possible. However, current trends for marine transportation and commercial and recreational fishing indicate stable levels of activity and little or no demand for increased port capacity. The trend of increasing cargo handling and decreasing vessel calls reflect a shift to larger vessels; reduced vessel traffic may have a beneficial impact on the incidence of vessel strikes of marine mammals.

Wind energy IPFs are expected to interact with land use and coastal infrastructure to the extent that transmission lines for offshore power generation will require infrastructure to connect to onshore power distribution systems. This interaction is expected to result in little or no change in the potential impact of land use and coastal infrastructure on marine mammals, which is expected to be negligible.

Marine minerals extraction

Data on projected sand mining, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island and Barnegat Inlet to Little Egg Harbor Inlet project, offshore New Jersey and the Sandbridge Beach project, offshore Virginia. Minerals mining IPFs have the potential to interact with wind energy IPFs under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts–one or two years–and impacts arising from seafloor disturbances from either activity are relatively localized in their spatial extent. However, the likelihood of dredging for a series of beach restoration projects is possible and could result in longer-term impacts.

IPFs of marine minerals mining relevant to marine mammals that may overlap with wind energy IPFs include: accidental releases; discharges from vessels; noise; and vessel traffic and vessel strikes. Marine minerals mining projects also may require G&G survey activities similar to oil and gas development and would result in related impacts e.g., vessel traffic, noise, and accidental releases.

The most consequential impact on marine mammals from offshore minerals mining likely is the acoustic impacts from G&G surveys. Because these surveys do not require the same depth of penetration sought for oil and gas G&G surveys, airguns are not used. Side scan sonar uses frequencies above hearing range of cetaceans, manatees, and seals and generates pulses of <0.5 ms; sub-bottom profilers emit a chirping sound between 500 Hz ─ 24 kHz with pulses of <1 ms. Sand and gravel resources surveys also have a shorter duration than oil and gas G&G surveys, further reducing potential impacts to marine mammals.

Wind energy IPFs are not expected to interact materially with marine minerals mining, which is expected to have a negligible impact on marine mammals.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (see Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016).

IPFs of marine transportation potentially relevant to marine mammals that may overlap wind energy-related IPFs include: accidental releases; discharges; noise; and vessel traffic and vessel strikes. Of these, noise from vessel traffic and vessel strikes are the most substantial IPFs relative to wind energy development and marine mammals.

The level of activity of marine transportation is projected to remain at about current levels. Vessel traffic and strikes from offshore wind energy development are expected to contribute little incremental addition for the existing, overall level of marine traffic and a commensurately negligible incremental impact on marine mammals.

Military use, military range complexes, civilian space programs

Among the IPFs the Navy considered to have a potential for marine mammal impacts, accidental releases, air emissions, discharges, noise, the presence of structures, and traffic would interact with wind energy IPFs. The Navy considered the impact of naval training and testing activities as low to discountable because although individuals may be affected, population level impacts are not expected; a high proportion of nonlethal, short-term, and localized interactions that have short recovery periods is expected; and widely dispersed naval activities occur offshore. Military activities are expected to present a negligible impact on marine mammals and not increase their vulnerability to the impacts of offshore wind energy development.

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to marine mammals and could overlap with those of wind energy development include: accidental releases; construction/installation impacts from vessels and anchoring buoys and structures, installing pilings, and dredging; demolition/structure removal; discharges from vessels; mortality of fauna in range of target structures; aircraft and vessel aircraft noise; noise from operations, e.g., sonar, weapons explosions, etc.; entanglement from operations using fiber optic cables or guidance wires; and vessel traffic and vessel strikes. Although there is great overlap of the AOI and military use areas (see Figure 3-3), the likelihood of interaction with wind energy development is low because BOEM has coordination and evacuation lease stipulations with the military and NASA that require cessation of activities prior to commencement of naval testing and training exercises.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018. Its lists six direct stressors on marine mammals resulting from its testing and training activities: acoustics, explosions, energy, physical disturbance, entanglements, and ingestion (AFTT). The Navy's conclusions about impacts to marine mammals are:

Acoustics. Because individual animals would typically only experience a small number of behavioral responses or temporary hearing threshold shifts per year from exposure to acoustic stressors and are unlikely to incur substantive costs to the individual, population level effects are unlikely.

Explosions. Because most estimated impacts from explosions are behavioral responses or temporary threshold shifts (TTS) and because the number of marine mammals potentially impacted by explosives are small compared to each species' respective abundance, population level effects are unlikely.

High energy lasers. Statistical probability analyses demonstrate with a high level of certainty that no marine mammals would be struck by a high-energy laser. Energy stressors associated with Navy training and testing activities are temporary and localized in nature and, based on patchy distribution of animals, no impacts to individual marine mammals and marine mammal populations are anticipated.

Physical disturbance. Historical data on Navy ship strike records demonstrate a low occurrence of interactions with marine mammals over the last 10 years. The Navy does not anticipate a change in the level of vessel use compared to the last decade; the potential for striking a marine mammal remains low. No recorded or reported instances of marine mammal strikes have resulted from in-water devices. Long-term consequences to marine mammal populations from physical disturbance and strike stressors associated with Navy training and testing activities are not anticipated.

Entanglement. Physical characteristics of wires and cables, decelerators/parachutes, and biodegradable polymers combined with the sparse distribution of these items throughout the AOI indicate a very low potential for marine mammals to encounter and become entangled in them. Long-term impacts to individual marine mammals and marine mammal populations from entanglement stressors associated with Navy training and testing activities are not anticipated.

Ingestion. The likelihood that a marine mammal would encounter and subsequently ingest a military expended item associated with Navy training and testing activities is considered low. Long-term consequences to marine mammal populations from ingestion stressors associated with Navy training and testing activities are not anticipated.

The estimated take of marine mammals over the Navy's five-year project plan was assessed for 6 species of endangered whales (North Atlantic right, blue, fin, sei, humpback, sperm whales), 8 species of non-listed whales, and 18 species of dolphin for their preferred alternative. Results are shown in Table 4- 12. These numbers should be taken in context. The estimated five-year take from sonar testing of endangered or threatened whales was 57,959 behavioral response; 17,547 TTS; and 9 PTS. For non-listed whales, estimates were 75,677 behavioral response; 10,346 TTS; and 10 PTS.

Table 4-12. 5-Year Take, Pile Driving, Marine Mammals, Atlantic Fleet from Naval Testing and Training Operations

Impact	Endangered whales	Non- endangered whales (9 spp.)	Dolphin (18 spp.)
Behavioral	10	102	1,126
TTS	292	231	3,485
PTS	16	30	303
Injury	0	0	21
Behavioral	10	102	1,126
TTS	292	231	3,485
PTS	16	30	303
Injury	0	0	21

TTS: temporary threshold shift; PTS: permanent threshold shift
Source: Navy 2018

The interaction of IPFs of military activities with wind energy development IPFs is very unlikely because of the requirement to cease wind energy activities prior to commencement of naval testing or training exercises.

Offshore wind energy is expected to have no impact on military use IPFs and their impacts on marine mammals.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

BOEM has extensively analyzed potential acoustic impacts of oil and gas G&G activity in the Mid- and South Atlantic regions (BOEM, 2014a). Sound sources used during G&G activities have the potential to produce stress, disturbance, and behavioral responses in marine mammals if they are present within the range of the operational array. Survey protocols and underwater noise mitigation procedures are implemented to decrease the potential for any marine mammal to be within the acoustic exclusion zone of an operating sound source and reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. BOEM also considers the details of a proposed survey during the site/permit-specific NEPA analysis to determine if there is an entrapment potential and, if so, mitigate to prevent it.

BOEM estimates for Potential Level A take using a 180-dB criterion for all airgun seismic survey types has been conservatively predicted for all listed marine mammal species except the West Indian manatee.

- sperm whale (45-310 individuals per year; total: 977 individuals for the project duration);
- humpback whale (2-12 individuals per year; total: 39 individuals for the project duration); and
- all other listed cetacean species (less than 9 individuals taken per year).

As a comparison, Level A incidental take estimates surveys using the Southall et al. criterion were predicted for all listed species except the fin whale. Estimated take is less than one individual per survey year (beginning in 2014) except for:

- humpback whale (0.7-5.9 individuals),
- blue whale (0.2-1.6 individuals), and
- Bryde's whale (0.1-1.2 individuals).

These Level A take estimates are meant to be highly conservative upper limits of take that do not consider the role of mitigation in reducing take with the exception of the time-area closure. They are not expected levels of actual take.

Estimates of total Level B take (160-dB criterion) were estimated for listed species; total estimated Level B take for all airgun seismic survey types has been conservatively predicted at levels of over 100 individuals per survey year (2014-2020) for all listed marine mammal species except the West Indian manatee. The species most affected were:

- sperm whale 361-30,356 individuals per year during the survey period
- North Atlantic right whale during this period ranges from 60-224 individuals.

These analyses used the upper limit of potential take based on highly conservative modeled estimates, applied what is known about the likelihood of species in the action area reacting to seismic airgun noise, considered the range of responses from animals that may occur, and applied mitigation to eliminate/limit the potential for Level A harassment and reduce the potential for Level B harassment. The effects of seismic airgun survey noise on marine mammals within the AOI would be moderate. Most impacts would be limited to short-term disruption of acoustic habitat and behavioral patterns, abandonment of activities, or displacement of individual marine mammals from discrete areas within the AOI, including both critical and preferred habitats.

The IPFs related to G&G surveys relevant to marine mammals that may overlap with those of offshore wind energy primarily involve noise from seismic surveys, including airgun blasts; vessel noise, vessel traffic, and vessel strikes. The interaction of oil and gas extraction and wind energy development IPFs can be minimized by timing and location considerations. Seismic surveys can extend over a time scale of months, as does construction and installation of wind energy structures. However, identifying the locations and schedules of wind energy G&G and construction/installation activities and of oil and gas G&G activities could avoid overlapping noise and vessel strike impacts by scheduling activities to avoid cumulative impacts to marine mammals from both oil and gas and offshore wind energy development impacts.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies (i.e., G&G surveys, without airguns), site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to impacts on marine mammals are:

- *Site characterization surveys*. G&G surveys IPFs include: accidental releases from vessels; discharges from vessels; noise from vessels; HRG (non-airgun) surveys; and vessel traffic and vessel strikes.
- *Site assessment studies: installation of meteorological towers and/or buoys*. Site assessment studies have the same IPFs as G&G surveys with the exception of noise from HRG surveys. In addition, site assessment-related IPFs include: installation of pilings and towers or buoys; construction/installation impacts; noise from driving pilings and setting of buoys
- *Installation of turbine structures*. Installation of turbines will have all of the IPFs described for site assessment studies but also include accidental releases structures; electromagnetic fields; new cable emplacement; noise from O&M and decommissioning/structure removal.

BOEM (2016b) released an extensive study on the acoustic sound fields associated with high-resolution marine geophysical (HRG) surveys. Acquiring data to characterize the acoustic fields radiated by marine geophysical acoustic survey systems was critical to understanding the potential impact of HRG surveys on marine life. The study was performed under interagency agreements between BOEM, USGS and the Naval Undersea Warfare Center Division Newport (NUWD-N), Naval Sea Systems Command. The study acquired and analyzed calibrated acoustic source data, including source levels, intensity spectra, and beam patterns for 18 commonly used marine geophysical survey systems that included boomers, sparkers, airguns, chirp profilers, side-scan sonars, and multibeam bathymetric echosounders.

BOEM (2014a) has estimated the distance to 180 dB and 160 dB acoustic thresholds from G&G survey equipment (see Table 4-13). Distances to these acoustic thresholds are on the order of less than ten meters to less than a kilometer. The IPFs of offshore wind energy development most consequential to marina mammals are noise and vessel traffic and associated vessel strikes. Among noise impacts, the most serious is that generated driving piles; noise from G&G surveys and vessels are other sources of lesser acoustic stress. BOEM (2014a) has estimated the distance to 180 dB and 160 dB acoustic thresholds from G&G survey equipment (see Table 4-13). Distances to these acoustic thresholds are on the order of less than ten meters to less than a kilometer.

In contrast to potential impacts from wind energy development G&G surveys that projected maximum impacts of less than a kilometer, a study of wind turbine noise on harbor porpoises, bottlenose dolphins, harbor seals, and North Atlantic right whales indicated that pile-driving sounds are audible to marine mammals at ranges of more than 100 km. The frequency range for pile-driving sound overlaps with the hearing frequency for all marine mammals. Others have estimated audibility to all hearing groups ranging from 15 to 50 km.

Table 4-13. Acoustic Thresholds from G&G Survey Equipment

Source	Max dB	Radial distance to 180 dB, m	Radial distance to 160 dB, m
Boomer	212	5	16
Side-scan sonar	226	65 – 96	337 – 450
CHIRP sub-bottom profiler	222	26 – 35	240 – 689
Multibeam depth sounder	213	<5	12

BOEM concluded disturbance of marine mammals from underwater noise generated by site characterization and site assessment activities would likely result in temporary displacement and other behavioral or physiological consequences. NMFS concluded in its Biological Opinion that offshore wind energy development in the North Atlantic is likely to result in takes of North Atlantic right, humpback, fin, and sei whales in the form of harassment, when increased underwater noise will temporarily impair normal behaviors. This harassment will occur in the form of avoidance or displacement from preferred habitat and behavioral and/or metabolic compensations in response to short-term masking or stress. Because of the mitigation measures are expected to minimize potential effects to right whales and other marine mammals, BOEM expects no major impacts on marine mammals.

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has issued 12 commercial energy permits for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, New York to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island. infrastructure

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. Multiple proposals for pipelines and LNG terminals offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles, e.g., security, energy, navigational and fisheries concerns, and incomplete information on environmental impacts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

Submarine cables, lines, and pipeline IPFs relevant to marine mammals and may overlap with those of wind energy development include: accidental releases; installation of new subsea cables; vessel discharges; electromagnetic fields; vessel and construction noise; vessel traffic; and vessel strikes.

Future seabed cable, line, and pipeline activity appears to be dynamic and has the potential to interact with wind energy IPFs. Most of this activity appears to be located close to shore. The IPFs of seabed cables, lines, and pipelines of note for marine mammals are primarily related to noise from construction/installation and vessels and vessel strikes. Impacts from construction will only be significant if pile driving is required to support needed infrastructure; impacts of pile driving have been discussed above. The level of vessel activity is relatively low and not expected to be a significant contributor to anticipated vessel traffic noise. The impact of submarine cable, lines, and pipelines is not expected to interact with relevant IPFs of offshore wind energy development to any material degree and is expected to be negligible for marine mammals.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change may directly alter the impacts of IPFs such as increasing ambient sound due to more violent storms that masks communication and indirectly such as alterations of habitat and range due to changes in food source locations in response to changing ocean temperatures and current patterns. Wind energy development could have a beneficial impact on climate change to the extent its energy generation reduces energy generation from fossil fuels that would otherwise be used to meet power demands.

4.3.2.6 Sea Turtles

Table 4-14. Cumulative Impacts Scenario IPFs – Sea Turtles

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Discharges	●	●	●	●	●	●	●	●	●	
Electromagnetic fields								●	●	
Energy generation, security								●		
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Bycatch		●								
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Gear utilization		●		●		●				●
Ingestion						●				
Pipeline trenching							●			
Resource exploitation		●								●
Warming and sea level rise										●

Of the six species of sea turtles found in offshore U.S. waters, only the Olive Ridley is found off the Pacific coast while five species may potentially occur in North and Mid-Atlantic waters: Kemp's ridley, loggerhead, green, hawksbill, and leatherback. All five species of these sea turtles are listed as threatened or endangered: Kemp's ridley, hawksbill, and leatherback turtles are listed as endangered; loggerheads are separated into nine distinct population segments (DPSs), and the Northwest Atlantic DPS of this species is listed as threatened; green sea turtles are listed in two populations, and in the AOI are listed as threatened (BOEM 2014b). Loggerhead turtles nest along the southeast coast as far north as Virginia. There is no formally designated critical habitat for sea turtles in the Mid-Atlantic WEAs (BOEM, 2012a).

Dredged material ocean disposal

There are 15 disposal sites located in the North Atlantic, half of those around New York harbor (EPA 2018). Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable. Vessel traffic is will concentrate around shoreward routes to these 15 sites. The contribution of ocean dumping to overall marine traffic is small compared to other sources of vessel traffic, e.g., that from marine transportation, commercial/recreational fishing, military marine activity.

The IPFs related to ocean disposal relevant to sea turtles that may interact with wind energy-related IPFs are primarily vessel-derived stressors and include accidental releases; discharges; noise; and vessel traffic and strikes. Important IPFs for sea turtles are noise and vessel strikes. Fuel spills and releases of trash and debris due to their low probability of occurrence and relatively limited spatial impact are expected to have lesser potential impact on sea turtles.

IPFs of ocean disposal have a low probability of interacting with those of offshore wind energy development unless the wind energy leases are located close to designated dump sites. Because the vessel traffic related to ocean disposal is an insignificant contributor to the overall vessel traffic in the North and Mid- Atlantic regions (some 3,300 disposal events over 40 years), its potential contribution to the regional noise and strike impacts on sea turtles is commensurately small and expected to be negligible.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual, continual decline in activity since 2004, and vessels stay relatively near shore. Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity. Some areas are closed to fishing or have seasonal restrictions due to fisheries conservation or species protection measures and may reduce fishing traffic in designated areas (BOEM 2012a).

The IPFs of commercial and recreational fishing relevant to marine mammals that may interact with offshore wind energy development are all vessel-related: accidental releases; waste discharges; noise; fishing gear utilization; and vessel traffic and strikes. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast but is expected to remain stable for the foreseeable future; the long-term trend for recreational fishing shows a gradual, persistent decline in angler trips since 2004.

A substantial impact of commercial fishing on sea turtles is the entrapment or entanglement that occurs with a variety of fishing gear. The impacts of bycatch on marine mammals that has been discussed previously is entirely appropriate to a discussion of the impacts of bycatch on sea turtles. Estimated average annual bycatch of loggerhead turtles in Mid-Atlantic bottom otter trawl gear during 1996-2004 was 616 animals (Murray 2006). Impacts from bycatch are a primary threat to sea turtles (NOAA 2018). A reduction in bycatch has been achieved by the requirement for the use of bycatch mitigation measures. A comparison pre- versus post-regulation mean annual bycatch data for Mid-Atlantic fisheries (otter trawl, gillnet, scallop trawl, scallop dredge, Virginia pound net) showed sea turtle bycatch was reduced from 2,400 incidents to 1,700 and mortality reduced from 1,000 to 470 based on data over the period 1990 to 2007 (Finkbeiner 2011).

The interaction between fisheries and offshore wind energy development extend primarily to vessel traffic, and the expected vessel traffic from wind energy development is far less than that of commercial and recreational fisheries and contributes little to the cumulative impacts of North and Mid- Atlantic waters.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. This includes: site assessment and characterization studies through turbine and distribution platform installation; seabed transmission line emplacement; and onshore substation connections. 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 modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand. The incremental increase from offshore wind development will be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014).

IPFs related to land use and coastal infrastructure relevant to sea turtles that may interact with wind energy-related IPFs include accidental releases; effluent discharges; land disturbance/development with habitat loss, noise, and vessel traffic and strikes. These impacts will be spatially limited to the area near the port, with the possible exception of viewshed. The impacts of land use and coastal development will affect sea turtles primarily through habitat loss from development near sea turtle nesting areas, which within the AOI are reliably found along the Virginia coast. Coastal land use and infrastructure impacts on sea turtles will be a negligible contributor to impacts on sea turtles; existing port infrastructure is sufficient to address the requirements of offshore wind energy development so there will be little or no contribution from offshore wind energy to any port expansion developments.

Marine minerals extraction

Data on projected sand mining, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island and Barnegat Inlet to Little Egg Harbor Inlet project, offshore New Jersey and the Sandbridge Beach project, offshore Virginia. Currently, there are six active lease agreements for sand mining in the South Atlantic; the closest sand mining activity is offshore Morehead City, North Carolina, more than 250 km from the Virginia/North Carolina border. Sand mining IPFs have the potential to interact with wind energy IPFs under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts−one or two years−and impacts arising from seafloor disturbances from either activity are relatively localized in their spatial extent, on the order of a several kilometers at most. However, the likelihood of dredging for a series of beach restoration projects is possible, resulting in longer-term impacts.

IPFs that are relevant to sea turtle impacts and may overlap with wind energy IPFs include: accidental releases; discharges from vessels; noise; and vessel traffic and strikes. Marine minerals mining activities projects may also require G&G survey activities similar to but less than oil and gas G&G activity (by using non-airgun technology) and related impacts e.g., vessel activity, noise, and spills.

Vessel strikes and noise are important IPFs in evaluating minerals mining impacts on sea turtles. Because dredging vessel activity is a small contributor to overall marine traffic in the AOI, marine mining vessel traffic will have a negligible impact on sea turtles. Offshore wind energy development will have no interaction with minerals mining impacts on sea turtles.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (see Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016).

IPFs that overlap wind energy-related IPFs include: accidental releases; vessel discharges, and noise; port utilization and dredging; and vessel traffic and vessel strikes. Of these, local impacts vessel traffic at ports and terminals and vessel strikes are the most substantial relative to wind energy development. Marine transportation is a major ocean-based activity; large vessels make some 12,000 port calls annually to ports in the AOI. But this level of vessel traffic is nearly negligible compared to the millions of commercial and recreational fishing trips made annually in the same region. The contribution of marine transportation to the impacts of vessel traffic on sea turtles is expected to be similarly negligible. Offshore wind energy development has little overlap with marine transportation, principally limited to vessel-related impacts;

offshore wind energy-related vessel traffic represents a similarly negligible contribution to regional vessel traffic.

Military use, military range complexes, civilian space programs

The IPFs the Navy considered for sea turtles that could interact with wind energy IPFs included: accidental releases, air emissions, discharges, noise, the presence of structures, and traffic. The Navy concluded the impact of naval training and testing activities was low to discountable because: although individuals may be affected, population level impacts were not expected; a high proportion of nonlethal, short-term, localized interactions that have short recovery periods; and naval activities occur in widely dispersed offshore waters, resulting in a low number of exposed individuals and low potential for interactions. Military activities are expected to present a negligible impact for sea turtles. and not increase their vulnerability to the impacts of offshore wind energy development.

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology.

IPFs of military and civilian space uses that are relevant to sea turtles and could overlap with those of wind energy development include: accidental releases; construction/installation impacts from vessels and anchoring buoys and structures, installing pilings, and dredging; discharges from vessels; mortality of fauna in range of target structures; and vessel traffic. Although there is great overlap of the AOI and military use areas (see Figure 3-5), the likelihood of interaction with wind energy development is low because BOEM has coordination and evacuation lease stipulations with the military and NASA that require cessation of activities prior to commencement of naval testing and training exercises.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018 and assessed the impacts of six IPFs relevant to sea turtle impacts (Navy 2018).

Acoustics. Because the number of sea turtles potentially affected by sound-producing activities is small, although individual may be affected population-level effects are unlikely.

Explosives. Sea turtles would be exposed to explosive stressors in the nearshore and offshore portions of the Study Area. One loggerhead sea turtle mortality is predicted. Because the number of sea turtles potentially impacted by explosives is small, population-level effects are unlikely.

High energy lasers. Potential impacts from high-energy lasers would only result for sea turtles directly struck by the laser beam. Statistical probability analyses demonstrate with a high level of certainty that no sea turtles would be struck by a high-energy laser.

Physical disturbance and strikes. Vessels, in-water devices, and seafloor devices present a risk for collision with sea turtles, particularly in coastal areas where densities are higher. Strike potential by expended materials and debris is statistically small. Because of the low numbers of sea turtles potentially exposed to activities that may cause a physical disturbance and strike, although there is a possibility for individuals to sustain injury, population level effects are unlikely.

Entanglement. Sea turtles could be exposed to multiple entanglements from inshore and offshore training and testing locations. The potential for impacts is dependent on the physical properties of the expended materials and the likelihood that a sea turtle would encounter a potential entanglement stressor and become entangled. Physical characteristics of wires and cables, decelerators/parachutes, and biodegradable polymers combined with the sparse distribution of these items throughout the Study Area indicates a very low potential for sea turtles to encounter these materials. Long-term impacts on individual sea turtles and sea turtle populations from entanglement stressors associated with Navy training and testing activities are not anticipated.

Ingestion. Navy training and testing activities have the potential to expose sea turtles to multiple ingestion stressors and associated impacts from inshore and offshore training and testing locations Adverse impacts from ingestion of military expended materials would be limited to events where a sea turtle would be harmed from ingesting an item. The likelihood that a reptile would encounter and subsequently ingest a military expended item associated with Navy training and testing activities is considered low. Long-term consequences to reptile populations from ingestion stressors associated with Navy training and testing activities are not anticipated.

The Navy also produced an estimated take of sea turtles from sonar, explosives, and ship shock testing and training; no impacts from pile driving and air guns on sea turtles were expected. Sonar produced 38 instances of TTS impact. The impact of explosives and ship shock trials is shown in Table 4-15.

The interaction of IPFs of military activities with wind energy development IPFs is very unlikely because of the requirement to cease wind energy activities prior to commencement of naval testing or training exercises. Offshore wind energy is expected to have no impact on military use IPFs and impacts on sea turtles.

Table 4-15. Five-Year Take, Explosives and Ship Shock, Atlantic Fleet from Naval Testing and Training Operations

	Green turtle	Hawksbill turtle	Kemp's ridley turtle	Loggerhead turtle	Leatherback turtle	total
TTS	96	8	84	1,722	763	2,673
PTS	17	0	22	268	42	349
Injury	0	0	1	49	5	55
Mortality	0	0	0	4	0	4

TTS: temporary threshold shift; PTS: permanent threshold shift
Source: Navy 2018

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs of note related to G&G surveys that overlap with those of offshore wind energy primarily involve noise and vessels: noise from seismic surveys, including airgun blasts, vessel noise, vessel traffic, and vessel strikes. IPFs that impact sea turtles include noise, vessel traffic, vessel strikes, and seismic surveys. BOEM concluded that impacts from airguns used in oil and gas G&G surveys on sea turtles. BOEM’s assessment of the impact of G&G activity in the Mid-Atlantic on sea turtles concluded:

- Depending on various factors, if surveys occur in nearshore areas breeding adults, nesting adult females, and hatchlings could be exposed to high levels of airgun seismic survey-related sound. Potential impacts could include auditory injuries to adults and dispersion of hatchlings, From this analysis, seismic airgun survey impacts on sea turtles would be expected to range from minor to moderate.
- Non-airgun HRG surveys are not likely to be detectable by sea turtles, and the effects from these sources on sea turtles are expected to be negligible.
- Noise from survey vessels may elicit behavioral changes such as evasive maneuvers that are not expected to adversely affect these individuals or the population; impacts would be negligible.
- The risk of vessel strikes on sea turtles is expected to be minimized because of strike avoidance guidelines, the typical slow speed of seismic vessels; and the use of observers; vessel strikes are expected to be avoided and vessel traffic-related impacts would be negligible.

The interaction of oil and gas extraction and wind energy development IPFs can be minimized by timing and location considerations. Seismic surveys can extend over a time scale of months, as does construction and installation of wind energy structures. However, identifying the locations and schedules of wind energy G&G and construction/installation activities and of oil and gas G&G activities could avoid overlapping impacts by scheduling activities to avoid cumulative impacts to sea turtles.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. Currently, three leases have been granted; one has an SAP submitted; three have SAPs approved; two have approved SAPs with COPs under development; two have approved SAPs and have submitted COPs; one leases has an approved Research Activities Plan.

BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies (i.e., G&G surveys, without airguns), site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to impacts on sea turtles are:

- *Site characterization surveys*. G&G surveys IPFs include: accidental release of fuel, fluids, trash, and debris; air emissions and discharges from vessels; noise from vessels and HRG (no airguns) surveys; and vessel traffic and vessel strikes.
- *Site assessment studies: installation of meteorological towers and/or buoys***.** Site assessment studies have the same IPFs as G&G surveys with the exception of noise from HRG surveys. In addition, site assessment-related IPFs include: air emissions from offshore installation of pilings and towers or buoys and from onshore fabrication of structures; discharges from onshore fabrication of structures; construction/installation impacts and seabed alterations from anchoring, driving pilings, and setting foundations for buoys; noise from driving pilings and setting of buoys; port utilization and traffic; impacts from presence of structures, including creating fishing exclusion zones and gear entanglement, damage, or loss; navigational hazards; and viewshed impacts.
- *Installation of turbine structures***.** Installation of turbines will have all of the IPFs described for site assessment studies but also include accidental release of fuel or fluids from structures; air emissions from generators; impacts from scour protection; electromagnetic fields; energy generation; new cable emplacement; noise from O&M and decommissioning/structure removal; presence of structure impacts from habitat creation/fish aggregation, altered migration, radar disturbances; air space conflicts; and turbine bird and bat strikes.

The effects to sea turtles, specifically leatherback, loggerhead, Kemp's ridley, and green sea turtles, are expected to be short term and would result in minimal to negligible harassment depending on the specific activity. Harassment from noise, minor loss/displacement from forage areas, and to a lesser degree, vessel collisions, are the primary anticipated impacts to ESA-listed sea turtles; but these impacts, if any, are anticipated to be short-term and minimal. During pile driving, sound levels would have dissipated to below the 160 dB threshold within a distance of 7 km. Sea turtles within 7 km would be exposed to potentially injurious or harassing levels of sound. However, changes to individual's movements are expected to be minor and short-term, and are therefore, not likely to have population-level impacts.

This conclusion is supported by the NMFS (NMFS, 2011c). NMFS concluded that the proposed lease issuance, associated site characterization, and subsequent site assessment activities are not likely to adversely affect listed sea turtles, when implemented according to the project design criteria and the conditions outlined in this assessment.

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has issued 12 commercial energy permits for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, New York to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island infrastructure.

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/ New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. Multiple proposals for pipelines and LNG terminals offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles, e.g., security, energy, navigational and fisheries concerns, and incomplete information on environmental impacts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

Submarine cables, lines, and pipeline IPFs relevant to sea turtles that may overlap with those of wind energy development include: accidental releases; installation of new subsea cables; vessel discharges; vessel and construction noise; presence of structure impacts; vessel traffic and vessel strikes.

Future seabed cable, line, and pipeline activity appears to be dynamic and has the potential to interact with wind energy IPFs. Most of this activity appears to be located close to shore. The Virginia coast has loggerhead nesting areas, so reviews and approvals of future applications should avoid landfall in nesting areas. The IPFs of seabed cables, lines, and pipelines of note are primarily related to the benthic impacts of installation, maintenance, and repair. The level of vessel activity is relatively low; impacts from presence of structures are spatially localized.

The construction/installation related activity will involve vessel traffic, noise, and sediment resuspension that may impact sea turtles. These activities will be of a relatively short duration. Vessel strike avoidance protocols may be considered depending upon the frequency of sea turtle sightings or stranding near project locations. Wind energy development IPFs clearly overlap with these general public and private subsea cable, line, and pipeline activities from the need to bring offshore power to the onshore distribution grid. Coordination among local, state, federal, and public and private sector stakeholders may be needed to avoid potential site or resource conflicts.

Climate change

Climate change disrupts geophysical and biological resources globally (see Section 3.8). Climate change may directly alter the impacts of IPFs such as increasing ambient sound due to more violent storms that masks communications. Climate change may indirectly alter the impacts of IPFs that affect sea turtles in several ways. Warming may alter current nesting habitat suitability or stability; it also may alter availability/location of food sources, requiring sea turtle adaptations or population redistribution. Rising sea levels can have an even greater impact on nesting habitat. More intense and frequent storm events can affect habitat and may have acoustic impacts such as masking communications. Wind energy development could have a beneficial impact on climate change to the extent its energy generation reduces energy generation from fossil fuels that would otherwise be used to meet power demands.

4.3.2.7 Areas of Special Concern

Table 4-16. Cumulative Impacts Scenario IPFs – Areas of Special Concern

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Air emissions	●	●	●	●	●	●	●	●	●	
Anchoring						●	●	●		
Discharges	●	●	●	●	●	●	●	●	●	
Energy generation/security								●		
Light			●				●	●		
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Non-wind Energy IPFs										
Beach restoration	●			●						●
Gear utilization		●		●		●				●
Land disturbance			●				●			●
Pipeline trenching							●			
Regulated fishing effort		●								●
Resource exploitation		●								●
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea level rise										●

Areas of special concern include a variety of marine protected areas, including: national marine sanctuaries, deepwater protected areas, national seashores, national estuaries program and national estuaries research reserves, national wildlife refuges, and state designated areas. There are no national marine sanctuaries or deepwater protected areas in the AOI. National Seashores found along the coast include Assateague Island, Maryland; Fire Island, New York; and Cape Cod, Massachusetts. Two national estuaries program sites are located along the Mid-Atlantic coast: Delaware Island Bays and Maryland Coastal Bays. National Wildlife Refuges along the Virginia coast include Chincoteague, Back Bay, Eastern Shore of Virginia, and Fisherman's Island National Wildlife Refuges (NWR). Other NWR and NWR Complexes include: Cape May and Edwin B. Forsythe NWRs, New Jersey; Long Island NWR Complex, New York; Rhode Island NWR Complex, Rhode Island; Eastern Massachusetts NWR Complex, Mashpee NWR, and Parker River NWR, Massachusetts; and Maine Coastal Islands NWR Complex and Rachel Carlson NWR, Maine. These sites do not extend into offshore waters.

Dredged material ocean disposal

There are 15 disposal sites located in the North Atlantic (MMS 2007), half of those being around New York harbor (EPA 2018). Although the national trend appears to be a gradual increase in dredge spoil generation, ocean dumping in the North and Mid-Atlantic appears to be decreasing or remaining stable. Vessel traffic is concentrated around shoreward routes to these 15 sites. The contribution of ocean dumping to overall marine traffic is small compared to other sources of vessel traffic, e.g., that from marine transportation, commercial/recreational fishing, military marine activity.

The IPFs of ocean disposal relevant to areas of special concern that may interact with wind energy-related IPFs are primarily vessel-derived stressors and include accidental releases; air emissions; vessel discharges; noise; sediment deposition/burial; and vessel traffic. Seafloor and benthic impacts from vessel anchoring and installation of pilings for wind energy structures could potentially interact with disposal activities but only if located near disposal sites and thus overall have a low probability of interacting with ocean disposal benthic impacts.

Vessel traffic and vessel-related IPFs are the most likely IPFs that could potentially affect these areas of special concern. However, the potential for impact is primarily limited to vessel transits to and from ports. Due to the location of these areas of special concern at the coastline, potential impacts from dredge material ocean disposal are expected to be negligible.

Fisheries use and management

Although there are variations across years and seasons for commercial fisheries activities, as well as differences among states, there are no apparent long-term temporal trends in the level of commercial fisheries activity (BOEM 2014a). Recreational fishing trip data indicate a gradual decline in activity, and vessels stay relatively near shore. Some commercial fishing activities occur throughout the year; others are seasonal. Particularly in the northern Atlantic, summer months see more commercial fishing activity.

The IPFs of commercial and recreational fishing relevant to areas of special concern that may interact with offshore wind energy development are vessel-related: accidental releases; waste discharges; noise; and vessel traffic. Vessel traffic from commercial and recreational fishing is a significant contributor to overall vessel traffic along the North and Mid-Atlantic coast but is expected to remain stable for the foreseeable future.

Potential impacts to areas of special concern are expected to be low as most fishing occurs farther offshore; commercial and recreational fishing near these areas have been compatible with areas of special concern and the future activity is expected to remain stable or decrease. Thus, impacts to areas of special concern from commercial and recreational fishing are expected to be negligible.

Land use and coastal infrastructure

The impact of wind energy development on land use requirements primarily relates to the increase in port activity required to meet the demands for fabrication, construction, transportation and installation of wind energy structures. This includes: site assessment and characterization studies through turbine and distribution platform installation; seabed transmission line emplacement; and onshore substation connections. 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 modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand. The incremental increase from offshore wind development will be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014).

The IPFs of land use and coastal infrastructure relevant to areas of special concern that may interact with wind energy-related IPFs include accidental releases, air emissions, waste discharges, land disturbance/development with habitat loss, noise, viewshed, and traffic. These impacts will be spatially limited to areas near ports, with the possible exception of viewshed impacts. Port activity is not expected to require much expansion, and that will largely be in response to the need to handle larger ships. Residential and commercial coastal development can exert pressure on these areas, which in large part have been established to limit coastal development and preserve valuable ecological habitat. The impacts of land use and coastal infrastructure are expected to be negligible.

Marine minerals extraction

Data on projected sand mining, based on current lease agreements for Maine to Virginia, indicate a stable or decreasing trajectory through 2020. There is one currently active negotiated lease agreement and one current request for sand and gravel mining, respectively, the Long Beach Island and Barnegat Inlet to Little Egg Harbor Inlet project, offshore New Jersey and the Sandbridge Beach project, offshore Virginia.

Marine minerals mining IPFs potentially relevant to areas of special concern may interact with wind energy IPFs under limited spatial and temporal conditions. Project-level dredging activities and wind energy construction and installation activities are typically relatively short-term efforts−one or two years−and impacts arising from seafloor disturbances from either activity are relatively localized in their spatial extent. However, the likelihood of dredging for a series of beach restoration projects is possible and could result in longer-term impacts; the expected low levels of dredging need to be reviewed in the event natural or anthropogenic actions alter current projections.

IPFs that may overlap with wind energy IPFs include: accidental releases; air emissions and discharges from vessels; noise; and vessel traffic. Marine minerals mining activities projects also may require geophysical and geotechnical survey activities similar to oil and gas development and related impacts e.g., vessel activity, noise, air emissions, spills. Because of the distance from shore to these borrow areas, direct impacts from sand and gravel mining have little likelihood of affecting areas of special concern. Vessel traffic and vessel-related IPFs are the most likely IPFs that could potentially affect areas of special concern. However, the potential for impact is primarily limited to vessel transits to and from ports. Potential impacts from marine minerals mining are expected to be negligible.

Marine transportation

Certain types of vessel traffic have increased recently (e.g., ferry use and the cruise industry) and may continue to increase in the foreseeable future. East coast ports have recently or will soon undertake channel deepening to accommodate deeper-draft vessels accommodated by the expanded Panama Canal locks. The lack of any clear trend in the number of vessel calls at North and Mid-Atlantic ports and terminals from 2006 to 2015 (see Figure 3-5 and Table 3-12) suggests that, with the exceptions noted above, vessel traffic is expected to remain relatively steady into the reasonably foreseeable future. Major vessel traffic routes are also expected to be relatively stable (NROC 2016).

IPFs relevant to areas of special concern that may overlap wind energy-related IPFs include: accidental releases; air emissions; discharges; noise; port utilization and channel maintenance dredging; and vessel traffic. Of these, local impacts at ports and terminals are the most substantial relative to areas of special concern. Because marine transportation appears to have a stable trajectory and current activity appears compatible with maintaining the quality of areas of special concern, future impacts are likely to be negligible.

Military use, military range complexes, civilian space programs

The Navy represents a significant military use of the offshore environment; NASA represents the civilian space program use in the Mid-Atlantic. In the near term, the level of military activity will likely remain relatively stable in the AOI. However, fiscal trends are placing pressure on sustaining resources for instrumentation, range operation, and manpower. There is always substantial uncertainty in predicting the levels of military use of the range complexes in the future as world events unfold. Civilian space program uses in the region may increase above the present level, given the recent expansion of operations at Wallops Flight Facility and interest in commercial applications of space technology. Future cumulative impact scenarios should confirm there has been no significant change in the expected stable level of military and civilian space uses.

IPFs of military and civilian space uses that are relevant to areas of special concern that could overlap with those of wind energy development include: accidental releases; air emissions; construction/installation impacts from vessels and anchoring buoys and structures, installing pilings, and dredging; discharges from vessels; mortality of fauna in range of target structures; and vessel traffic. Although there is great overlap of the AOI and military use areas (see Figure 3-3), the likelihood of interaction with wind energy development is low because BOEM has coordination and evacuation lease stipulations with the military and NASA that remove civilian activities from testing and training areas in active use.

The Navy released its Final EIS on its Atlantic fleet training and testing in September 2018. Training exercises that occur in nearshore coastal areas have the greatest potential for impacts on areas of special concern. Air quality impacts were considered the most significant potential impact. Due to the relatively brief duration of these exercises, and the attainment status of potentially affected areas, impacts to these nearshore areas would not create any violation of air quality standards.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

The IPFs of oil and gas extraction are related to G&G surveys; IPFs relevant to areas of special concern that may overlap with those of offshore wind energy primarily involve noise and vessels: noise from seismic surveys, including airgun blasts, vessel noise, vessel traffic, and vessel strikes. IPFs that impact areas of special concern include noise from vessels and seismic surveys. The interaction of oil and gas extraction and wind energy development IPFs can be minimized by timing and location considerations. Identifying the locations and schedules of wind energy G&G and construction/installation activities and of oil and gas G&G activities could avoid overlapping impacts by scheduling activities to avoid cumulative impacts to areas of special concern. Because of their distance from shore, these surveys are very unlikely to impact areas of special concern and are expected to be negligible.

Renewable energy development, wind

Wind energy development is expected to continually increase in the foreseeable future. Currently, there is one operating wind energy facility, the Block Island Wind Farm. BOEM has 12 active offshore leases, from Massachusetts to Virginia. BOEM assesses whether a project is included in the cumulative impact scenario based on its stage in the permitting process, the quantity of information about the project, and the economic viability of the project. BOEM considers Tier 1 and Tier 2 projects are sufficiently advanced for inclusion in a wind energy cumulative impact scenario (see Table 3-4, Tiers for Offshore Wind Construction Activity). Currently, five projects are Tier 1 or Tier 2 projects: New Jersey State Waters/Atlantic City Wind Farm and Coastal Virginia Offshore Wind (Tier 1); South Fork Wind Farm, Vineyard Wind, and Bay State Wind (Tier 2). Three projects are considered Tier 3 projects; they have PPA or OREC agreements in place but have not yet submitted COPs. These projects are: Revolution Wind, Skipjack Wind, and U.S. Wind. These projects should be monitored to determine if their status has changed and merits inclusion in the cumulative impacts scenario.

Wind energy development has the potential to produce impacts from site characterization studies (i.e., HRG surveys, without airguns), site assessment data collection activities that involve installation of meteorological towers or buoys and installation and operation of turbine structures. The IPFs relevant to areas of special concern are:

- *Site characterization surveys***.** G&G surveys IPFs include: accidental releases; air emissions and discharges from vessels; noise from vessels and HRG surveys; and vessel traffic and vessel strikes.

- *Site assessment studies: installation of meteorological towers and/or buoys*. Site assessment studies have the same IPFs as G&G surveys with the exception of HRG surveys. In addition, site assessment-related IPFs include: air emissions from offshore installation of pilings and towers or buoys and from onshore fabrication of structures; discharges from onshore fabrication of structures; construction/installation impacts and seabed alterations from anchoring, driving pilings, and setting foundations for buoys; noise from driving pilings and setting of buoys; port utilization and traffic; impacts from presence of structures; and viewshed impacts.
- *Installation of turbine structures*. Installation of turbines will have all of the IPFs described for site assessment studies but also include accidental releases; air emissions from generators; impacts from scour protection; new cable emplacement; noise from O&M and decommissioning/structure removal; and presence of structure impacts from habitat creation/fish aggregation and altered migration patterns.

Because of the distance from shore, wind energy impacts to areas of special concern are expected to be limited. Vessel transits to and from port and related impacts, e.g., air emissions, noise, discharges, will be localized to navigation routes and port activity. Visual impacts could occur if turbine structures are sufficiently tall and/or close to shore and require extra consideration if located within the viewshed of these shoreline, barrier island, or nearshore coastal island areas of special concern.

Submarine cables, transmission/telecommunication lines, pipelines

BOEM has issued 12 commercial energy permits for offshore wind development from Virginia to south of Cape Cod; one right-of-way grant for a transmission line has been issued as of June 2018. Multiple seabed transmission lines connect offshore islands to the New York/New Jersey/Massachusetts mainland. There is no current offshore oil and gas activity in the North or Mid-Atlantic and no pipelines to support the industry. Two pipelines in Massachusetts Bay connect to offshore LNG terminals; a third connects Long Island, New York to a transcontinental pipeline in New Jersey. As of December 2012, NOAA had charted 77 seabed cables, including active or inactive cables. A trade association, NASCA, identifies 35 cables in the North Atlantic, of which 12 are out of service. The majority of submarine telecommunications cables connect to New York, New Jersey, or Rhode Island infrastructure.

In June 2018, BOEM approved the qualifications for a right-of-way grant to the New York/New Jersey Ocean Grid project for a 5,000 MW offshore transmission system for future offshore wind energy generation. The Atlantic Link project proposes a 375-mile transmission line from Canada to Massachusetts, originating in the Bay of Fundy and ending in Plymouth, Massachusetts. Multiple proposals for pipelines and LNG terminals offshore New York and New Jersey have been submitted but have encountered political or regulatory obstacles, e.g., security, energy, navigational and fisheries concerns, and incomplete information on environmental impacts. The FCC has two pending submarine telecommunication cable applications for landfall in the North Atlantic. Submarine telecommunications cables are continually maintained, repaired, upgraded, and replaced and new cables installed to support telecommunications operations.

Submarine cables, lines, and pipeline IPFs relevant to areas of special concern that may overlap with those of wind energy development include: accidental releases; air emissions from vessels; installation of new subsea cables; vessel discharges; vessel and construction noise; presence of structure impacts such as offshore and onshore new cable infrastructure; onshore space use conflicts; and vessel traffic.

Future seabed cable, line, and pipeline activity appears to be dynamic and has the potential to interact with wind energy IPFs. Although most of this activity appears to be located close to shore, an investigation of future application approvals will be needed and the routes of these transmission connections reviewed in relation to areas of special concern. The level of vessel activity related to submarine cables, lines, and pipelines is relatively low and the construction/installation phase of the cables, lines, or pipelines is when the most significant impacts are likely to occur and are of limited duration. Impacts from presence of related structures are local and can be sited to avoid areas of special concern or mitigation measures implemented.

Impacts from submarine cable, telecommunications, and pipelines on areas of special concern are expected to be negligible.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change will directly or indirectly alter the impacts of IPFs that affect areas of special concern by warming and altering habitat. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3 Socioeconomic and Cultural Resources

4.3.3.1 Demographics, Employment, Economic Resources, and Environmental Justice

Table 4-17. Cumulative Impacts Scenario IPFs – Socioeconomic Resources

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Air emissions	●	●	●	●	●	●	●	●	●	
Energy generation/security								●		
Light			●				●	●		
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Demolition, structure removal						●	●			
Land disturbance			●				●			●
Regulated fishing effort		●								●
Resource exploitation		●								●
Warming and sea level rise										●

The coastal zone from Maine to Virginia is a large population hub with diverse populations and economies. Waterborne commerce, as well as tourism and port infrastructure are important components of many coastal economies. As highlighted in the table above, myriad activities have the potential to contribute to cumulative impacts on socioeconomic resources such as demographics, employment, public services, and property values. Actions occurring offshore could result in additional employment related to offshore and onshore construction activity, increased port utilization as well as vessel traffic and associated support. Cumulative impacts of alternative energy facilities on employment and income would depend on the number of people employed during construction and operations, the size of the populations in the areas where facilities were sited, and whether jobs would be able to utilize existing capacity in the local workforce. Since many coastal communities already support port infrastructure and activity the available capacity in the local workforce and marine crews with the required skillset for potential activities will determine the related demographic and employment impacts. Also, the duration and scale of offshore activities would determine the level of impacts to employment.

Several recent studies discuss the potential for creation of high-paying and sustained local jobs as a result of offshore wind development (BVG 2017; MA CEC 2018). These jobs may be particularly important if they are created in areas that have experienced economic declines such as many industrialized coastal areas. Employment and regional economic impacts of wind energy development projects can be calculated using the Offshore Wind Jobs and Economic Development Impact (JEDI) model developed by the National

Renewable Energy Labs (NREL). Given information on a project location, construction start year, nameplate capacity, and turbine size (if available), JEDI can provide information on construction phase and operating phase impacts, including local labor impacts, local revenue, and supply chain and induced impacts.

Cumulative impacts to demographics (e.g. population size, population growth, age, and racial distributions) are unlikely from temporary activities such as construction (BOEM 2016c). Numerous activities in the same geographic region could result in larger numbers of jobs but the numbers would likely still be small relative to the overall economy and population (MMS 2007). Socioeconomic impacts from wind energy development are typically positive impacts related to additional employment.

Cumulative impacts to property values can result from the presence of structures and changes to the viewshed. Cumulative impacts depend on the density of visible offshore development and its distance from shore.

Environmental justice impacts are environmental or economic impacts to minority or low-income populations. IPFs from a variety of activities that affect demographics and employment have the potential to disproportionately affect certain populations. These impacts are likely to be highly site-specific and require review for every specific project (MMS 2007). Considering that major activities for offshore development would occur at a distance away from populations the temporary onshore construction would likely have the largest potential environmental justice implications (MMS 2007). These impacts could include adverse health impacts from air emissions and noise, which could negatively affect local populations. Construction, operation and decommissioning of facilities have a variety of impacts ranging from air, water and noise pollution as well as potentially affecting land use and property values disproportionately (MMS 2007). The potential for cumulative environmental justice impacts depends on the regional distribution of minority and low-income population groups (MMS 2007).

Dredged material ocean disposal

Vessels required for dredging and disposal activities create oceangoing traffic as well as air emissions and noise associated with those vessels. Additional dredging and disposal activities could increase traffic and potentially create environmental justice issues. There are 36 dredged material disposal sites designated in the Atlantic region and the majority of dumping activity occurs at these designated sites (MMS 2007). Fifteen sites are located in the North Atlantic with half of those around New York harbor (EPA 2018). Potential environmental justice issues from dredging and disposal activities would be localized and concentrated around these areas.

Fisheries use and management

Fisheries use and management can affect demographics, employment and environmental justice through several different IPFs. Vessels conducting fishing activity (both commercial and recreational) can create air emissions, noise and traffic. Increases in fishing activity would create new employment opportunities; however, resource exploitation (e.g., overfishing) or regulations could result in constrained fishing effort, and lower employment levels (BOEM 2016c). Fishing communities are often of particular interest for environmental justice issues as they are often low-income or minority communities (BOEM, 2014a). Thus, changes in fishing activity in the region may be an important factor to consider when evaluating cumulative environmental justice impacts.

Land use and coastal infrastructure

Impacts to demographics, employment and environmental justice from onshore infrastructure would be related to onshore construction, port utilization and vessel traffic transiting to and from ports. Additional vessel traffic associated with ports could impact demographics, employment and environmental justice both positively and negatively. Some growth in employment and associated economic activity would be expected in areas where port expansion is occurring; these areas include many ports along the Atlantic coast offshore of Maine to Virginia (see Chapter 3 for a table illustrating expected port developments). Port expansion may also lead to an increased need for support services onshore which could affect employment and demographics. Baseline levels of port utilization and vessel traffic need to be considered when determining the significance of potential cumulative impacts.

Vessel traffic to and from ports can create oceangoing traffic as well as air emissions and noise, which can potentially add to cumulative negative impacts on environmental justice populations. In addition, light associated with industrial facilities in coastal areas may affect local communities. Construction activities associated with port development and other coastal infrastructure could also create air emissions, noise and light. These IPFs should be considered to assess environmental justice issues.

Marine minerals extraction

Marine minerals extraction occurs in the study area in particular locations. Sand and gravel mining along the Atlantic coast offshore of Maine to Virginia includes use of existing and potential borrow sites where sand mining will occur. Beach restoration associated with this activity has the potential to impact demographics and employment positively. During the restoration activity, employment may be positively affected if the restoration activity creates jobs. Once the restoration is complete, this could positively affect the local environment. Vessels utilized for marine minerals surveys are typically smaller vessels that employ fewer people than larger seismic survey vessels (BOEM, 2014a). Survey vessels create light, noise and air emissions that could potentially impact onshore communities adversely through cumulative pollution of the local environment. Light, noise and air emissions resulting from vessels use in marine minerals extraction activities should be considered to assess cumulative environmental justice impacts.

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that generates substantial vessel traffic in locations along the Atlantic coast offshore of Maine to Virginia. Changes in port utilization for marine transportation purposes could have impacts on local economies, in terms of increased employment and economic activity. Vessel traffic associated with marine transportation would create air emissions and noise that may adversely impact coastal communities. Close to shore, traffic is concentrated in key shipping channels and port areas (BOEM, 2014a). Environmental justice issues should be considered where cumulative impacts from marine transportation and other activities may occur.

Military use, military range complexes, civilian space programs

Activities might be restricted in military range complexes and civilian space program use areas causing disruptions to economic activity. The Navy’s standard operating procedures require that an area is clear of non-participating vessels and aircraft before an activity using ordnance or expended materials occurs (Navy 2018). Temporary and short duration (hours) impacts may occur from limits on accessibility to marine areas used for fishing or tourism and hence result in a loss of income; however, most limitations on accessibility are temporary and would be lifted upon completion of training and testing activities (Navy 2018). Similarly, people may experience noise from vessels or aircraft involved in training or testing activity. These occurrences would likely be of short duration and infrequent, and other than transiting vessels and aircraft, noise from military activities is often further from shore than fishing or recreational activities. Impacts on socioeconomic resources from military activities would be unlikely contribute to cumulative impacts due to their short-term and limited nature.

Similar to other activities involving vessel traffic, vessels associated with military use and programs have the potential to create noise, air emissions and light offshore, which have the potential to affect onshore communities and should be considered to assess cumulative environmental justice impacts.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

Surveying activities are occurring, and have the potential to impact demographics, employment and environmental justice through creation of additional traffic and changes to port utilization. These vessel trips could create additional employment opportunities and generate income for local communities. The type of surveys being conducted for oil and gas development would determine the number of potential jobs created; however, in 2014 BOEM did not find that these activities create new jobs as they often require specialized expertise (BOEM, 2014a). Indirect economic impacts from these activities nevertheless generate economic benefits to the port sites and surrounding areas where the survey crews are based. These are positive, temporary impacts, which should be considered in comparison to baseline levels of economic activity.

Survey vessels also create light, noise and air emissions that could potentially impact onshore communities and should be considered to assess cumulative property value and environmental justice impacts.

Renewable energy development, wind

Construction and development of wind energy may result in short-term impacts to demographics and employment in localized areas. Impacts of construction, operation and decommissioning would likely be small as diverse local economic infrastructure and labor markets would be able to meet demand (MMS 2007). BOEM estimates that three direct jobs are created per wind turbine during construction and one during operation/decommissioning (MMS 2007). Cumulatively these impacts would depend on the number facilities in a single region; however, the cumulative impact is still likely to be small (MMS 2007).

Construction/installation of wind energy has the potential to impact onshore populations by creating noise and vessel activity; however, permitting processes would likely ensure that these impacts are limited. The presence of wind turbines as well as light from these facilities along the coastline could result in visual impacts. Air emissions, noise and light as well as vessel traffic impacts from the construction, installation, operation and decommissioning of wind energy projects would be localized and should be considered to assess cumulative environmental justice impacts.

Offshore wind energy development has the potential to impact demographic, employment and environmental justice activity in a variety of ways.

- *Site characterization surveys*. Surveys have the potential to add vessel traffic and create direct employment for a coastal port community (BOEM, 2014a).
- *Installation of meteorological towers and/or meteorological buoys*. Depending on the location of towers/buoys, this may result in viewshed or light impacts on environmental justice communities and also could impact property values.
- *Installation of turbine structures*. This can result in positive effects on employment activity during construction and installation. However, this would be temporary and there would be smaller employment impacts during the operation of a turbine.
- *Presence of turbine structures*. Depending on the location of turbines, this may result in viewshed or light impacts on environmental justice communities and could also impact property values.

Whether the presence of structures related to wind energy activities will contribute to cumulative impacts on environmental justice or property values depends on the siting of the project and the staging point. Cumulative impacts could occur if multiple offshore wind energy facilities were sited in close proximity to one another with socioeconomic impacts focused in certain coastal communities (MMS 2007).

Submarine cables, transmission/telecommunication lines, pipelines

The Atlantic coast offshore of Maine to Virginia contains significant existing undersea cable infrastructure. The impacts to demographics, employment and environmental justice from existing and new submarine cables, transmission/ telecommunication lines, pipelines are related to the vessel traffic associated with installation and O&M. The size of a survey vessel and the installation vessel determine the number of potential jobs created. Onshore construction of a landing station for the cable could also create temporary local jobs. Vessels involved in installation and O&M for submarine cables, transmission/ telecommunication lines, and pipelines also create light, noise and air emissions that could potentially impact onshore communities adversely through cumulative pollution of the local environment and should be considered to assess cumulative environmental justice impacts.

Climate change

Climate change disrupts geophysical and biological resources globally (see Section 3.8). Climate change will directly or indirectly alter the impacts of IPFs that affect socioeconomics by impacting coastal communities through property loss, property value changes, and higher costs of maintenance or insurance due to more frequent storms. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3.2 Cultural and Historic Resources

Table 4-18. Cumulative Impacts Scenario IPFs – Cultural/Historic Resources

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●		●	●	●	●	●	●	
Anchoring						●	●	●		
Discharges	●	●	●	●	●	●	●	●	●	
Energy generation, security								●		
Light			●				●	●		
Port utilization					●		●	●		●
Presence of structures			●			●	●	●	●	●
New cable emplacement/maintenance								●	●	●
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Demolition, structure removal						●	●			
Gear utilization		●		●		●				●
Land disturbance			●				●			●
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Sediment deposition and burial	●									●
Warming and sea level rise										●

Cultural resources are evidence of past human activity, including Traditional Cultural Properties (TCPs). TCPs are properties that are eligible for inclusion in the National Register of Historic Places (NRHP) based on associations with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community. These may include pioneer homes, buildings, or old roads; structures with unique architecture; prehistoric village sites; historic or prehistoric artifacts or objects; shipwrecks; rock inscription; human burial sites; or earthworks, such as battlefield entrenchments, prehistoric canals, or mounds. These nonrenewable resources often yield unique information about past societies and environments and provide answers for modern-day social and conservation problems. Although many have been discovered and protected, numerous forgotten, undiscovered, or unprotected cultural resources exist in the marine environment. Although neither NEPA nor any other federal law defines "cultural resource," several laws and executive orders deal with resources that are cultural in character.

Activities and associated IPFs occurring along the Atlantic coast offshore of Maine to Virginia have the potential to impact cultural resources if they result in seabed or land disturbance, or affect culturally important viewsheds. Similarly, proposed wind energy projects have the potential to affect cultural resources if they disturb the seabed or undisturbed land areas as well as culturally important viewsheds. In areas where seabed cables are common, cumulative impacts to cultural resources may be important to consider, although siting multiple seabed cables in the same corridor may reduce cumulative impacts.

To the extent that onshore facilities will be developed in previously undisturbed areas, potential cumulative impacts to cultural resources may be important to consider. In addition, oil spills or other accidental releases have the potential to damage cultural resources. The likelihood of accidental releases is higher in areas with larger ports and vessel activities (BOEM 2015). Offshore cultural resources are unlikely to be affected as the mitigation strategy has and will continue to be avoidance (BOEM, 2012a). For example, siting of meteorological towers and buoys would be adjusted to avoid adverse effects to offshore cultural resources.

The following subsections discuss the potential IPFs and impacts of each activity on cultural resources.

Dredged material ocean disposal

Dredged materials disposal occurs in designated areas offshore in the marine environment. Fill in these areas has likely resulted in impacts to submerged cultural resources if they are present within the designated disposal area. EPA has site designation criteria that include consideration of proximity to historical/cultural sites and prepares EAs or EISs when designating sites. Thus, the likelihood of impacts on cultural resources from authorized ocean disposal is low. However, vessels used in dredged materials disposal have the potential for discharges, spills of fuel or fluids or dredge material that could cause damage to cultural resources outside of the disposal site. New wind energy development is unlikely to directly interact with these impacts, but to the extent that an offshore wind project is planned near an existing disposal site, potential cumulative impacts to cultural resources should be considered.

Fisheries use and management

Fisheries that utilize bottom gear (e.g. traps, pots, or dredges) may affect cultural resources by moving, breaking, or destroying resources (gear utilization IPF). While these actions are very localized, they also occur frequently in many areas along the Atlantic coast offshore from Maine to Virginia. Impacts of future wind energy projects would be additive to other impacts that have occurred related to bottom gear use by commercial as well as recreational fisheries. In addition, vessels used in commercial and recreational fisheries have the potential for spills of fuel or fluids as well as discharges, which could cause damage to cultural resources.

Land use and coastal infrastructure

Many coastal shore land areas along the Atlantic coast from Maine to Virginia have been disturbed by human development over time. To the extent that onshore facilities will be developed in previously undisturbed areas, and particularly undisturbed areas nearby disturbed areas, cumulative impacts to cultural resources may be important. The expansion and development of existing port infrastructure also has the potential to affect cultural resources on coastal land areas. There also is the potential for light from onshore development to affect culturally important viewsheds.

Marine minerals extraction

Marine minerals extraction occurs in the study area in specified, designated locations. Sand and gravel mining along the Atlantic coast offshore of Maine to Virginia includes use of existing and potential borrow sites where sand mining will occur and may have affected cultural resources. Based on technology and cost factors, sand mining activity appears limited to depths less than 30 m (98 ft) (BOEM, 2014a). New wind energy development is possible but unlikely to interact directly with impacts of marine mineral extraction activities. OCS wind developers are likely to avoid laying cables through borrow areas to avoid the potential damage that dredging activities could inflict. To the extent that a wind energy project is planned near sand mining activities, the potential interaction and combined cumulative impacts to cultural resources should be considered. In addition, vessels used in marine minerals extraction have the potential for discharges and spills of fuel or fluids which could cause damage to cultural resources. It is also possible the export cables could occur within or close to a borrow area and be damaged from dredging operations (gear utilization IPF). Thus, coordination with BOEM MMP is called for to avoid potential conflicts.

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that generates substantial vessel traffic in locations along the Atlantic coast offshore of Maine to Virginia. While generally speaking, vessel traffic is not anticipated to substantially affect cultural resources, accidental releases as well as discharges from vessels, as well as port utilization associated with vessel traffic could have effects on cultural resources.

Military use, military range complexes, civilian space programs

Repetitive and routine military training activities could result in impacts to cultural resources if they affect the seabed or otherwise undisturbed land areas. To the extent that future wind energy projects are planned near ongoing military activities, cumulative impacts to cultural resources should be considered. In addition, vessels used in military or civilian space programs have the potential for discharges and spills of fuel or fluids which could cause damage to cultural resources.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

G&G surveying activities are occurring, and have the potential to affect cultural resources if they affect the seafloor as well as through use of temporary or permanent lighting both onshore and offshore. New wind energy development is unlikely to directly interact with impacts of G&G surveys. However, to the extent that a new wind energy project is planned near an area being surveyed, cumulative impacts to cultural resources should be considered. In addition, vessels used in G&G surveying activities have the potential for discharges and spills of fuel or fluids which could cause damage to cultural resources.

Renewable energy development, wind

Wind energy development has the potential to impact cultural resources in a variety of ways. Seafloor disturbance can result from construction activities, such as excavations for offshore turbine installation, offshore drilling, or offshore cable placement; this in turn can result in destruction or removal of cultural resources from their primary context. There is also the potential that the presence of wind turbines can affect cultural resources on the coast if visual factors are important for maintaining the integrity of the resource (MMS 2007).

In addition, and similar to other activities involving vessel traffic, vessels associated with construction and O&M for wind energy have the potential to impact cultural resources through accidental releases. Accidental releases or discharges of fuel/fluids from service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms), could harm cultural resources. The expansion and development of existing port infrastructure to accommodate renewable energy development also has the potential to affect cultural resources on coastal shore land areas.

Submarine cables, transmission/ telecommunication lines, pipelines

The Atlantic coast offshore of Maine to Virginia contains significant existing undersea cable infrastructure. Installation submarine cables, transmission/ telecommunication lines, pipelines may create seafloor disturbances, which may impact affect cultural resources. In addition, discharges and accidental releases of fuel or fluids from operation of pipelines, or from vessels used in installation or O&M could cause damage to cultural resources.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change will directly or indirectly alter the impacts of IPFs that affect cultural/historic resources by loss (submerging) of coastal resources/lands and destruction of properties due to flooding/storms. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3.3 Visual Resources

Table 4-19. Cumulative Impacts Scenario IPFs – Visual Resources

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Light			●				●	●		
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Demolition, structure removal						●	●			
Land disturbance			●				●			●
Port utilization, maintenance, dredging	●									●
Warming and sea level rise										●

Visual resources include the aesthetic, perceptual, and experiential aspects of any objects and features that make landscapes and seascapes distinctive as well as key observation points (also known as KOPs, considered representative of the varied character of the landscape or seascape and typical observer experience). Impacts to visual resources may negatively or positively affect the perceived quality of a landscape or seascape and may affect the "feel," "character" or "sense of place" of an area. Visual impacts tend to come from three sources: the addition of an element or features, change or loss of existing visual elements or features and the combined effects on views or visual amenity. Whether impacts are perceived positively or negatively depends on the visual impact receivers (i.e. viewers), how much they value the visual resources as well as how many viewers there are and how familiar viewers are with the land or seascape or other site-specific factors (BOEM 2018).

Activities and associated IPFs occurring off the Atlantic coast offshore of Maine to Virginia could result in potential short-term impacts to visual resources if they result in onshore or coastal construction activities. Offshore construction activities may affect visual resources depending on the distance of those activities to shore as well as seasonal weather and lighting conditions. Long-term impacts on visual resources could result from development of permanent structures onshore or offshore, as well as continuing increases in vessel traffic. While many activities result in vessel traffic that transit seascapes, it should be noted that onlookers are unlikely to be able to distinguish the specific activities resulting in vessel traffic offshore. Baseline levels of vessel traffic need to be considered when determining the significance of potential cumulative impacts.

Wind energy development projects may add to both short-term and long-term impacts to visual resources through construction activities as well as longer-term operations. Similarly, impacts would be larger in undeveloped areas where new infrastructure could permanently affect viewsheds (BOEM 2016a). Impacts to visual resources are highly site-specific and can depend on the number of viewers as well as the perception of impacts by different viewers (e.g., some viewers might find the appearance of wind turbines to be a positive addition to the viewshed) (MMS 2007). The distance from shore and the height of offshore structures or vessels would also determine the level of visual impacts (BOEM 2016c). Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in nighttime views and may be a major focus of visual attention at distances of up to 10 mi (16 km) (Argonne 2018).

Cumulative impacts to visual resources can occur when the presence of multiple projects considered together change the essential character of the seascape or landscape, for example (BOEM 2018):

- Where multiple offshore facilities or structures are within the same view without a viewer turning their head;
- Where multiple facilities or structures can be seen successively if the viewer turns their head; or
- Where multiple facilities are viewed in succession as the viewer moves through the landscape. In this case, multiple facilities can affect the viewing experience for moving viewers even if the facilities are not visible from a single viewpoint.

Cumulative impacts to visual resources that are most likely to be significant are those that change the seascape/landscape character through major effects on its key characteristics, or that transform it into a different seascape/landscape type entirely. This may happen if the proposed project “tips the scale” by adding its effects to the combined impacts of existing or planned projects/activities (BOEM 2018). BOEM is developing additional, specific guidance on evaluating cumulative visual impacts to be released in Spring 2019. It is likely that this guidance will be refined over time as experience, changes in technology, and public input shape the approach for evaluating visual impacts for offshore wind projects in the U.S.

Dredged material ocean disposal

Vessels required for dredging and disposal activities create oceangoing traffic, which can interfere with visual resources. There are 36 dredged material disposal sites designated in the Atlantic region and the majority of dumping activity occurs at these designated sites (MMS 2007). Fifteen sites are located in the North Atlantic with half of those around New York harbor (EPA 2018). Vessel traffic impacts to visual resources from dredging and disposal activities would be concentrated around these areas.

Fisheries use and management

Fisheries management activities limit fisheries through a variety of closures, which remove vessels from certain areas. These closures could limit the number of vessel transits through a specific viewshed. Closures and restrictions depend on species, season and location. For example, certain areas are closed to trap/pot fishing at certain times to protect the right whale (83 FR 49046). Ongoing trends in fisheries are important for analysts to consider in cumulative impacts analyses for wind projects.

Land use and coastal infrastructure

Impacts to visual resources from onshore infrastructure would be related to coastal infrastructure and vessel traffic transiting to and from ports. Additional vessel traffic associated with ports could impact visual resources negatively. Some growth in vessel traffic to and from ports would be expected in areas where port expansion is occurring; these areas include many ports along the Atlantic coast offshore of Maine to Virginia (see Chapter 3 for a table illustrating expected port developments). In addition, analysts should consider specific local land use areas where coastal development and onshore activity is concentrated as these visual impacts will be site-specific and dependent on siting (MMS 2007-046). In some cases, construction or land disturbance onshore can also create visual impacts that should be considered in the cumulative impacts analysis. Larger onshore facilities are more likely to have impacts on coastal visual resources as both the facility structures and the light they generate are visible at greater distances (BOEM 2016a). Nighttime visual impacts from direct glare and sky glow can occur at larger facilities (BOEM 2016a).

Marine minerals extraction

Marine minerals extraction occurs in the study area in particular locations. Sand and gravel mining along the Atlantic coast offshore of Maine to Virginia includes use of existing and potential borrow sites where sand mining will occur. Additional vessel traffic associated with these activities may affect visual resources. Based on technology and cost factors, sand mining activity appears limited to depths less than 30 m (98 ft) (BOEM 2014a), which would likely be nearshore and contribute to impacts on visual resources.

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that generates substantial vessel traffic in locations along the Atlantic coast offshore of Maine to Virginia. Close to shore, traffic is concentrated in key shipping channels and port areas (BOEM 2014a). Vessel traffic associated with marine transportation may interfere with visual resources in the same locale. Shipping fairways, traffic lanes, anchorage areas, separation, danger, and safety/security zones, and other navigational areas designated to provide safe access routes to and from ports also have an impact in terms of concentrating vessel traffic.

Military use, military range complexes, civilian space programs

Construction of facilities offshore as well as the presence of military operations onshore can affect visual resources. The Navy's standard operating procedures require that an area is clear of non-participating vessels and aircraft before an activity using ordnance or expended materials occurs (Navy 2018). Some military activity may limit accessibility to marine areas (Navy 2018); this could result in positive impacts as areas have reduced non-military vessels in the seascape. Repetitive and routine training could result in additional impacts.

Similar to other activities involving vessel traffic, vessels associated with military use and programs have the potential to affect visual resources as they pass through seascapes. Cumulative impacts would be expected in and adjacent to areas where military training or testing activity occurs (Navy 2018).

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

Surveying activities are occurring, and have the potential to impact visual resources through creation of additional traffic. Transportation of oil and gas including tankers and other vessels can result in visual impacts (BOEM 2016a). If installed, oil and gas infrastructure offshore would have visual impacts related to the offshore construction and structures as well as lighting, but currently none exist in the North Atlantic OCS.

Renewable energy development, wind

Wind energy development has the potential to impact visual resources in a variety of ways.

- *Meteorological towers and/or meteorological buoys.* Depending on the location of towers/buoys, this may affect visual resources. Due to their lower height than wind energy turbines, impacts would be expected to be negligible to minor with towers likely be out of the view of onshore viewers. Due to curvature of the earth, towers would likely fall below the horizon for onshore viewers depending on the height and distance with shorter towers falling below the horizon at a closer distance (e.g., BOEM determined that a tower with an assumed height of 394 ft would fall below the horizon at a distance of 23.5nm, any lower towers would fall below the horizon at a closer distance) (BOEM 2016c). Offshore light from meteorological towers, if visible, would likely be indistinguishable from ongoing vessel traffic and other offshore light with negligible or minor impacts depending on the type of lighting (BOEM 2016c).
- *Turbine structures.* Multiple wind energy projects could have aggregation effects on visual resources. Turbines can result in positive or negative effects on visual resources depending on perceptions of wind turbines in the region, and would be likely to be long term based on project

lifetimes. The further from shore turbines are sited the lower the impact to visual resources with the potential for minor impacts to visual resources. For Vineyard Wind turbines would be visible at distances less than 27.4 miles from shore and between this distance and 35.3 miles the top of rotors could be visible from shore (BOEM 2018a). Decommissioning of facilities could also affect positively or negatively visual resources but impacts would be brief. Towers would have very brief but major visual impacts to vessels close by. Light impacts would be limited by the distance to shore (BOEM 2018a).

- Atmospheric conditions could limit the amount of time turbines are visible from shore reducing any impacts to visual resources (BOEM 2018a).
- Inshore views can be obstructed by onshore structures and landscape features making visual impacts concentrated at coastal areas and beach front that has unobstructed views (Epsilon Associates 2018).

Cumulative impacts to visual resources from wind energy development could be larger if projects are sited in close proximity to each other and clearly visible from one viewpoint. This is particularly true if the facilities create a visual "wall" across the view. In addition, similar to other activities involving vessel traffic, vessels associated with construction and O&M for wind energy have the potential to affect visual resources though this is likely to be difficult to distinguish from regular vessel traffic.

Submarine cables, transmission/telecommunication lines, pipelines

The Atlantic coast offshore of Maine to Virginia contains significant existing undersea cable infrastructure. The impacts to visual resources from existing and new submarine cables, are related to the vessel traffic associated with installation and O&M. Onshore facilities for connection of undersea cables could impact visual resources permanently but the size and nature of onshore substations and other equipment as well as proximity to viewers would determine the level of impact. Visual impacts from associated construction would be temporary but the facilities would be permanent (MMS 2007).

Climate change

Climate change disrupts geophysical and biological resources around the world (see Section 3.8). Climate change will directly or indirectly alter the impacts of IPFs. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3.4 Tourism and Recreation

Table 4-20. Cumulative Impacts Scenario IPFs – Tourism & Recreation

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Light			●				●	●		
Noise	●	●	●	●	●	●	●	●	●	
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●

Diverse recreation and tourism activities occur along the Atlantic coast from Maine to Virginia, including boating, swimming, surfing, diving, sunbathing, wildlife viewing (e.g. whale watching or birding), and fishing (note, recreational fishing is discussed in Section 4.3.9). The majority of recreation and tourism activity potentially affected by wind energy development occurs along the coastline or fairly close to shore. A recent BOEM EA considered recreation and tourism activity occurring within 0.25 mi (0.4 km) of the coastline as having the potential to be affected by that proposed action (BOEM 2016c). However, actions occurring farther offshore also can contribute to cumulative impacts on recreation and tourism resources, particularly through visual and noise affects.

The impacts of Atlantic region offshore wind development on tourism and recreation have been the subject of two recent BOEM reports (BOEM 2012b; 2018c). Offshore wind development can result in changes to natural resources which can in turn impact recreation (e.g. changes in surfing conditions) or changes in the viewshed which may impact tourism activities (e.g. attracting new visitors or negatively impacting visitation to the area). Depending on the public perception of offshore wind facilities, these impacts can be positive or negative. An offshore wind power project has potential to affect beachgoers’ experience/enjoyment on beach trips, change trip behavior, as well as to generate “curiosity trips.” “Curiosity trip” refers to trips taken for the purpose primarily of seeing an offshore wind power project (i.e., a “special trip,” different than a primarily beach-recreation trip. The recent stated preference survey found that an offshore wind power project could have negative economic effects on beach recreation for projects near shore (closer than 7.5 miles), especially at larger, more popular beaches. However, a wind project located 12.5 to 20 miles offshore, in many instances was found to result in a net positive effect on recreation (i.e., trip increases and curiosity trips are greater than lost trips) (BOEM 2018c).

IPFs that may interact with wind energy-related IPFs and affect recreation and tourism include: construction/installation and decommissioning; stressors related to the presence of structures both offshore and onshore; light; noise; vessel-derived stressors such as accidental releases of fuel, trash and debris; and vessel traffic. Increased vessel traffic and noise have the potential to change the aesthetics of coastal and offshore areas and to affect recreational activities and tourism (BOEM 2012b). An operating wind facility can change the viewshed on the marine horizon both during the day and at night. Effects depend on the number of turbines, the height and size of the turbines, their distance from shore, and the weather conditions

(BOEM 2012b). While the risk of spill effects on recreational resources in the region offshore from Maine to Virginia may be small, depending on the location of recreation and tourism activity, accidental releases may pose the potential for direct but limited effect on recreational activities (BOEM 2016c). In addition, permitting requirements for various activities such as sand mining, offshore wind, tidal and wave energy development, and pipeline/cable projects would likely be sited and designed to avoid or minimize potential recreational impacts (MMS 2009).

The following subsections discuss the potential IPFs and impacts of each type of action on recreation and tourism resources.

Dredged material ocean disposal

Vessels required for dredging and disposal activities create oceangoing traffic, which can interfere with recreational boating activities. There are 36 dredged material disposal sites designated in the Atlantic region and the majority of dumping activity occurs at these designated sites (MMS 2007-046). Fifteen sites are located in the North Atlantic with half of those around New York harbor (EPA 2018). Vessel traffic impacts to recreational activities from dredging and disposal activities would be localized and concentrated around these areas. These vessels also may result in accidental releases which have the potential to affect recreation and tourism activities if they preclude activities from occurring or result in oiling or trash along the shoreline at recreation/tourism locations.

Fisheries use and management

Fisheries use and management can affect recreation and tourism through several different IPFs. Vessels conducting fishing activity (both commercial and recreational) can interfere with recreational boating activity. In addition, accidental releases from fishing vessels could occur which have the potential to affect recreation and tourism activities if they preclude recreational activities from occurring or result in oiling or trash along the shoreline at recreation/tourism locations.

Land use and coastal infrastructure

Impacts to recreation and tourism from onshore infrastructure would be related to port utilization and vessel traffic transiting to and from ports. Additional vessel traffic associated with ports could impact recreation and tourism negatively; however, baseline levels of vessel traffic need to be considered when determining the significance of potential cumulative impacts. Some growth in vessel traffic to and from ports would be expected in areas where port expansion is occurring; these areas include many ports along the Atlantic coast offshore of Maine to Virginia (see Section 3.6 for information on expected port developments). In addition, light associated with industrial facilities in coastal areas may also affect the enjoyment of recreational activities offshore or along the coast through cumulative light pollution.

Marine minerals extraction

Sand and gravel mining along the Atlantic coast offshore of Maine to Virginia includes use of existing and potential borrow sites where sand mining will occur. Beach restoration associated with this activity has the potential to impact recreation and tourism, either negatively or positively. During the restoration activity, recreation/tourism may be negatively affected; however, once the restoration is complete, this could positively affect recreational experiences.

Vessel traffic associated with these activities may interfere with recreational boating on a localized basis. In addition, accidental releases from vessels involved in marine minerals mining could occur which have the potential to affect recreation and tourism activities if they preclude recreational activities from occurring or result in oiling or trash along the shoreline at recreation/tourism locations.

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that generates substantial vessel traffic in locations along the Atlantic coast offshore of Maine to Virginia. Close to shore, traffic is concentrated in key shipping channels and port areas (BOEM, 2014a). Vessel traffic associated with marine transportation may interfere with recreational boating operating in the same locales. These vessels also may result in accidental releases that can affect recreation and tourism.

Military use, military range complexes, civilian space programs

Recreational activities may be restricted in military range complexes and civilian space program use areas. The Navy's standard operating procedures also require that an area is clear of non-participating vessels and aircraft before an activity using ordnance or expended materials occurs (Navy 2018). Temporary and short duration (hours) impacts may occur from limits on accessibility to marine areas used for recreation; however, most limitations on accessibility are temporary and would be lifted upon completion of training and testing activities (Navy 2018). Similarly, people participating in recreation or tourism activities may experience noise from vessels or aircraft involved in a training or testing activity. These occurrences would likely be of short duration and infrequent, and other than transiting vessels and aircraft, most Navy training and testing that generates airborne noise would occur farther from shore than most recreational and tourism activities (Navy 2018).

Similar to other activities involving vessel traffic, vessels associated with military use and programs have the potential for accidental releases, which have the potential to affect recreation and tourism activities if they preclude recreational activities from occurring or result in oiling or trash along the shoreline at recreation/tourism locations.

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

G&G surveying activities are occurring, and have the potential to impact recreation and tourism activities, through creation of additional traffic and accidental releases.

Renewable energy development, wind

Offshore wind energy development has the potential to impact recreation and tourism activity in a variety of ways.

- *Site characterization surveys.* Surveys have the potential to add vessel traffic and which can also result in accidental releases (BOEM 2014a).
- *Installation of meteorological towers and/or meteorological buoys*. Depending on the location of towers/buoys, this may result in interference with recreational boating, or viewshed or light impacts.
- *Installation of turbine structures.* This can result in negative effects on recreational activity during installation, due to increased traffic that could interfere with recreational boating, and potential for accidental releases. However, during operations, wind turbines may have a neutral or slightly positive impact on recreation and tourism activity, in both the short and long term depending on public perception.

Cumulative visual impacts could occur to onshore recreational resources from the presence of vessels associated with wind energy construction/installation/decommissioning when combined with the presence of vessels associated with other projects (BOEM 2014b). Whether the presence of structures related to wind energy activities will contribute to cumulative impacts on recreation and tourism depends on the siting of the project; most recreational boating activity occurs closer to shore, and visual impacts will depend on the location of the site in relation to onshore tourism/recreation locations (e.g. see BOEM 2013b, because the WEA was proposed to be located more than 9 nm offshore, no visual impacts on recreational resources were expected). Cumulative impacts could occur if multiple offshore wind energy facilities were sited in close proximity to one another (MMS 2007).

Submarine cables, transmission/telecommunication lines, pipelines

The Atlantic coast offshore of Maine to Virginia contains significant existing undersea cable infrastructure. The impacts to recreation and tourism from existing and new submarine cables, transmission/ telecommunication lines, pipelines are related to the vessel traffic associated with installation and O&M. Vessels associated with construction and O&M have the potential to impact recreation and tourism through accidental releases. Installation of submarine cables, transmission/telecommunication lines, and pipelines may create seafloor disturbances, which may impact recreational activities dependent on benthic resources, such as diving. The introduction of many hard-substrate structures in a given has the potential to displace certain species and alter ecosystems, because species requiring hard substrate could move into the area.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources globally. Climate change will directly or indirectly alter the impacts of IPFs that affect tourism and recreation by affecting the availability and location of recreational resources due to rising sea levels and the potential for more frequent hurricanes which threaten coastal tourist communities. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3.5 Commercial and Recreational Fisheries

Table 4-21. Cumulative Impacts Scenario IPFs – Commercial and Recreational Fisheries

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Air emissions	●	●	●	●	●	●	●	●	●	
Anchoring						●	●	●		
Discharges	●	●	●	●	●	●	●	●	●	
Energy generation/security								●		
Light			●				●	●		
New cable emplacement/maintenance								●	●	●
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Gear utilization		●		●		●				●
Land disturbance			●				●			●
Pipeline trenching							●			
Regulated fishing effort		●								●
Resource exploitation		●								●
Sediment deposition and burial	●									●
Seabed profile alterations				●						●
Warming and sea level rise										●

The management area for the New England Fisheries Management Council and of the Mid-Atlantic Fisheries Management Council for all federal fisheries includes the U.S. Exclusive Economic Zone (from 3 to 200 nm from the coastline), plus state waters (from 0 to 3 nm from the coastline). As such, the focus of the analysis of cumulative impacts to fisheries is likely to be limited to this zone.

A recent study by BOEM indicates that based on federal permit data, an annual average of about $14.0 million in commercial fishing revenue was derived from the eight proposed wind energy planning areas (WEAs) (including Massachusetts, Rhode Island/Massachusetts, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina WEAs) annually between 2007 and 2012, representing 1.5% of the total annual average commercial fishing revenue generated in New England and the Mid-Atlantic over the same time period (Kirkpatrick et al. 2017). With respect to recreational fisheries, over the five-year period from 2007 to 2012, the area from Maine to Virginia experienced an average of over 546,000 angler trips annually, of which BOEM estimates 6.1% occurred within one mile of a WEA (Kirkpatrick et al. 2017).

Most activities and associated IPFs occurring off the Atlantic coast offshore of Maine to Virginia have some potential to impact commercial and recreational fisheries, as shown in Table 4-1 above. Key factors to be considered include the extent to which (1) the presence of structures may affect the ability of commercial fishing vessels to operate in the vicinity of the wind project, and (2) vessel traffic related to the wind project would affect regional fishing vessel traffic. While most vessels may be able to avoid commercial fishing vessels with gear in the water as they transit to an offshore location, impacts to commercial fisheries from other vessel traffic are important to consider. Air emissions associated with vessel use may also contribute to increased ocean acidification and declines in water quality and fishing conditions.

The following subsections discuss the potential IPFs and impacts of each activity on commercial and recreational fisheries.

Dredged material ocean disposal

Vessels required for dredging and disposal activities create oceangoing traffic, which can interfere with fishing activities. There are 36 dredged material disposal sites designated in the Atlantic region and the majority of dumping activity occurs at these designated sites (MMS 2007). Fifteen sites are located in the North Atlantic with half of those around New York harbor (EPA 2018). Vessel traffic impacts to fisheries from dredging and disposal activities Site would be localized and concentrated around these areas. These vessels also may result in accidental releases and add to chronic noise in the marine environment that can affect fish and associated fisheries. In addition, air emissions associated with vessel use may also contribute to increased ocean acidification and declines in water quality and fishing conditions.

Fisheries use and management

Fisheries management activities limit fisheries through a variety of closures and gear restrictions designed to support sustainable fisheries and protect threatened and endangered species and marine mammals. Closures and restrictions depend on species, season and location. For example, certain areas are closed to trap/pot fishing at certain times to protect the right whale (83 FR 49046). Ongoing trends in fisheries are important for analysts to consider in cumulative impacts analyses for wind projects that include fisheries impacts.

For species along the Atlantic coast from Maine to Virginia, including highly migratory Atlantic species, NMFS has placed 25 fish stocks on either or both the overfished list (i.e. stock having a population size that is too low and that jeopardizes the stock’s ability to produce its maximum sustainable yield) or overfishing list (i.e., a stock having a harvest rate higher than the rate that produces its maximum sustainable yield). These species are likely subject to stricter regulations to rebuild the species.

Land use and coastal infrastructure

Impacts to commercial and recreational fisheries from onshore infrastructure would be related to port utilization and vessel traffic transiting to and from ports. Additional vessel traffic associated with ports could impact fishing negatively; however, baseline levels of vessel traffic need to be considered when determining the significance of potential cumulative impacts. Some growth in vessel traffic to and from ports would be expected in areas where port expansion is occurring; these areas include many ports along the Atlantic coast offshore of Maine to Virginia (see Section 3.6 for a table illustrating expected port developments). In addition, air emissions associated with industrial facilities in coastal areas may also contribute to increased ocean acidification and declines in water quality and fishing conditions.

Marine minerals extraction

Sand and gravel mining along the Atlantic coast offshore of Maine to Virginia includes use of existing and potential borrow sites where sand mining will occur. Vessel traffic associated with these activities may interfere with commercial fisheries operating in the same locales. Based on technology and cost factors, sand mining activity appears limited to depths less than 30 m (98 ft) (BOEM, 2014a). This may limit potential for interaction with commercial fishing fleets that operate in greater depths.

Vessels associated with marine minerals extraction have the potential to impact fish, and thus fisheries, through accidental releases, discharges or noise. In addition, marine minerals extraction may create seafloor disturbances through use of hopper dredges, which may impact fisheries that are reliant on benthic resources.

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that generates substantial vessel traffic in locations along the Atlantic coast offshore of Maine to Virginia. Close to shore, traffic is concentrated in key shipping channels and port areas (BOEM, 2014a). Vessel traffic associated with marine transportation may interfere with commercial fisheries operating in the same locales. Shipping fairways, traffic lanes, anchorage areas, separation, danger, and safety/security zones, and other navigational areas designated to provide safe access routes to and from ports also have an impact in terms of limiting locations where fishing can occur. These vessels also may result in accidental releases and add to chronic noise in the marine environment that can affect fish and associated fisheries. Air emissions associated with vessel use also may contribute to increased ocean acidification and declines in water quality and fishing conditions.

Military use, military range complexes, civilian space programs

Commercial and recreational fishing activities may be restricted in military range complexes and civilian space program use areas. The Navy's standard operating procedures also require that an area is clear of non-participating vessels and aircraft before an activity using ordnance or expended materials occurs (Navy 2018). Temporary and short duration (hours) impacts may occur from limits on accessibility to marine areas used for fishing; however, most limitations on accessibility are temporary and would be lifted upon completion of training and testing activities (Navy 2018). Repetitive and routine training could result in additional impacts. Cumulative impacts would be expected in and adjacent to areas where military training or testing activity occurs (Navy 2018).

Similar to other activities involving vessel traffic, vessels associated with military use and programs have the potential to impact fish, and thus fisheries, through accidental releases, discharges or noise. In addition, air emissions associated with vessel use also may contribute to increased ocean acidification and declines in water quality and fishing conditions.

Oil and gas extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

Surveying activities are occurring, and have the potential to impact fish, and thus commercial and recreational fisheries, through creation of additional traffic, noise, routine discharges, bottom/land disturbance, lighting, and accidental releases. In addition, air emissions associated with operations and vessel use also may contribute to increased ocean acidification and declines in water quality and fishing conditions.

Renewable energy development, wind

Wind energy development has the potential to impact commercial and recreational fisheries in a variety of ways.

- *Site characterization surveys.* Surveys have the potential to affect commercial and recreational fisheries through active acoustic sound sources, vessel traffic, seafloor disturbance, trash and debris, and accidental releases (BOEM, 2014a).
- *Installation of meteorological towers and/or meteorological buoys*. Depending on the location of towers/buoys, they may result in reduced availability of fish, and increase the difficulty of catching fish in these areas, especially for certain gear types. These structures present a risk of entanglement for fishing gear.
- *Installation of turbine structures*. This can result in negative effects on fish populations (such as displacement), and thus fisheries, due to electromagnetic fields and noise, both during construction

and operations. However, during operations, wind turbines may have a neutral or slightly positive impact on recreational fishing activity, in both the short and long term (Kirkpatrick et al., 2017).

In addition, similar to other activities involving vessel traffic, vessels associated with construction and O&M for wind energy have the potential to impact fish, and thus fisheries, through accidental releases, discharges or noise. Accidental releases of fuel/fluids from service vessels, or spills of other fluids (e.g., dielectric fluids from alternative energy facility electric support platforms) could harm fisheries through fish kills or contamination of large numbers of fish.

Submarine cables, transmission/telecommunication lines, pipelines

The Atlantic coast offshore Maine to Virginia contains significant existing undersea cable infrastructure. The impacts to fisheries from existing and new submarine cables, transmission/telecommunication lines, and pipelines are related to the vessel traffic associated with installation and O&M, as well as risk of entanglement for certain gear types. In addition, dead cables, which have not been removed, pose a risk of entanglement. Vessels associated with construction and O&M have the potential to impact fish, and thus fisheries, through accidental releases, discharges or noise. Installation of submarine cables, transmission/ telecommunication lines, and pipelines creates seafloor disturbances, which may impact fisheries dependent on species reliance on benthic resources. Further, the introduction of many hard-substrate structures in a given area has the potential to displace certain species and alter ecosystems, because species requiring hard substrate could move into the area. These impacts could occur for all types of alternative energy facilities and for oil and gas development, LNG facility development, and artificial reef programs (MMS 2007-046). In addition, air emissions associated with vessel use also may contribute to increased ocean acidification and declines in water quality and fishing conditions.

Climate change

Climate change disrupts geophysical and biological resources globally (see Section 3.8). Climate change will directly or indirectly alter the impacts of IPFs that affect fisheries, including changes in suitable location, prey abundance/availability, and accessibility for commercial fishing vessels if species move to deeper (cooler) waters. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3.6 Land Use and Infrastructure

Table 4-22. Cumulative Impacts Scenario IPFs – Land Use and Infrastructure

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●		●	●	●	●	●	●	
Air emissions	●	●	●	●	●	●	●	●	●	
Discharges	●	●	●	●	●	●	●	●	●	
Light			●				●	●		
Noise	●	●	●	●	●	●	●	●	●	
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Beach restoration	●			●						●
Land disturbance			●				●			●
Warming and sea level rise										●

Offshore activities have some potential to affect onshore land use and coastal infrastructure, particularly due to onshore construction activities and in the event of accidental releases. The likelihood of accidental releases is higher in areas with larger ports and vessel activities (BOEM 2015). Some discharges and wastes are also required to be transported and stored onshore (BOEM 2016a). Discharges are largely regulated and where allowed would be likely to dissipate quickly (MMS 2007). For discharges to directly affect coastal land and terrestrial environments would likely require a catastrophic discharge event or major oil spill (BOEM 2016a). Land use and infrastructure are highly localized and zoning and planning rules should be examined on a site specific basis.

Land use and coastal infrastructure

Land use along the Atlantic coast offshore of Maine to Virginia is diverse, and includes heavily industrialized ports, large metropolitan areas (including Boston, New York City, Newark, and Norfolk, among others), large tourist areas, as well as natural areas with a variety of coastal habitats. A network of federal, state and local authorities manages land use and coastal infrastructure to balance conservation of the environment with economic development. These include the CZMA, the National Historic Preservation Act, among other state and federal statutes and regulations (BOEM 2016a).

Existing onshore infrastructure as well as construction activities produce air emissions, noise, traffic, and light pollution to varying degrees along the Atlantic coast. Electric grid structures, shipyards, ports and transportation networks are important to the development of offshore alternative energy resources (MMS 2007). However, some sites where these activities occur may already meet the infrastructure needs of North Atlantic OCS energy development (MMS 2007). In addition, onshore facilities are typically sited in previously developed locations when possible. As a result, while development of onshore infrastructure may affect existing land uses to some degree, cumulative effects of new onshore infrastructure from offshore wind energy projects appear likely to be small in most cases. Consistent with this assumption, BOEM's Renewable Energy PEIS identified onshore development of renewable energy on land use and infrastructure as likely to result in negligible impacts (MMS 2007).

Military use, military range complexes, civilian space programs

There are twelve major onshore military installations on the Atlantic coast offshore of Maine to Virginia (not including U.S. Coast Guard facilities) that undertake a wide variety of activities, including sheltering military personnel, as well as facilitating training and operations. A number of U.S. military installations support coastal and offshore training activities (Navy 2018). Navy activities are often supported onshore by commercial shipbuilding facilities (Navy 2018). While most military installations are permanent facilities, temporary structures can also be used in training activities onshore, such as tent encampments (Navy 2018). The Atlantic Fleet Training and Testing EIS (Navy 2018) did not consider land use as it did not require any new actions and was deemed not connected to the resource (Navy 2018). Offshore, similar to other activities, vessels have the potential for spills of fuel or fluids which could affect onshore habitats and land use.

Oil and gas surveys and extraction

At present, no active OCS oil and gas leases exist in any of the four BOEM OCS planning areas in the Atlantic, and no oil and gas lease sales are proposed under the current Five Year Leasing Program 2012-2017 (BOEM 2018). However, BOEM's Draft Proposed Program for the 2019-2024 New National OCS Program proposed to open the entire Atlantic OCS to oil and gas leasing. G&G survey activities are allowable in the region, though restrictions apply to some areas. Onshore support activities for surveys are minimal (BOEM, 2014a). Survey vessels and other vessels could have accidental fuel or oil spills that affect land use and surrounding communities (BOEM, 2014a).

If oil and gas development occurs in the future, onshore support activities could include installation of onshore pipeline infrastructure and support facilities, changes to existing zoning, and construction of roads (BOEM 2016a). These activities would create air emissions from onshore transportation as well as onshore facilities (BOEM 2016a). Onshore discharges associated with liquid wastes would also be expected, and accidents are possible that could result in fluid spills (BOEM 2016a).

Renewable energy development, wind

Wind energy development has the potential to affect existing land use and infrastructure primarily through infrastructure demand. Wind energy developments have the potential for larger structures with more land required than tidal energy developments, although general activities onshore including construction, staging and maintenance activities are similar (MMS 2007). Impacts of onshore infrastructure for wind energy development projects may include short-term impacts to air emissions from vehicles, fugitive dust, as well as longer term lighting and noise effects. Cumulative impacts analyses of wind energy projects on land use and infrastructure should consider whether onshore facilities for other wind energy projects occur in the vicinity of proposed facilities.

Submarine cables, transmission/telecommunication lines, pipelines

Seabed cables for the telecommunications industry are common on the Atlantic coast offshore of Maine to Virginia. A small number of submarine pipelines for LNG exist that transmit LNG to offshore facilities, and a transcontinental pipeline runs from New York to Europe. Development of permanent facilities for offshore wind has the potential to affect existing cables through bottom disturbances for construction as well as laying of new cables to support wind activities. The impact of these activities on coastal land use and other infrastructure would be limited. To the extent that catastrophic accidents associated with pipelines occur, impacts to land use and infrastructure could occur. Impacts of onshore facilities that connect to these features are addressed under the land use and coastal infrastructure category.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change will directly or indirectly alter the impacts of IPFs that affect land use and infrastructure through changing coastlines, more frequent hurricanes, flooding, and construction projects designed to contain rising sea levels. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3.7 Military Range Complexes and Civilian Space Program Uses

Table 4-23. Cumulative Impacts Scenario IPFs – Military Range Complexes & Civilian Space Program Uses

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Accidental releases	●	●	●	●	●	●	●	●	●	
Presence of structures			●			●	●	●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Guidance/fiber optic/wires, entanglement						●				
Warming and sea level rise										●

As described in Section 3.5, there are numerous military range complexes and civilian space use areas established in the area off the U.S. coastline from Maine to Virginia. In addition, the military has extensive radar systems in place in this area (MMS 2007). Restricted areas and danger zones are established in areas off U.S. coastlines to allow military forces to conduct training and testing activities. Portions of these areas can be closed or subject to limited public access at certain times to protect the public or to provide security for government property. NASA also has designated danger zones and restricted areas for rocket testing and shuttle launches offshore Wallops Island in Virginia. In addition, certain activities (e.g., commercial and recreational fishing, oil and gas production, laying of submarine cables) may be restricted in some military use areas. The focus of the analysis of cumulative impacts to military and civilian space uses includes impacts on airspace, surface, and subsea areas that are utilized by military entities, NASA or civilian space companies in the region.

Military uses of the offshore sea and air areas are generally compatible with other vessel and aircraft use; however, where naval vessels and aircraft conduct operations that are not compatible with commercial or recreational transportation, they are confined to Operating Areas (OPAREAs) away from commercially used waterways and inside Special Use Airspace (SUA). To ensure safety, hazardous operations are communicated to all vessels and operators by use of Notices to Mariners issued by USCG and Notices to Airmen issued by the FAA.

Commercial wind energy developments have the potential for space use conflicts with military use areas because of the potentially large areas of the ocean that such developments could occupy (e.g., the area of a commercial wind facility could be about 26 km^2 [10 mi^2]) (MMS 2007). In addition, wind energy developments could impact the use of military radar because the rotor height may exceed 122 m (400 ft) (MMS 2007). Such impacts to military uses would be additive if multiple wind energy developments were located in a fairly small geographic area. Assuming that the siting of offshore wind energy development is coordinated with the U.S. Department of Defense (DOD) and NASA, cumulative impacts on military and civilian space use areas associated with offshore wind projects are generally anticipated to be limited.

As discussed in the following subsections, limited impacts to military and civilian space use would be related to the activities and associated IPFs occurring off the Atlantic coast offshore of Maine to Virginia shown in Table 4-1 above. Key factors to be considered include the extent to which additional tall structures installed as part of the wind development may affect military radar use, and the extent to which additional vessel traffic or accidental releases related to wind energy developments may interfere with military or civilian space use activities.

Dredged material ocean disposal, fisheries use and management, marine minerals, marine transportation/navigation, oil and gas, and seabed lines/cables/pipelines

Dredged material disposal, fisheries use and management, marine minerals, marine transportation/ navigation, oil and gas, and seabed lines/cables/pipelines all generate traffic (vessel or aircraft or both) to varying degrees, which has the potential to interfere with military or civilian space program activities. Impacts on military activities in the designated OPAREA and aviation from routine activities may occur as a result of increased vessel traffic (BOEM 2013b). While there are high levels of vessel activity associated with shipping and marine transportation and other activities around ports along the U.S. coastline from Maine to Virginia, impacts to military as well as civilian space program activities are likely to be modest. This is because areas used for military testing and training include established restricted areas and danger zones which can be closed or subject to limited public access at certain times to protect the public or to provide security for government property. Thus, interactions between vessel traffic and military activities are already largely controlled. Any activities that may directly or indirectly affect military activities will likely involve consultation with DOD to determine the extent of potential impacts and may result in specific DOD requirements, recommendations, or further mitigation measures necessary to eliminate or reduce potential impacts on military activities (BOEM 2013b).

In addition to impacts from vessel or aircraft traffic, accidental releases such as fuel spills related to vessels traversing the area have the potential to impact military activities. All vessel movements are associated with a risk of collision and subsequent loss of fuel. Depending on the extent of the accidental release, military or civilian space program use activities could be affected if areas were considered unusable due to an accidental release. However, increased incidence of such spills related to proposed wind development activities are anticipated to be minimal.

Several activities have the potential for space use conflicts with military activities, including fisheries, marine transportation/navigation, oil and gas, tidal energy, and seabed lines/cables/pipelines. Whether conflicts would occur would depend on the site-specific location and size of activities.

Renewable energy development, wind

BOEM currently has 13 active leases in the area off the U.S. coastline from Maine to Virginia (refer to Section 3.1 for additional details). Wind energy development may affect military use and civilian space program use through vessel traffic and the presence of structures, as follows.

- *Site characterization surveys*. Surveys have the potential to affect military and civilian space use primarily through vessel traffic (BOEM, 2014a).
- *Installation of meteorological towers and/or meteorological buoys.* Towers/buoys may affect vessel transit routes for military vessels. However, the effects would be highly localized.
- *Installation of turbine structures.* Turbine structures may also affect vessel transit routes, but again, the effects on military vessels in transit would be highly localized.

It is not anticipated that installation of meteorological towers or wind turbines would interfere with military activities (BOEM 2013b). In general, impacts from wind energy development on military activity would be expected to be highly localized. Vessel traffic within military range complexes and civilian space program use areas would increase due to activities related to wind energy development; however, the level of vessel traffic likely to be generated would be relatively minor when compared with existing vessel traffic from commercial shipping, personal recreational vessels, passenger vessels, military vessels, and commercial/recreational fishing vessels. The establishment of vessel exclusion zones as part of wind energy development activities could result in incremental increases in impacts to military range complexes and civilian space program uses if traffic is rerouted.

Offshore wind energy development has the potential for space program use conflicts with military activities depending on the size of a proposed project. However, coordination with DOD during the siting process would be expected to minimize multiple use conflicts.

Climate change

Climate change disrupts geophysical and biological resources globally (see Section 3.8). Climate change will directly or indirectly alter the impacts of IPFs that affect military range complexes and civilian space program uses through changing coastlines, the need for coastal base alterations (construction), and global instability caused by more frequent violent weather events. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.3.8 Marine Transportation, Navigation and Traffic

Table 4-24. Cumulative Impacts Scenario IPFs – Marine Transportation, Navigation, and Traffic

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Anchoring						●	●	●		
Port utilization					●		●	●		●
Presence of structures			●			●	●	●	●	●
New cable emplacement, burial and maintenance								●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Guidance/fiber optic/wires, entanglement						●				
Demolition, structure removal						●	●			
Gear utilization		●		●		●				●
Port utilization, maintenance, dredging	●									●
Pipeline trenching							●			
Regulated fishing effort		●								●

Marine transportation in the North Atlantic region is diverse, with vessels originating from numerous ports and private harbors within the North Atlantic, as well as elsewhere in the U.S and internationally. Commercial traffic in the North Atlantic includes commercial fishing, passenger vessels (e.g., cruise ships, ferries), cargo, tug/barge, liquid tanker, military or military training, research, dredging/underwater/diving operations, and search-and-rescue vessels. Recreational traffic includes pleasure, sailing, charter, recreational fishing, and high speed craft (USCG 2007). Close to shore, traffic is concentrated in key shipping channels and port areas (BOEM, 2014a). Many vessel types, such as ferries and personal craft, generally remain within State waters (MMS 2007). In offshore federal waters, transit routes are numerous and varied. Thus, the analysis of cumulative impacts to marine transportation should consider the entire area off the Atlantic coast from Maine to Virginia. Additional discussion of marine transportation is provided in Section 3.6.

Most activities and associated IPFs (e.g., construction/installation, G&G surveys, new cable emplacement and maintenance) occurring offshore from Maine to Virginia have some potential to impact marine transportation, navigation, and traffic, as shown in Table 4-1 above. The factors that are most likely to have cumulative impacts on marine transportation are vessel traffic (traffic IPF) and the presence of structures (presence of structures IPF). Vessel traffic and the presence of structures can increase the risk of collisions and allisions, which can result in loss of the structures or vessels, as well as loss of life and spill of diesel fuel or other cargo material (e.g., crude oil) (BOEM, 2012a). Collisions and allisions are generally considered unlikely because vessel traffic is typically controlled by multiple routing measures, such as safety fairways, TSS, and anchorages (BOEM, 2012a). Vessel traffic and the presence of structures can also result in vessel maneuvering and potential traffic inefficiencies and delays. Larger vessels may have limited ability to maneuver, while smaller vessels may sustain more damage from collisions and allisions.

Cumulative impact evaluations should consider the relative volume of traffic from a proposed activity compared to existing traffic and whether the proposed activity (specifically, traffic or structures from the proposed activity) is likely to disrupt popular transit routes. (These analyses are typically provided in a traffic study supporting permit applications.) Measures for proposed activities that would minimize the cumulative impacts to marine transportation include designs that do not interfere with designated fairways and shipping lanes, and appropriate signage and/or lighting to warn passing vessels (MMS 2007). When these criteria are met, cumulative impacts are expected to be minor.

The following subsections discuss the potential IPFs and impacts of each activity on marine transportation.

Dredged material ocean disposal

Vessels required for dredging and disposal activities create oceangoing traffic, which can interfere with marine transportation. There are 36 dredged material disposal sites designated in the Atlantic region, and the majority of dumping activity occurs at these designated sites (MMS 2007). Fifteen sites are located in the North Atlantic with half of those around New York harbor (EPA 2018). Impacts to marine transportation from dredging and disposal activities would be localized and concentrated around these areas and common routes to these areas (e.g., from harbors during major dredging activities).

Fisheries use and management

Fisheries management activities affect marine transportation through vessel traffic. Fishing closures and restrictions may minimize impacts to marine transportation in the areas of the closures, which can also vary by season. Ongoing trends in fisheries (including routes, frequency of trips, closure areas, and seasonal patterns) should be considered in cumulative impacts analyses for wind projects.

Land use and coastal infrastructure

Impacts to marine transportation from onshore infrastructure would be related to port utilization and vessels transiting to and from ports. Some growth in vessel traffic to and from ports would be expected in areas where port expansion is occurring; these areas include many ports along the Atlantic coast offshore of Maine to Virginia (see Section 3.2 for expected port developments).

Marine minerals extraction

Sand and gravel mining along the Atlantic coast offshore of Maine to Virginia includes use of existing and potential borrow sites where sand mining will occur. Vessel traffic associated with these activities may interfere with existing marine transportation operating in the same locales. Based on technology and cost factors, sand mining activity appears limited to depths less than 30 m (98 ft) (BOEM, 2014a), which would limit interaction with existing marine transportation to these areas. In general, the impacts of marine minerals extraction on marine transportation are expected to be minor.

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that generates substantial vessel traffic in locations along the Atlantic coast offshore of Maine to Virginia. Additional marine transportation will affect existing marine transportation. As noted in the discussion of other activities in Section 3.6, many activities contribute to vessel traffic. Cumulative impact evaluations should consider the relative contribution of vessel traffic from proposed wind projects compared to existing traffic, as the anticipated increase in vessel traffic from wind energy projects is anticipated to be minor.

Military use, military range complexes, civilian space programs

Marine transportation may be restricted in military range complexes and civilian space program use areas, which can include designated danger zones, restricted areas, and closure areas that may limit access by vessel traffic. In some cases, areas may be closed temporarily to all vessel traffic for military or safety reasons (BOEM 2016c). The Navy’s standard operating procedures also require that an area is clear of non-participating vessels and aircraft before an activity using ordnance or expended materials occurs (Navy

2018). Temporary and short duration (hours) impacts may occur from limits on accessibility to marine transit routes; however, most limitations on accessibility are temporary and would be lifted upon completion of training and testing activities (Navy 2018). Repetitive and routine training could result in additional impacts. Cumulative impacts would be expected in and adjacent to areas where military training or testing activity occurs (Navy 2018).

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

However, surveying activities are occurring, and have the potential to impact marine transportation through additional traffic. These activities are generally infrequent and localized and are expected to have minor impacts on marine transportation. BOEM's Draft Proposed Program for the 2019-2024 New National OCS Program proposed to open the entire Atlantic OCS to oil and gas leasing. There are currently no petroleum platforms or pipeline production systems in the area offshore of Maine to Virginia (BOEM, 2014a).

Renewable energy development, wind

BOEM issued 10 wind energy leases between 2012 and 2016 from Massachusetts through Virginia (BOEM 2016c). Wind energy development could affect marine transportation through vessel traffic and the presence of structures, as follows.

- *Site characterization surveys*. Surveys have the potential to affect marine transportation primarily through vessel traffic (BOEM, 2014a).
- *Installation of meteorological towers and/or meteorological buoys*. Towers/buoys may affect vessel transit routes. However, the effects would be highly localized.
- *Installation of turbine structures*. Turbine structures may affect vessel transit routes, but the effects would be highly localized.

Impacts from wind energy development on marine transportation would generally be highly localized.

Submarine cables, transmission/telecommunication lines, pipelines

The Atlantic coast offshore of Maine to Virginia contains significant existing undersea cable infrastructure (see section 3.12). Marine transportation may be affected by the installation and O&M of this infrastructure, including submarine cables, transmission/telecommunication lines, and pipelines, which would necessitate vessels and heavy equipment (MMS 2007). However, impacts on marine transportation are generally expected to be localized and minor.

Climate change

As described in Section 3.8, climate change disrupts geophysical and biological resources around the world. Climate change will directly or indirectly alter the impacts of IPFs that affect marine transportation, navigation, and traffic by altering navigation routes due to changing coastal configurations and the possible need to conduct more cargo transfer offshore should ports need to be reconfigured due to higher sea levels. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

4.3.2.8 Energy Production and Distribution

Table 4-25. Cumulative Impacts Scenario IPFs – Energy Production & Distribution

	Dredge Material Ocean Disposal	Fisheries Use and Management	Land Use /Coastal Infrastructure	Marine Minerals Extraction	Marine Transportation, Navigation, and Traffic	Military Ranges & Civilian Space Program Uses	Oil and Gas Surveys and Extraction	Renewable Energy-Wind	Submarine Cables, Lines, & Pipelines	Climate Change
Offshore Wind Energy Development IPFs										
Energy generation, security								●		
Port utilization		●			●	●	●	●		●
Presence of structures			●			●	●	●	●	●
New cable emplacement/maintenance								●	●	●
Traffic	●	●	●	●	●	●	●	●	●	
Cumulative Impact Scenario, Other IPFs										
Demolition, structure removal						●	●			
Energy stressors/devices/lasers						●				
Pipeline trenching							●			
Warming and sea level rise										●

Energy production and distribution refers to hydrocarbon energy projects, which could include geophysical surveys; drilling of oil and natural gas exploration, development, and production wells; installation and operation of offshore platforms and pipelines, onshore pipelines, and support facilities; transport of hydrocarbons using pipelines or tankers to processing locations; and decommissioning (BOEM 2016a). At present, no active OCS oil and gas leases exist in any of the four BOEM OCS planning areas in the Atlantic, and no oil and gas lease sales are proposed under the current Five Year Leasing Program 2012-2017 (BOEM 2018). However, BOEM’s Draft Proposed Program for the 2019-2024 New National OCS Program proposed to open the entire Atlantic OCS to oil and gas leasing. There are currently no petroleum platforms or pipeline production systems in the area offshore of Maine to Virginia (BOEM, 2014a). However, surveying activities are occurring, which require vessels and on-water equipment. Additionally, there are four LNG terminals from Maine to Virginia (two onshore and two offshore; see section 3.10), which result in the transiting of LNG carriers and support vessels. Because of the wide range of types and locations of energy production and distribution elements, the analysis of cumulative impacts to this resource should consider the entire area off the Atlantic coast from Maine to Virginia. Additional discussion of energy distribution and production is provided in Section 3.9.

Most activities and associated IPFs occurring offshore from Maine to Virginia have some potential to impact energy production and distribution, as shown in Table 4-1 above. The factors that are most likely to have cumulative impacts on energy production and distribution are vessel traffic (traffic IPF), the presence of structures (presence of structures IPF), and space use conflicts (space use conflicts IPF). However, these factors are expected to typically have only minor impacts on energy production and distribution, based on frequency and the implementation of best practices.

The majority of the activities in Table 4-1 have the potential to result in increased vessel traffic, and vessel traffic also is associated with most of the IPFs (e.g., construction/installation, G&G surveys, new cable emplacement and maintenance). Vessel traffic and the presence of structures can increase the risk of collisions and allisions (vessel accidents with stationary vessels or objects) with energy production and distribution vessels and equipment, which can result in loss of the structures or vessels, as well as loss of life and spills of diesel fuel or other cargo material (e.g., crude oil) (BOEM, 2012a). Collisions and allisions are generally considered unlikely because vessel traffic is typically controlled by multiple routing measures, such as safety fairways, TSS, and anchorages (BOEM, 2012a). Vessel traffic and the presence of structures also can result in vessel maneuvering and potential traffic inefficiencies and delays, as well as potential disruptions to survey activities. Larger vessels may have limited ability to maneuver, while smaller vessels may sustain more damage from collisions and allisions.

Cumulative impact evaluations should consider the relative volume of traffic from a proposed activity compared to existing traffic and on-water work from energy production and distribution and whether the proposed activity (specifically, traffic or structures from the proposed activity) is likely to disrupt popular transit routes. Measures for proposed activities that would minimize the cumulative impacts to energy production and distribution include locations that are removed from known energy production and distribution sites (e.g., offshore LNG terminals), designs that do not interfere with designated fairways and shipping lanes, and appropriate signage and/or lighting to warn passing vessels (MMS 2007). When these criteria are met, cumulative impacts are expected to be minor to negligible.

The following subsections discuss the potential IPFs and impacts of each activity on energy production and distribution.

Dredged material ocean disposal

Vessels required for dredging and disposal activities create oceangoing traffic, which can interfere with energy production and distribution. Designated disposal sites also can create space-use conflicts with energy production and distribution activities. There are 36 dredged material disposal sites designated in the Atlantic region and the majority of dumping activity occurs at these designated sites (MMS 2007). Fifteen sites are located in the North Atlantic with half of those around New York harbor (EPA 2018). Impacts to energy production and distribution from dredging and disposal activities would be localized and concentrated around these areas and common routes to these areas (e.g., from harbors during major dredging activities).

Fisheries use and management

Fishing vessel traffic and other fishing activities have the potential to affect energy production and distribution. Fishing closures and restrictions may minimize impacts to energy production and distribution in the areas of the closures, which can also vary by season. Ongoing trends in fisheries (including routes, frequency of trips, closure areas, and seasonal patterns) should be considered in cumulative impacts analyses for wind projects.

Land use and coastal infrastructure

Impacts to energy production and distribution from onshore infrastructure would be related to port utilization, vessels transiting to and from ports, and space-use conflicts with onshore oil and gas terminals and onshore oil and gas infrastructure. Some growth in vessel traffic to and from ports would be expected in areas where port expansion is occurring; these areas include many ports along the Atlantic coast offshore of Maine to Virginia (see Chapter 3 for a table illustrating expected port developments).

Marine minerals extraction

Sand and gravel mining along the Atlantic coast offshore of Maine to Virginia includes use of existing and potential borrow sites where sand mining will occur. Vessel traffic and dredging associated with these activities may interfere with energy production and distribution in the same locales, and areas leased for marine minerals extraction would not be available for oil and gas activities. Based on technology and cost factors, sand mining activity appears limited to depths less than 30 m (98 ft) (BOEM, 2014a), which would limit interaction with energy production and distribution to these areas. In general, the impacts of marine minerals extraction on energy production and distribution are expected to be minor.

Marine transportation and navigation

Marine transportation is an ongoing, regular activity that generates substantial vessel traffic in locations along the Atlantic coast offshore of Maine to Virginia. Marine transportation has the potential to affect energy production and distribution. As noted above, many activities contribute to vessel traffic. Cumulative impact evaluations for energy production and distribution should consider the relative contribution of vessel traffic from proposed activities compared to existing traffic, as the anticipated increase in vessel traffic may be minor.

Military use, military range complexes, civilian space programs

Energy production and distribution may be restricted in military range complexes and civilian space program use areas, which can include designated danger zones, restricted areas, and closure areas that may limit access by vessel traffic. In some cases, areas may be closed temporarily to all vessel traffic for military or safety reasons (BOEM 2016c). The Navy's standard operating procedures also require that an area is clear of non-participating vessels and aircraft before an activity using ordnance or expended materials occurs (Navy 2018). Temporary and short duration impacts (hours) may occur from limits on accessibility to marine transit routes; however, most limitations on accessibility are temporary and would be lifted upon completion of training and testing activities (Navy 2018). Repetitive and routine training could result in additional impacts. Cumulative impacts would be expected in and adjacent to areas where military training or testing activity occurs (Navy 2018).

Oil and gas surveys and extraction

The current five-year OCS oil and gas lease sale plan has no lease sales scheduled through 2020. The region has not historically proven to be an economically viable source of oil or gas. Therefore, the cumulative impact scenario considers only the impacts of G&G activities.

Surveying activities are occurring, and have the potential to impact energy production and distribution through additional traffic and space-use conflicts. These activities are generally infrequent and localized and are expected to have minor impacts on energy production and distribution.

Renewable energy development, wind

BOEM issued 10 wind energy leases between 2012 and 2016 from Massachusetts through Virginia (BOEM 2016c). Wind energy development could affect energy production and distribution through vessel traffic, presence of structures, and space-use conflicts, as follows.

- *Site characterization surveys.* Surveys have the potential to affect energy production and distribution, primarily through vessel traffic (BOEM, 2014a).
- *Installation of meteorological towers and/or meteorological buoys.* Towers/buoys may affect vessel transit routes and limit energy activities through space-use conflicts. However, the effects would be highly localized.
- *Installation of turbine structures*. Turbine structures may affect vessel transit routes and limit energy activities through space-use conflicts.

Impacts from wind energy development on energy production and distribution would generally be highly localized.

Submarine cables, transmission/telecommunication lines, pipelines

The Atlantic coast offshore of Maine to Virginia contains significant existing undersea cable infrastructure (see Section 3.12). Energy production and distribution may be affected by the installation and O&M of this infrastructure, including submarine cables, transmission/telecommunication lines, and pipelines, which would necessitate vessels and heavy equipment and would result in vessel traffic and potential space-use conflicts (MMS 2007). However, impacts are expected to be minor.

Climate change

Climate change disrupts geophysical and biological resources around the world (see Section 3.8). Climate change will directly or indirectly alter the impacts of IPFs that affect energy production and distribution by increasing the demand for energy and thereby increasing the need to develop more offshore energy sources. To the degree wind energy development offsets the use of fossil fuel used to generate power, it will reduce carbon emissions and further efforts to reduce global warming.

5. CONCLUSION

The methodologies and descriptions in this report will be used when preparing NEPA documents for renewable energy leasing and projects proposed offshore from Maine to Virginia. This document is intended to be a living document that will be revised and adapted through its use to include updated information and to incorporate any new activities or effects not currently identified. This report will aid in improving consistency and efficiency amongst NEPA documents for renewable energy leasing and projects.

6. REFERENCES

ACCSP (Atlantic Coastal Cooperative Statistics Program). 2016. Inventory and comparison of for-hire data collections in the Atlantic and Gulf of Mexico, 2016. ACCSP Recreation Fisheries Program, Arlington, VA.

Argonne National Laboratory. 2018. Draft: Methodology for Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States. Preliminary Draft V 1.1 8/23/18.

BOEM. 2018. Marine Minerals: Website for Requests and Active Leases. Accessed online August 2018: https://www.boem.gov/Requests-and-Active-Leases/

_____. 2018a. Vineyard Wind Offshore Wind Energy Project Draft Environmental Impact Statement. December 2018. BOEM 2018-060.

_____. 2018c. Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism. March 2018. BOEM 2018-013. 52 p.

_____. 2018d. Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables. March 2018. OCS Study BOEM 2018-003. 254 pp.

_____. 2017. Effects Matrix for Evaluating Potential Impacts of Offshore Wind Energy Development on U.S. Atlantic Coastal Habitats. Final Report. February 2017. OCS Study BOEM 2017-014. 137 pp.

_____. 2017a. Flight Activity and Offshore Movements of Nano-Tagged Bats on Martha’s Vineyard, MA. Office of Renewable Energy Programs. June 2017. OCS Study BOEM 2017-054. 39 pp. + frontmatter.

_____. 2016a. Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022 Final Programmatic Environmental Impact Statement. BOEM 2016-060.

_____. 2016b. Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys. March 2016. BOEM 2016-044.

_____. 2016c. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Revised Environmental Assessment. October 2016. BOEM 2016-070.

_____. 2016d. Collision Risk Model for “*rufa*” Red Knots (*Calidris canutus rufa*) Interacting with a Proposed Offshore Wind Energy Facility in Nantucket Sound, Massachusetts. OCS Study BOEM 2016-045. 90 pp. + frontmatter and appendix

_____. 2016e. Abundance and Distribution of Seabirds off Southeastern Massachusetts, 2011-2015. Final Report. OCS Study BOEM 2016-067. 82 pp.

_____. 2015. Commercial Wind Lease and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore North Carolina: Revised Environmental Assessment. September 2015. BOEM 2015-038.

_____. 2015a. Baseline Bioacoustic Characterization for Offshore Alternative Energy Development in North Carolina and Georgia Wind Planning Areas. BOEM Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2015-026. 183 pp.

_____. 2014a. Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement. BOEM 2014-001.

_____. 2014b. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment. June 2014. BOEM 2014-603.

_____. 2014c. Characterization and potential impacts of noise producing construction and operation activities on the Outer Continental Shelf: Data Synthesis. BOEM Gulf of Mexico Region, New Orleans, LA. June 2014. OCS Study BOEM 2014-608. 84 pp.

_____. 2013a. Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities. Final Report. June 2013. BOEM 2013-01163.

____. 2013b. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts. Revised Environmental Assessment. BOEM 2013-1131.

_____. 2013c. Review of Biological and Biophysical Impacts from Dredging and Handling of Offshore Sand. May 2013. BOEM 2013-0119

_____. 2012a. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment. January 2012. BOEM 2012-003.

_____. 2012b. Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development. Impacts of Offshore Wind on Tourism and Recreation Economies. BOEM 2012-085.

_____. 2012c. Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017. Final Programmatic Environmental Impact Statement. July 2012. BOEM 2012-030.

Bredesen, R.E. 2017. Icethrow from wind turbines. Assessment and risk management. Presentation at IEA Wind Task 19, Winterwind 2017. 57 pp. http://winterwind.se/wp-content/uploads/2015/08/3_3_28_Bredesen_IEA_Task_19_-_IceRisk_Review_of_current_knowledge_and_the_way_forward_in_risk_assessments_associated_with_ice_throw_from_wind_turbine_blades_Pub_v1-1.pdf

Brostrom, G. 2008. On the influence of large wind farms on the upper ocean circulation. J. of Marine Systems. 74 (2008) 585-591.

BVG Associates. 2017. U.S. Job Creation in Offshore Wind. A Report for the Roadmap Project for Multi-State Cooperation on Offshore Wind Final Report. October 2017. NYSERDA Report 17-22.

Canaport LNG. 2018. Canaport LNG website. https://www.canaportlng.com/. Accessed 10/16/2018.

Congressional Research Service. 2018. Maritime Fuel Regulations. August 2018. Online: https://fas.org/sgp/crs/misc/IF10945.pdf

Council on Environmental Quality. 1997. Considering Cumulative Effects Under the National Environmental Policy Act. Accessed May 2019. Online: https://ceq.doe.gov/publications/cumulative_effects.html

Cruise Lines International Association (CLIA). 2015. Cruise Lines, Passengers Spent $21 Billion in 2014, Jumping 16 Percent in Four Years and Representing New Peak in US Cruise Industry Expenditures. Press release, 10/19/2015. https://www.marketwatch.com/press-release/cruise-lines-passengers-spent-21-billion-in-2014-jumping-16-percent-in-four-years-and-representing-new-peak-in-us-cruise-industry-expenditures-2015-10-19

DOE (Department of Energy). 2014. Assessment of Ports for Offshore Wind Development in the United States. March 2014. 700694-USPO-R-03

DOT (Department of Transportation). 2018. Port Performance, Freight Statistics Program: Annual Report to Congress 2017. January 30, 2018. Accessible at: https://www.bts.gov/content/port-performance-profiles

Dybas, C. and T. Knoss. 2018. Upwind wind farms can reduce the energy production of downwind neighbor turbines. November 26, 2018. https://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=297014

Ecology and Environment. 2017. New York State Offshore Wind Master Plan Consideration of Potential Cumulative Effects, Final Report. Prepared for New Your State Energy Research and Development Authority. December 2017.

ENGIE. 2018. 50 years of LNG – 2000: the Everett LNG terminal in Boston – the largest in the USA joins the ENGIE Group. https://www.engie.com/en/news/50-years-of-lng-everett-terminal/. Accessed 10/16/2018.

EPA (U.S. Environmental Protection Agency). 2018. Ocean Disposal Map. Ocean Dumping: Disposal Sites and Vessel Disposals. Accessed 3/26/19. https://www.epa.gov/ocean-dumping/ocean-disposal-map

EPA. 2010. Designation of the North American Emission Control Area to Reduce Emissions from Ships. Regulatory Announcement. March 2010. Online: https://www.epa.gov/regulations-emissions-vehicles-and-engines/designation-north-american-emission-control-area-marine. EPA-420-F-10-015.

EPA. 1999. Consideration of Cumulative Impacts in EPA Review of NEPA Documents. Office of Federal Activities (2252A). EPA 315-R-99-002/May 1999.

Epsilon Associates, Inc. 2018. Draft Construction and Operations Plan. Vineyard Wind Project. July 23, 2018.

Excelerate Energy. 2018. Northeast Gateway Deepwater Port. Dual Buoy system in Massachusetts Bay. http://excelerateenergy.com/project/northeast-gateway-deepwater-port/

Exponent Engineering PC. 2018. Deepwater Wind South Fork Wind Farm Offshore Electric and Magnetic Field Assessment. South Fork Wind Farm COP. Appendix K. May 24, 2018. 101 pp. https://www.boem.gov/Appendix-K1/

FCC. 2018. Pending Submarine Cable Applications. Accessed on 10/17/18. https://www.fcc.gov/submarine-cable-applications

FERC (Federal Energy Regulatory Commission). 2018. Website for Liquefied Natural Gas with listings for existing, approved, and proposed LNG import/export terminals. Online: https://www.ferc.gov/industries/gas/indus-act/lng.asp. Updated July 26, 2018.

Floeter, J. et al. 2017. Pelagic effects of offshore wind farm foundations in the stratified North Sea. August 2017. Progress in Oceanography, Volume 156, p. 154-173

Gill, A.B. 2009. Review: Offshore renewable energy: ecological implications of generating elecgtricity in the coastal zone. J. Appl. Ecology 2005 42, 605-615. British Ecological Society.

Global Change (United States Global Change Research Program). 2014. National Climate Assessment: Northeast Region. October 2014. Accessible at: https://nca2014.globalchange.gov/report/regions/northeast

Hasager, C., Nygaard, N., Volker, P., Karagali, I., Andersen, S. and Badger, J., 2017. Wind farm wake: The 2016 Horns Rev photo case. *Energies*, *10*(3), p.317.

ICES (International Council for the Exploration of the Seas). 2000. Effects of Different Types of Fisheries on North Sea and Irish Sea Benthic Ecosystems. Report of the ICES Advisory Committee on the Marine Environment 2000. ICES Coop. Res. Rep. No. 241.

ICPC (International Cable Protection Committee). 2011a. About Submarine Power Cables. November 2011. November 2011. ICPC.org

ICPC. 2011b. About Submarine Telecommunications Cables. October 2011. October 2011. ICPC.org.

IPCC (Intergovernmental Panel on Climate Change). 2015. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf

Kirkpatrick, A.J., S. Benjamin, G.S. DePiper, T. Murphy, S. Steinback, and C. Demarest. 2017. Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic. Volume I—Report Narrative. BOEM Atlantic OCS Region, Washington, D.C. OCS Study BOEM 2017-012. 150 pp.

Knorr, P.O. 2017. Stewards of the Sand, BOEM's Marine Minerals Program. Preparedness, Resilience, and Response. Presentation at GSA Annual Meeting. October 22, 2017.

Koeller, J. J. Koeppel, and W. Peters (eds). 2006. Offshore Wind Energy Research on Environmental Impacts. 367 pp. Berlin, Germany. ISBN 978-3-540-34677-7.

Le, K. 2013. Bigger Ships: Crane Productivity Between Panamax and New-Panamax Ships. Pacific Maritime Magazine. October 1, 2013.

MA Office of CZM. 2013. Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning. December 2013. https://www.mass.gov/files/documents/2016/08/vp/slr-guidance-2013.pdf

MA CEC (Massachusetts Clean Energy Center). 2017. Massachusetts Offshore Wind Ports and Infrastructure Assessment. October 2017. Accessible at: https://www.masscec.com/massachusetts-offshore-wind-ports-infrastructure-assessment

MARAD (Maritime Administration). 2018. MARAD Open Data Portal, Maritime Data & Statistics. https://www.marad.dot.gov/resources/data-statistics/. Accessed 10/18/2018

McFadden, J., A. Barrows, C. Reschovsky. 2017. 2016 Highlights of Ferry Operations in the United States. November 2, 2017. www.bts.gov/surveys/national-census-ferry-operators-ncfo/2016-highlights-ferry-operations-united-states..

MMS (Minerals Management Service). 2009. Cape Wind Energy Project. Final Environmental Impact Statement. MMS EIS-EA. January 2009. OCS Publication No. 2008-040. Only available online: https://books.google.com/books?id=A-E3AQAAMAAJ&pg=PP5&lpg=PP5&dq=OCS+Publication+No.+2008-040&source=bl&ots=0kWS8wtM1R&sig=ACfU3U3aF0M5JnfNLYmpr_M16-h8YCAW4A&hl=en&sa=X&ved=2ahUKEwj01arZrqDhAhXJk1kKHR3rBYMQ6AEwAXoECAYQAQ#v=onepage&q=OCS%20Publication%20No.%202008-040&f=false

MMS. 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. October 2007. MMS 2007-046.

MRECo (Marine Renewable Energy Collaborative). 2017. New England Marine Energy Development System (NEMEDS) brochure. Online: https://www.mreconewengland.org/marine_renewable_energy/wp-content/uploads/2017/08/MRECo_Testing_Facilities_v2017.pdf.

MRECo. 2018. Bourne Tidal Test Site Brochure. Online: https://www.mreconewengland.org/marine_renewable_energy/wp-content/uploads/2017/12/BrochurewithCompletedStructure.pdf.

NASA (National Aeronautics and Space Administration). 2018. About Wallops and Wallops Flight Facility Fact Sheet. https://www.nasa.gov/centers/wallops/about/index.html. Accessed 10/19/18.

Navy (U.S. Department of the Navy). 2018. Atlantic Fleet Training and Testing: Final Environmental Impact Statement/Overseas Environmental Impact Statement. AFTT EIS/OEIS September 2018.

NGA (Northeast Gas Association). 2018. The Role of LNG in the Northeast Natural Gas (and Energy) Market. https://www.northeastgas.org/about_lng.php. Accessed 10/17/18.

NPS (National Parks Service). 2018. Maritime Heritage Program. Accessed 10/29/2018. https://www.nps.gov/maritime/inventories/intro.htm

NOAA (National Oceanic and Atmospheric Administration). 2018a. Fishing Gear and Risks to Protected Species. Accessed October 16, 2018 at: https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-and-risks-protected-species. Last Updated August 3, 2018.

_____. 2018b. Federally Managed Fish Species, Greater Atlantic Fish Species. Accessed October 16, 2018. https://www.greateratlantic.fisheries.noaa.gov/educational_resources/seafood/fish/.

_____. 2018c. NMFS Commercial Fisheries Statistics. Accessed December 31, 2018 at: https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/index.

_____. 2018d. 2018 Quarterly Updates. Stocks on the Overfished and Overfishing Lists by Region. Accessed October 12, 2018 at: https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates.

_____. 2018e. Understanding Climate Change: Global Temperature. Accessed 10/16/2018. Available at: https://www.climate.gov/

_____. 2010. Northeast Regional Land Cover Change Report: 1996 to 2010. Accessible at: https://coast.noaa.gov/digitalcoast/training/regional-land-cover-change.html

Normandeau, Exponent, T. Tricas, and A. Gill. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

NRC (National Research Council). 2002. Effects of Trawling and Dredging on Seafloor Habitat. Washington, DC: The National Academies Press. https://doi.org/10.17226/10323

NROC (Northeast Regional Council on the Oceans, formerly Northeast Regional Planning Body [NRPB]). 2016. Northeast Ocean Plan. Online: https://neoceanplanning.org/wp-content/uploads/2018/01/Northeast-Ocean-Plan_Full.pdf. Accessed August 30, 2018.

PMEL (Pacific Marine Environmental Laboratory). 2018. Ocean Acidification: The Other Carbon Dioxide Problem. Accessed 10/18/2018. https://www.pmel.noaa.gov/co2/story/Ocean+Acidification

PONYNJ (Port Authority of New York & New Jersey). 2016. PONYNJ and the Panama Canal. https://portfolio.panynj.gov/2016/07/15/port-of-new-york-new-jersey-and-the-panama-canal/. Accessed 10/18/2018.

PurGen. 2012. PurGen One. Brief description from ZeroCo website. www.zeroco2.no/projects/scs-energy-purgen-one

Rahmstorf, S., J.E. Box, G. Feulner, M.E. Mann, A. Robinson, S. Rutherford, E.J. Schaffernicht. 2015. "Exceptional twentieth-century slowdown in Atlantic Ocean overturning circulation". Nature Climate Change. 5(5): 475–480. PDF for purchase: https://www.nature.com/articles/nclimate2554

Roy, S.B. and J.J. Traiteur. 2010. Impacts of wind farms on surface air temperatures. October 19, 2010. PNAS vol. 107, no 42: 17899-17904.

Saba, V. S., et al. (2016), Enhanced warming of the Northwest Atlantic Ocean under climate change, J. Geophys. Res. Oceans, 121, 118–132, doi:10.1002/2015JC011346.

Sarah, V.E., M. Mieke, H. Piet, S. Michiel and S. Marc. 2014. Offshore wind farms: sand as indispensable as wind. International Marine and Dredging Consultants. Berchem, Belgium.

Secretary of Defense. 2017. 2017 Sustainable Ranges. Report to Congress. February 24, 2017. https://prhome.defense.gov/Portals/52/Documents/RFM/Readiness/docs/2017SRR_FINAL.pdf?ver=2017-07-25-115014-387

Slavik, K., C. Lemmen, W. Zhang, O. Kerimoglu, K. Klingbeil, K.W. Wirta. 2017. The large scale impact of offshore windfarm structures on pelagic primary production in the southern North Sea. Hydrobiologia.

Stamieszkin, K. nd. Impacts of Noise from Wind Farm Construction and Installation on Large Whales, A Brief Summary. Provincetown Center for Coastal Studies.

Starbuck, K. and A. Lipsky. 2012. 2012 Northeast Recreational Boater Survey: A Socioeconomic and Spatial Characterization of Recreational Boating in Coastal and Ocean Waters of the Northeast United States. Technical Report. December 2013. Doc #121.13.10, 105 pp. http://www.trpa.org/wp-content/uploads/2012-Seaplan-NE-boater-survey.pdf. Accessed 10/20/2018.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, A. Carlier. 2018. A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions. Renewable and Sustainable Energy Reviews. Volume 96, November 2018, Pages 380-391.

Tethys. 2018.Western Passage Tidal Energy Project. Developed by ORPC Maine. https://tethys.pnnl.gov/annex-iv-sites/western-passage-tidal-energy-project. Accessed 11/15/18.

Thomsen, F., K. Lüdemann, R. Kafemann and W. Piper. 2006. Effects of offshore wind farm noise on marine mammals and fish. July 6, 2006. Hamburg, Germany on behalf of COWRIE Ltd.

Tougaard, J., O.D. Henriksen, and L.A. Miller. 2009. Underwater noise from three types of offshore wind turbines: Estimation of impact zones for harbor porpoises and harbor seals. J. Acoust. Soc. Am. 125 (6), June 2009.

USACE (Army Corps of Engineers). 2018a. Principal Ports of the United States. Accessible at: https://usace.contentdm.oclc.org/digital/collection/p16021coll2/id/2094

USACE. 2018b. Dredging anticipated to start in spring 2018: Corps of Engineers awards contract to conduct Boston Harbor improvement dredging in Boston. Posted 2/20/2018. http://www.nae.usace.army.mil/Media/News-Releases/Article/1445611/dredging-anticipated-to-start-in-spring-2018-corps-of-engineers-awards-contract/. Accessed 10/18/2018.

USACE. 2017. Public Notice. File Notice NAE-2005-658 to decommission Neptune Deepwater. New England District. February 28, 2017. http://www.nae.usace.army.mil/portals/74/docs/regulatory/publicnotices/NAE-2005-00658_Neptune_LNG_LLC.PDF. Includes attachment: PCS. 2016. Neptune Deepwater Port Decommissioning Plan. Prepared for Neptune LNG LLC. 43 pp. Accessed 10/16/2018.

USCG (U.S. Coast Guard). 2018. Annual Light List: Volume 1. 2018. Accessible at: https://www.navcen.uscg.gov/?pageName=lightlists

USCG. 2014. Frequently Asked Questions: North American Emission Control Area (ECA) U.S. Coast Guard Office of Commercial Vessel Compliance. Revised December 2014. Online: https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/CG-CVC/CVC2/psc/general/marpolVI/USCG_ECA_faqs_Rev_12-3-14.pdf

USCG. 2007. Guidance on the Coast Guard's Roles and Responsibilities for Offshore Renewable Energy Installations (OREI). Navigation and Vessel Inspection Circular No. 02-07. March 9, 2007. 26 pp.

U.S Lighthouse Society. 2018. Lighthouse Directories and Lists. Accessed 10/29/2018: https://uslhs.org/resources/lighthouse-directories-organizations/directories

Watts, A. 2011. Wind turbine turbulence. What are the micro-climate effects? windturbinesyndrome.com. November 7, 2011. https://www.windturbinesyndrome.com/2011/wind-turbine-turbulence-what-are-the-micro-climate-effects/

WSJ (Wall Street Journal). 2015. Bigger Container Ships Pose Bigger Risks. Insurers, Others Worry About the Potential for Catastrophic Accidents. By G.J. Millman (subscription required: https://www.wsj.com/articles/bigger-container-ships-pose-bigger-risks-1423443013)

Department of the Interior (DOI)
The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)
The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.